UNDER
DBT STAR COLLEGE STRENGTHENING SCHEME 2019

E-MAGAZINE

CHEMQUEST

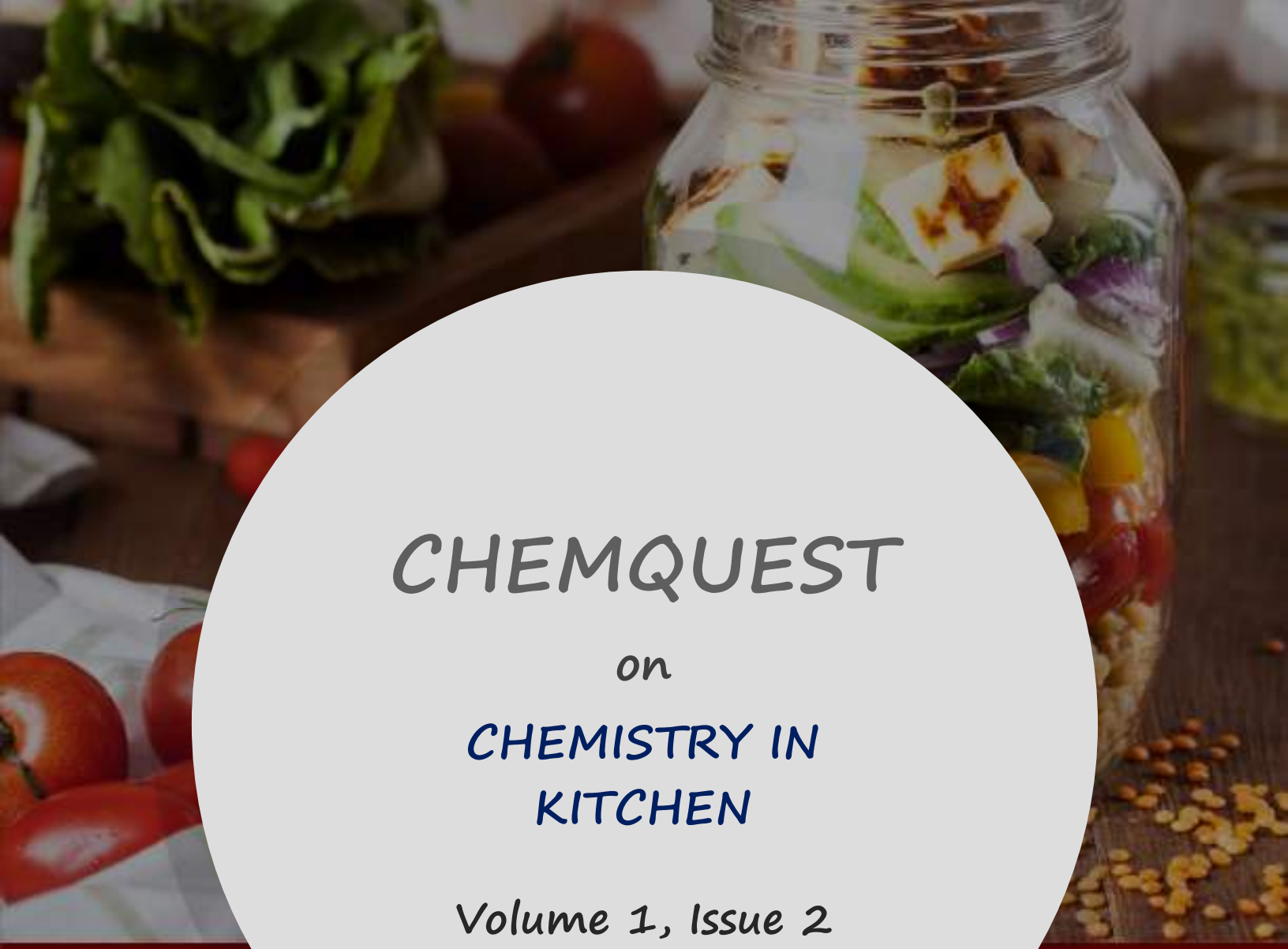
31ST DECEMBER' 2020 VOMUME 1, ISSUE 2

CHEMISTRY IN KITCHEN

AS A CELEBRATION OF NEW YEAR 2021

DEPARTMENT OF CHEMISTRY

SURENDRANATH COLLEGE
24/2, M.G. ROAD, KOLKATA – 700009, WEST BENGAL



CHEMQUEST

on

CHEMISTRY IN KITCHEN

Volume 1, Issue 2

31st December'2020

A Department of Chemistry

Surendranath College

Endeavour

Editors Words

"If your world looks gloomy and you are feeling grin and glum
Make a rainbow for yourself; do not wait for one to come.
Do not sit watching at the window for the clouds to part,
There'll soon be a rainbow if you start one in your heart."

So true! We, all the members of Department of Chemistry, Surendranath College also have tried consistently to create our own rainbows on every possible opportunity during this pandemic and lockdown period at our own capacity.

This time we feel proud and excited to acclaim that we are ready with all new hopes and hues to bring out the 2nd issue of the 1st volume of our e-journal CHEMQUEST on the festive occasion of New Year' 2021 on a seemingly interesting and popular topic "Chemistry in Kitchen".

We sincerely hope that this issue will help its readers to unfold the unraveled world of the most happening chemistry in day-to-day cooking in their own home kitchens. The enthusiastic write ups and sincere reviews in this field by all the students and faculty members of our department would be hopefully sufficient to hold the interest and appreciation of all the readers.

We have put in persistent efforts to bring excellence to this treasure trove. The extraordinary task of editing this issue would not have been possible without sincere support of all the executive members of the Editorial Board, who sorted out the articles from the writings we obtained from our enthusiastic and inquisitive students, edited them sincerely and finally made a fair and presentable draft. We are thankful to them who literally dipped their oars into turbulence of Covid-19 pandemic and have sailed it to the shore of publication within a truly short tenure despite all their usual college and university duties.

We are thankful to DBT, Govt. of India for the funding and grateful to our respected Principal Sir, Dr. Indranil Kar, for his inspirations in all our unique ventures like this. We also take this opportunity to thank all the members of Surendranath College family for their sincere support and best wishes.

Finally, we heartily wish all the readers, Merry Christmas and hope this journal issue would enjoy critical acclaim and play a vital role in the all-round development of scientific mindset even in the trivial work of cooking in the home kitchens of all.

All stay safe, stay healthy. Happy Reading!!!

Editors in Chief

31st December'2020

Message from Principal

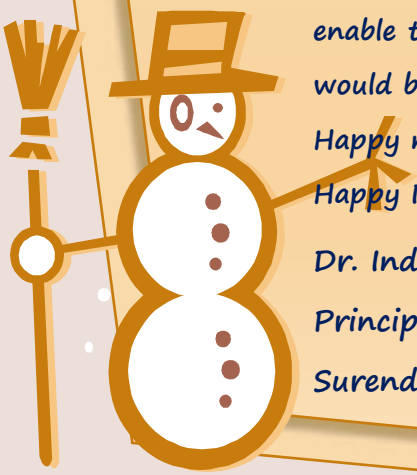
"The mind is not a vessel to be filled, but a fire to be kindled." CHEMQUEST the biannual E-Magazine published by Department of Chemistry literally kindles the imagination of its students. I am happy to notice that swaying from serious thinking to playful inventiveness, they are brimming with a zeal for life, empowering themselves with skills and creativity under able leadership of their enthusiastic faculty members.

I congratulate all the faculty members and students of the department who have used various mediums of expression to present their ideas. As long as our ideas are expressed and thoughts are kindled, we can be sure of learning, as everything begins with an idea. I appreciate all of them who have shared the joy of participation in publishing this e-magazine along with their commitment to curriculum and regular duties.

Hope this 2nd issue of Volume 1 of CHEMQUEST published on New Year's Eve (2021) on a popular topic "Chemistry in Kitchen" will enable the students to give and get a little more of learning and would be able to satisfy its general readers too.

Happy new year to all the readers in advance.

Happy Reading!



Dr. Indranil Kar

Principal,

Surendranath College, Kolkata

Message from External Advisory Member

DBT STAR COLLEGE SCHEME

"Excellence is a continuous process and not an accident". I am happy to learn that Department of Chemistry, Surendranath College under DBT STAR College Scheme is going to publish the 2nd issue of volume 1 of its E-Magazine CHEMQUEST on the New Year's Eve 2021 to keep on striving for excellence. I appreciate the efforts of all the students and faculty members of the department for bringing out this issue.

The topic this time "Chemistry in Kitchen" is a popular one and I sincerely hope that it would help all its readers from all disciplines to learn a lot about the day-to-day chemistry always happening in the kitchens all over the world.

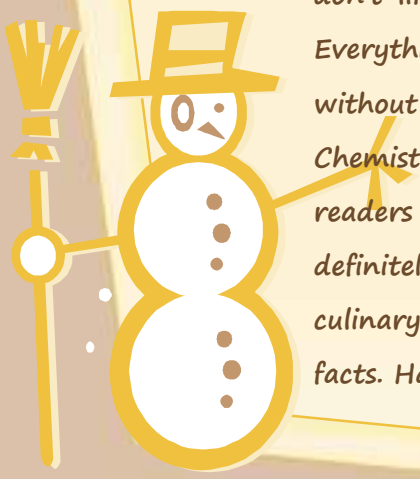
Happy New Year to all the readers! Enjoy reading!

With all best wishes,

Prof. Ashutosh Ghosh
Vice Chancellor,
Rani Rashmoni Green University, Hooghly

PREFACE

Cooking is all Chemistry and nothing but Chemistry! Believe it or not! Heating, boiling, freezing, mixing, and blending are all processes used in the laboratory and in the kitchen too. When we cook food, a myriad of different physical and chemical processes simultaneously take place to transform the ingredients (chemicals) involved. Carbohydrates are an interesting case study. Simple sugars combine with proteins in the Maillard reaction, which is responsible for the browning of food when it is cooked. Add a little more heat and caramelization takes over, while too much heat for too long time leads to burnt flavours! Starch is another carbohydrate well known for its ability to create gels, such as in a panna cotta. Upon heating, powdered starch combines with water and a completely different texture is created. Baking involves so much chemistry within it! So next time you hear someone say, "I don't like to put chemicals into my body", feel free to chuckle. Everything is made of chemicals. We would be in a bit of strife without chemicals, not least in the kitchen. As reliable members of Chemistry Community, our one and only motto is to make all the readers understand this simple fact. If they like it, that will definitely add to our pleasure. So just have a pleasant ride in the culinary world amidst new year festivities and explore amazing facts. Happy journey to all!



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COOKING: AN ART OR NECESSITY?

A HISTORICAL REVEALATION

CHEMQUEST, VOL-1, ISSUE-2, 2020, PAGE-A1-A14

PRELUDE

"Eating is necessary, but cooking is an art" this line has an ironical meaning but where eating is necessity, food is important so obviously the quality of food is also important.

Now when the question arises about quality of food, we should go through by its food value and

its harmfulness on our body, we mean whether it is good for our body or our body is suffering if we consume that kinds of food. Here it is noticeably clear that our body is suffering only when some harmful microbes are there and obviously the food value due to this reason is decreases.

Now just think if we eat some raw food items, is it so healthy?! Or it may be cause of some food poisoning. Is Cooking necessary? Or it is just a form of art? Going through this chapter we will try to find all the answers with proper reason.

Firstly, let us have a look on the History of raw foods and its Health effects.

RAW FOOD: THE OLD HABIT

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In the culinary world, early studies make us remember that the raw food dieting has always been linked with hermits and monks practicing asceticism. For example, John of Egypt a hermit from the Nitrian Desert lived on a diet of dried fruit and vegetables for fifty years and we also call upon about Lord Buddha's severe asceticism. Documented evidence of a commitment to raw food was by the Ethiopian monk Qozmos, who in the late 1300s CE committed to the ascetic discipline of eating only un-processed foods.

Coincidental raw food diets were first developed in Switzerland by Maximilian Bircher-Benner (1867 – 1939), who was dominance as a young man by the German Leben reform movement, which saw civilization sought to go "back to nature"; it embraced holistic medicine, exercise and other outdoors activity and foods that it judged were more natural. Bircher-Benner eventually adopted a vegetarian diet but took that further and decided that raw food was what humans were really meant to eat; he was influenced by Charles Darwin's ideas that humans were just another kind of animal. In 1904 he opened a sanatorium in the mountains outside of Zurich called "Lebendinge Kraft" or "Vital Force,"

One of the earliest books to advocate raw foodyism was Eugene Christian's “Uncooked Foods and How to Use Them”, 1904. In the 1970s, Norman W. Walker (inventor of the Norwalk Juicing Press) popularized raw food dieting. From the ancient time, mainly in the south-east Asia like Indonesia, Malaysia, etc, have a tradition of eating the raw food. Some traditional Raw foods are Indonesia-Brongkos, Pecel; Thailand-Som Tum, Tom Kai; Malaysia-Nasir Kerabu, Haka Lei Cha; etc.

HAKA LEI CHA

EFFECTS OF CONSUMING RAW FOOD

The consumption of raw foods or uncooked foods may probably give some effects or implications to human health, whether the effects are beneficial or dangerous to human. According to science, eating raw foods has its own pros and cons. Some people now a days prefer a raw food diet because of the potential health benefits and advantages.

This is due to the people's awareness to protect their health as they believe that raw foods will give them positive effect. Most of the people who prefer raw foods diet often include vegetables, fruits, nuts etc. Those foods are eaten raw or uncooked. According to the former research that has been made, raw foods have less processing and fewer added ingredients.

Thus, this is a great advantage and benefit to the person who choose this kind of raw foods as their disease. Another benefit that can be found through consuming raw foods is that the enzymes contained in those foods can be preserved. Furthermore, some scientific studies show that uncooked vegetables can help to reduce the risk of various cancers. However, some people also believe that eating raw food may give negative

impacts to their health. So, they prefer to cook that food rather than eating it without cooking.

POTENTIAL RISK

A raw food diet may come with some risks especially if anybody does not plan it well.

They may be nutritionally unbalanced: Raw food diets may appear to be low in vitamin B12, calcium and vitamin D, and proponents often discourage the use of iodized salt, which may further put any -body at risk of deficiency.

May Weaken Muscles and Bones: Several aspects of a raw vegan diet may result in weaker muscles and bones. Protein is also important for preserving muscle mass, especially during periods of low-calorie intake that lead to weight loss— such as can be expected on this diet.

May Reduce Fertility: Scientists note that one of the main ways a raw food diet may impact a woman's fertility is by being exceptionally low in calories. This may cause women to drop too much weight, reducing their ability to menstruate potential risks. So, it is now clear that raw food eating can cause of some health risk. So, what is the solution? Here comes the necessity of cooking for a healthy lifestyle. let us now take a brief look on the emerging importance of cooking.

HISTORY OF COOKING

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Cooking is the only way to destroy all microorganism and ensure you that your food is safe as uncooked food can cause of food poisoning. For most of the food, the cooking temperature should be above 70^{o}C for minimum 2 minutes at least. Poultry and meat food products are most dangerous if it is not perfectly cooked. Let us try to think about the importance of cooking point wise.

Cooking no doubt helps us to digest food. Cooked foods become incredibly soft and easy to chew and swallow. The juices which help us to digest are properly mixed with this softened food and carry out the digestion process.

Cooking enhances the texture, colour, flavour, visual aspects and obviously the taste of food.

Can you remember the appearance of a potato before and after boiling or frying, there is a huge difference between its taste and appearance? Cooking make the food delicious by adding some flavour. T For vegetables like carrots, beet roots, spinach or any others, cooking make their colour different which become more attractive.

The colour of meat or any other spicy food become much more tempting after cooking and the taste and smell of such foods are very inviting. The sticky soft dough of roti or paratha when changes into a roti or paratha its smell and crispiness really make us all foodie.

Inclusion of varies spices while cooking helps to improves the taste and flavour of the food.

The salt, chillies, and other herbs upgrade the taste. So, cooking enhances the texture, colour, flavour, and visual aspects, and the taste of food.

Cooking provides us a safe food to eat.
If food is not treated well while cooking, it can be extremely dangerous and become a reason of various disease such as stomach infection, food poisoning, worms, upset stomach, diarrhoea and even death. So, it is very necessary to cook a food properly to destroy all harmful causes of sickness. Before eating any food, we should ensure that the food is steaming hot and check that they are perfectly cooked.

Perfectly cooked food helps to avoid food poisoning. Most of the raw foods contains bacteria, parasites and viruses which are very harmful to our body, even it may be a reason of death.

All the microorganisms are destroyed while the food is cooked. Cooking provides you a safe food and make sure that your food is safe for human consumption.

Cooking is genuinely necessary for a balanced diet.
During cooking a lot of things are added. So, we may say, cooking gives us an opportunity to maintain a well-balanced diet that include protein, fat, carbohydrate, vitamins, and many other essential minerals.

This well-balanced diet is important for human body. So obviously cooking provides us a well-balanced diet food.

Cooking also adds variety to our meals.
From a simple raw potato, one can make potato pakora, potato curry, potato chips etc. So, via cooking a plenty of thing can be prepared from a raw material. Cooking helps to serve a variety of food in table using even a single ingredient.

Sometimes cooking helps to preserve food longer.

Just like milk, if it is not boiled some bad micro-organisms convert milk into curd, but after boiling they are destroyed. So, after boiling milk can be preserved for long. Thus, cooking helps to preserve food too. And there also numerous examples of jam, jelly, pickles. They involve also some processing that help preserve food.

VARITY OF COOKING METHODS

CONCLUSION

Hence, without any second thought we can conclude that cooking is obviously a necessity for our health. Cooking ensures that our food is bacteria free, safe for human consumption, tasty and obviously full of variety.

The next question that may arise in our mind is whether cooking is only a mere necessity, or it is an art? How it is related to regional culture and all. Let us try to find a suitable answer to those questions in the next section.

COOKING: ART AND CULTURE

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COOKING IS AN ART

You know the saying "The Way to A Man's Heart is Through His Stomach". Well, I think everyone would agree with me when I say the way to anyone's heart is through their stomach. Food can be considered as an art; for example: the decoration of a food, the way a food is constructed in the plates, or even the way many different foods

are being mixed to create a new food. The arrangement of plates in a table as an art. This is called Table Art. Brillat-Savarin in his book, "The physiology of taste" states that cooking is the oldest of all arts. Culinary artists are those chefs who day and night think over finer ways of presentation and garnishing of foods.

COOKING VARIATION WITH CULTURE & TRADITION

Every culture has a unique food philosophy. The way we cook our food tells a lot about who we are. Put together a group of Bengalis and the conversation will invariably veer towards food accompanied by spirited repartee involving two so called communities, Bangal (East Bengal) and Ghoti (West Bengal).

CHINGRI FAVOURITE OF GHOTI

HILSA FAVOURITE OF BANGAL

Bengali Traditional Thali

Food is a universal necessity. But it is only human beings who endeavour to transform food into something more. Several archaeologists and evolutionary biologists contend that cooking was, and still is, crucial to our evolution. Primitive hunter-gatherer societies developed into more sedentary ones; cooking became a social activity. In India we have so vast range of cuisine. I would try to mention only a few. There are some signature dishes also like Bada Pav of Mumbai and Rasogolla of Kolkata.

TYPICAL NORTH INDIAN CUISINE

TYPICAL INDIAN CUISINE

TYPICAL GUJRATI CUISINE

TYPICAL SOUTH INDIAN CUISINE

TYPICAL NORTH ODISA CUISINE

Just have a close look. How different they are in appearance, texture, presentation and obviously in their aroma and taste. However, that you all should try yourself!

TYPICAL HYDERABADI CUISINE

TYPICAL RAJASTHANI CUISINE

TYPICAL GOANESE CUISINE

TYPICAL MARATHI CUISINE

TYPICAL HIMALAYAN CUISINE

TYPICAL KARNATAKI CUISINE

BADA PAV OF MUMBAI

RASAGOLLA OF KOLKATA

SPECIAL COOKING ON OCASSION

Food is also inextricably linked to occasions and memories. Food became central to community celebrations. What would Eid be without sewai, Christmas be without cakes and Pongal without payasam?

PATISAPTA POUSH PARBAN SPECIAL

BHAPA PULI MAKAR SANKRANTI SPECIAL

EID SPECIAL SEWAI

PAYASAM IN PONGAL

MARATHI MODAK ON GANESH CHATURTHI

CHRISTMAS SPECIAL CAKE

So this much about relation of cooking with culture, tradition, and occasion. Let us now have a quick look on the mordernist cuisine to explore the induction of art in the cooking process using rigorous chemistry i.e., molecular gastronomy in the modern kitchens, where chefs generally act like chemists.

MODERN COOKING: A CULLINARY ART

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A culinary art is the art of cooking. Cooking is the process of preparing food and meals that will be eaten by us or the food served to other people. The word "culinary" is defined as related to or connected with, cooking or kitchens. People who are working in the culinary arts are known as culinary artists.

Culinary artists require a lot of knowledge about the science of cooking food. Mainly culinary artists work in restaurants, hospitals, and other institutions etc where kitchen conditions vary depending on the type of business.

In cooking the heat generated by fire is required to change the food's texture, flavours, colour, nutritional contents and even its appearance. Heating is very much important in the culinary arts because it disinfects the food and makes it softer and delicious. In between 4°c to 60°c the bacteria are found in cooked food or even those that were transferred to the food can grow at a very alarming rate. In the ideal condition bacteria can double their population every twenty minutes and it is a crazy fact about bacteria. Many people have the misconception that bacteria will die when we freeze our food or refrigerate them, but that is not right. Bacteria, merely it slows down their expansion in cold conditions.

The culinary art is decided in many categories. Some of which are tools, methods, combination of spices and ingredients that adds flavour to the food etc. It normally needs the right measurements, proper selection and true combination of ingredients involved in food to reach best result.

One of the most famous departments in the culinary arts is baking. This is used in producing pastry-based desserts like tarts, pies, and cakes etc. The ovens dry heat causes the starch to gelatinize, and the results to the browning or charring of the outside of the food. Some uneducated in the culinary arts might think that the brown part is not tasty, but this part gives taste and flavour to the baked good and sealing the moisture of the food. The baked food become dry day by day after it is cooked.

Boiling is one of the other important categories of the culinary arts. In boiling, there is a rapid vaporization of any type liquid when the liquid is heated that is boiling. In cooking, boiling is divided into many other categories.

Blanching, a cooking term used to describe the submersion of food into boiling water and removing it after a certain period. Then throwing it into cold water or letting water run over it causing the firming of food.

A different type of cooking is pressure cooking. When food is cooked inside an enclosed cooking tool like pressure cooker, that would limit the air that is coming in or going out of that tool and cook food properly. Pressure cooking is one of the fastest cooking types.

Stewing is also a popular cooking technique. It is a method where meats are cut up into small pieces and along with some vegetables are simmered into a liquid.

Simmering, then again is another cooking method. In this method the liquid is barely kept away from its boiling point.

Some other boiling techniques are infusion, poaching, double steaming, steeping braising, coding, steaming and vacuum flask cooking. There are in fact different techniques available that are used in different cases as and when needed.

Most Americans use grilling and microwaving in daily life.

The simplest and easiest method is microwave cooking, and this cooking technique is used mostly to reheat sumptuous meals ready to be consumed. With grilling, most North Americans people have a grill station in their backyard. Grilling are roasting methods like rotisserie, barbecuing, searing or even smoking food and they extensively use this all techniques.

CONCLUSION

So, from the above point of view, if we try to say, “yes, cooking is an art” it is accepted because the above points clearly showed that. Every cooked food has its own specifications, and several steps must be followed to prepare them, to make them different according to their taste, colour, and aroma. So obviously cooking is also a form of art.

Finally, if we try to draw a conclusion, we must say that cooking is obviously a necessity. But cooking is also a versatile art form, it has the capacity to enclose all the senses. We cannot choose between ‘necessity or art’. Cooking is necessary but also artistic. Foodyism has its own significance. So cooking is both a necessity and an art toot, we should not debate on them as they both have different importance. With this resolution let us move on to the next chapter.

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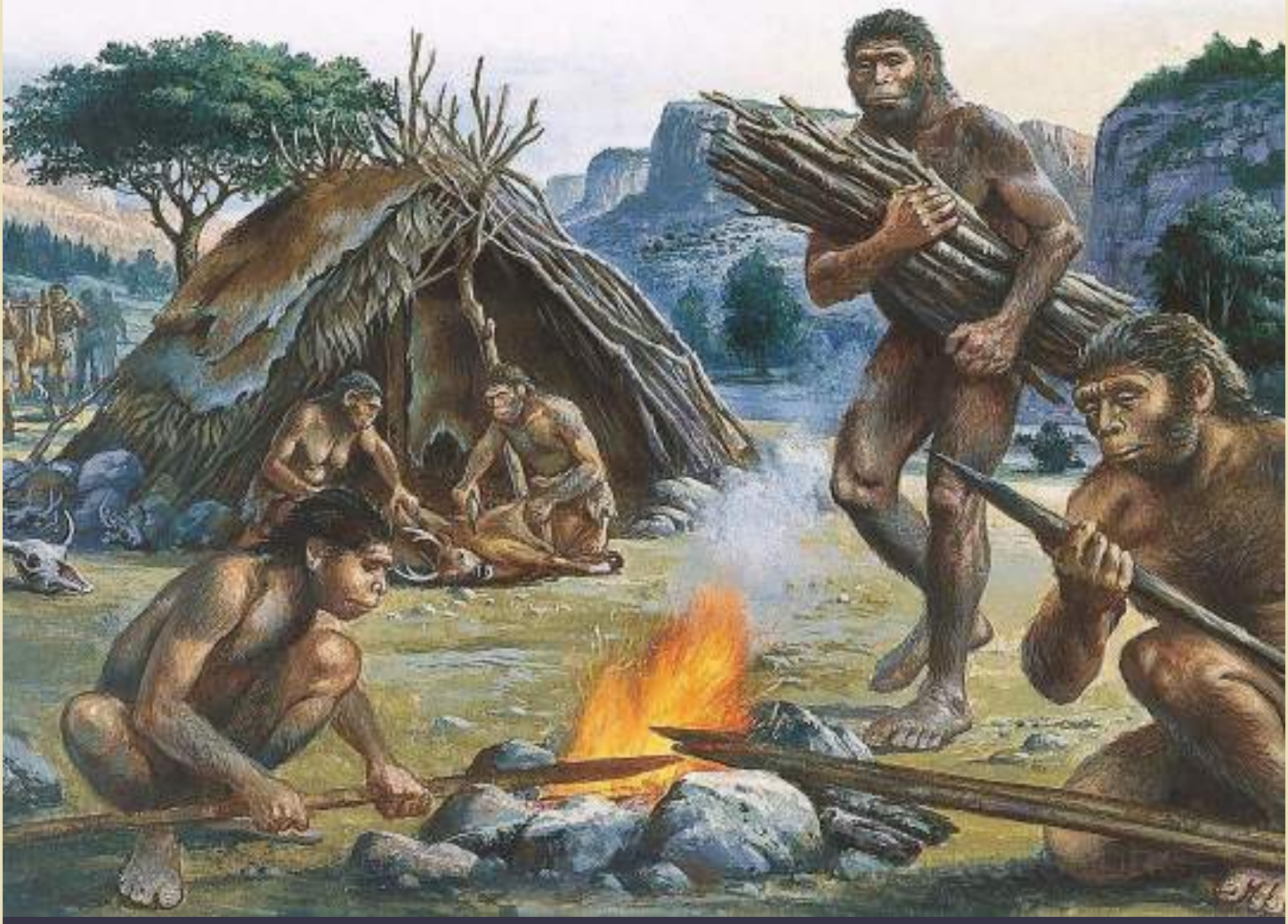
CHAPTER-B



EVOLUTION OF COOKING

A FASCINATING LOOK BACK

CHEMQUEST, VOL-1, ISSUE-2, **2020**, PAGE-B1-B15

PRELUDE

The first ever example of cooking dates back to two million years ago when humans began using an open fire to cook meals, the one and only way to prepare hot food. Then process of cooking has been changed through the ages. The history of cooking has been divided into six categories as follows-

In this chapter evolution of cooking has been discussed in a chronological order. Hope you will enjoy the fascination journey.

PREHISTORIC COOKING

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INTRODUCTION

"Cooking is the art and science of preparing food for eating by the application of heat."
Over 2 million years ago when ancestors of humans first ignited the fire and burnt the raw meats, the history of cooking was made. With the time, the process of cooking is innovated by developments of equipment, technique, foods etc. From roasting to modern cuisine an incredible journey has been spent.

PREHISTORIC COOKING

It was believed that primitive humans have begun to cook 250,000 years ago by tossing a raw piece of something into the fire. The first method of cooking was roasting, where a fish or a bird was placed on the end of a stick and held over an open fire. Some scientists say that the Peking man roasted meats, but there wasn't enough evidence to support the claim.

The origins of cooking cannot be exactly traced, but for sure, it has evolved significantly. For cooking to be possible, the discovery of fire must have happened first. Most likely, the first person who discovered how to cook has done it by accident. Maybe, raw meat happened to fall in a fire, and man has found out that it was tastier and easier to chew. Since then, the rest was history.

WHY ANCIENT HUMAN START COOKING?

To Wrangham, these morphological features are adaptations to cooking that arose around 1.9 million years ago. Cooking certainly changed our ancestors' lives for the better. Heat makes food softer, so less time is needed for chewing. It also releases more calories.

PREHISTORIC TIME

- 2.5-1.8 million years ago: The discovery of the use of fire and the sharing of the benefits of the use of fire may have created a sense of sharing as a group.
- 2 millions years ago: Hominids shift away from the consumption of nuts and berries to begin the consumption of meat.
- 250,000 years ago: Hearths appear, accepted archaeological estimate for invention of cooking.
- 170,000 years ago: Cooked starchy roots and tubers in Africa.
- 40,000 years ago: First evidence of human fish consumption: **isotopic analysis** of the skeletal remains of Taiyuan man, a modern human from eastern Asia, has shown that he regularly consumed freshwater fish.
- 30,000 years ago: Earliest archaeological evidence for flour, which was likely processed into an unleavened bread, dates to the upper Paleolithic in Europe.
- 25,000 years ago: The fish-gorge, a kind of fish hook, appears.
- 13,000 BCE: Contentious evidence of oldest domesticated rice in Korea. Their 15,000-year age challenges the accepted view that rice cultivation originated in China about 12,000 years ago. These findings were received by academia with strong skepticism and the results and their publicizing has been cited as being driven by a combination of nationalist and regional interests.

- 11,500 - 6200 BCE: Genetic evidence published in the Proceedings of the National Academy of Sciences of the United States of America (PNAS) shows that all forms of Asian rice, both Indica and japonica, spring from a single domestication that occurred 8,200–13,500 years ago in China of the wild rice Oryza rufipogon.

FACTS

- Cooking had profound evolutionary effect because it increased food efficiency, which allowed human ancestors to spend less time foraging, chewing, and digesting. H. erectus developed a smaller, more efficient digestive tract, which freed up energy to enable larger brain growth.
- The oldest form of cooking is basically fire-roasting and, specifically, opens fire cooking. The earliest forms of open-fired cooking would have consisted of placing food ingredients straight into a fire. Yep, right into the ashes! Some indigenous societies still cook in this way.

FIRST EVER POTTERY USED FOR COOKING?

Pottery was invented somewhere in eastern Asia between 12,000 and 20,000 years ago, but exactly where and when—and particularly why—isn't clear. Indeed, virtually nothing is known about how the first pots were used, says Oliver Craig, a biomolecular archaeologist at the University of York in the United Kingdom. Regardless of why such vessels were invented, they undoubtedly offered new and attractive ways to process and consume food, he notes. Layers of blackened material on the inner surfaces of some pot shards, many of them palm-sized or smaller, hinted that the vessels had been used for cooking, but scientists hadn't performed detailed studies to confirm the notion.

ANCIENT COOKING

Atanu Ganguly

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Food is a basic human need; it is a fuel that drives not only our biological system but also the march of civilization. In fact, each measures stage of human societal progress has been based on the quality and quality of food humans can procure or produce.

Chemistry plays a crucial role in the history of food and food is one of the most important driving forces of human history.

GATHERING OF FOOD ON EARLY DAYS:

Hunter- gatherer stage- for about 200,000 years of human existence, we are dependent on hunting and gathering to procure food. The social structure was mainly limited to families and tribes. People then were nomadic, as their supply of food varied greatly, which is depend on the particular season.
Agricultural stage about 12,000 years ago the hunter gatherer tribes began to domesticate animals and cultivate plants. This ushered in the agricultural stage. People begin to permanently settle near sources of fresh water for crop irrigation.

FOOD PREPARETION:

➢ **Artificial Flavour:**

We have used flavorings to add zest to our food and lives since well before recorded history. From early times, flavorings have been part of a quest to make foods and beverages taste better, leading to a more enjoyable life.
We are far from achieving the fictional replicators of Star Trek but humans have been synthesizing artificial flavors for at least 170 years. The first records artificial flavors were exhibited in 1851 in London during the crystal palace Exhibition. Visitor's sampled fruit flavored candies like pear, apple and grape. These flavors had been artificially made in chemical laboratories.

➢ **Fermentation:**

Fermentation is one of the common methods of changing food raw materials into different forms the oldest evidence for a wine fermentation was found in China is dated at around 9000 years old. The study of fermentation is called zymology.

HISTORY OF FERMENTATION

Fermentation is a natural process. People applied fermentation to make products such as wine, mead, cheese, and beer long before the biochemical process was understood. In the 1850s and 1860s, Louis Pasteur became the first zymurgies or scientist to study fermentation when he demonstrated fermentation was caused by living cells. However, Pasteur was unsuccessful in his attempts to extract the enzyme responsible for fermentation from yeast cells. In 1897, German chemist Eduard Buchner ground yeast, extracted fluid from them, and found the liquid could ferment a sugar solution. Buchner's experiment is considered the beginning of the science of biochemistry, earning him the 1907 Nobel Prize in chemistry.

Examples of Products Formed by Fermentation:

- Wine, Yogurt, Cheese
- Certain sour foods containing lactic acid, including sauerkraut, kimchi, and pepperoni
- Bread leavening by yeast
- Sewage treatment
- Some industrial alcohol production, such as for biofuels and Hydrogen gas.

MEDIEVAL COOKING

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WHAT IS MEDIEVAL COOKING?

Medieval COOKING includes foods, eating habits, and cooking methods of various European cultures during the Middle Ages, which lasted from the fifth to the fifteenth century. During this period, diets and cooking changed less than they did in the early modern period that followed, when those changes helped lay the foundations for modern European cuisine. Cereals remained the most important staple during the early Middle Ages as rice was introduced late, and the potato was only introduced in 1536, with a much later date for widespread consumption. Barley and oat were eaten by the poor. Wheat was for the governing classes.

History of Medieval cooking:

During medieval times, the cooking techniques that were developed are so innovative that we are still using these methods today. Most of these techniques allowed people to cook food much easier and faster, and some methods also enabled them to store food properly so that they won't spoil for a long time.

In the Middle Ages, what people eat depends on who they are. During feasts, large numbers of invited guests were served different dishes of varying number and quality of courses according to social status. The rich always ate better than the poor.

The average men had no kitchen; but in castles, monasteries, and palaces, there were huge kitchens equipped with all kinds of cooking wares and utensils. Huge houses had bread made in tall ovens, and their dinner included a roast, white bread, quarry, and custard or pudding.

From the 1400s through the 1500s, spice trading became popular, and more ingredients had been gradually added to recipes. Portuguese vessels reached South Africa, India and China to trade spices. These were used generously to create savory and flavorful dishes.

MEDIEVAL KITCHEN

In most households, cooking was done on an open hearth in the middle of the main living area, to make efficient use of the heat. This was the most common arrangement, even in wealthy households, for most of the Middle Ages, where the kitchen was combined with the dining hall.

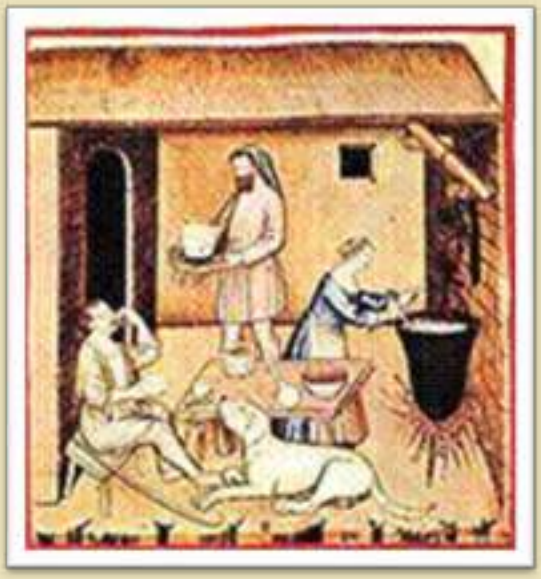
Towards the late middle ages a separate kitchen area began to evolve. The first step was to move the fireplaces towards the walls of the main hall, and later to build a separate building or wing that contained a dedicated kitchen area, often separated from the main building by a covered arcade. This way, the smoke, odors and bustle of the kitchen could be kept out of sight of guests, and the fire risk lessened. Few medieval kitchens survive as they were "notoriously ephemeral structures".

FOOD USED DURING MEDIEVAL PERIOD

HARVESTING CABBAGE

MEATS

DAIRY PRODUCTS



RENAISSANCE COOKING

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METHODS

Most foods were cooked over an open flame along with the help of pots, pans, kettles, skillets and cauldrons. Each cook kept a book of their own recipes. Cooking methods: spit, roasting, baking, boiling, smoking, salting, fried (Alchin).

HISTORY

The Renaissance was not only a period of the re-emergence of art and literature in Europe, but it was also the era where cooking was taken to new heights in terms of its complexity and artistry. During that period, cooking was considered as essential to the culture as art, and many people, especially the nobles, took cooking and dining seriously.

There are many cooking techniques that were created in the Renaissance, and some methods originating from the Middle Ages were refined and enhanced as well.

FOODS

The average person during the Renaissance was a peasant. Peasants would eat soup or mush for food just about every meal. They would also generally have some black bread. The soup would be made of scraps of food, usually vegetables such as carrots or eggs.

CUISINE

Food of the Middle Class: Broth, Pigeon, Bacon, Fruits, Vegetables, Chicken, Pastries, Hot honey lemonade, Honey roasted almonds. Cheeses etc. Many different types of cheeses. Spices:
They used vinegar in wine and other dishes. Salt was scarce in the Renaissance so to season their food they used spices instead of salt.

PASTRIES

Renaissance Patisserie is Charlotte's premier destination for dazzling French pastries, award-winning Viennoiserie, innovative macarons, rustic French loaves, traditional baguettes, and the home of Charlotte's only Kouign "Queen" Amann.

Medieval Italian food:

Many Italian staples and internationally recognized favorites were invented and refined during the Late Middle Ages and the early Renaissance; pasta was on everyone's dinner plate by the 13th century, though it was commonly made out of rice flour rather than durum wheat; pizza, the medieval Italian term for "pie"

FISH

England, as a small wet sea-faring nation, had no want for fish. Sea fish were transported all over the country, both that caught locally and those imported from Iceland. Religious observances meant fish was exclusively eaten on Fridays and Saturdays. Common sea fish included cod, haddock, mackerel, conger, and mullet. Freshwater fish included roach and dace. Shellfish comprised part of the diet, with oysters the most common, mussels, cockles and winkles less so. There were also eels of the "jellied eel" fame. To preserve them, fish were often pickled, smoked, salted or dried. Live fish were transported inland wrapped in wet grasses. Monesteries and manors kept fish ponds.

VEGETABLES

Elizabethans ate many of the same vegetables we eat today. They enjoyed the rich flavor of onions, leeks, garlic and mustard greens. They planted carrots, turnips, cabbage, radishes and parsnips. While the spices we know today were rare and expensive (pepper, nutmeg, etc), a large variety of herbs were grown locally: sage, mint, fennel, parsley, basil, marjoram. Sweet herbs were used as we used them now: to enliven otherwise dull dishes.

MODERN COOKING

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After the Renaissance of cooking, there is one of the biggest changes in the mid. 17th century. The change in cooking is naturally often led by changes in tools and tactics. The development of technological inventions plays a crucial part in this cultivation of cooking world.

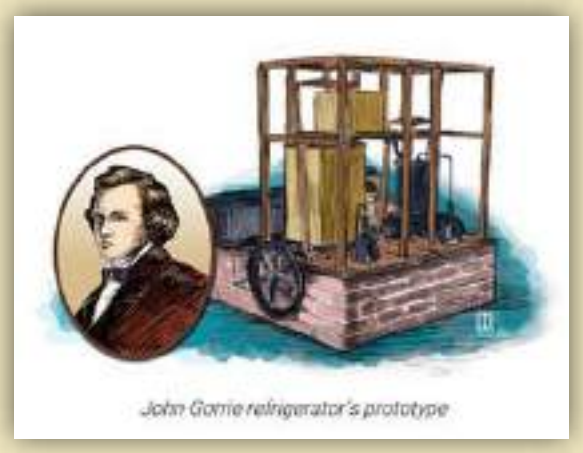
ADVANCEMENTS IN TECHNOLOGY

Cast iron range:

In this period the cast-iron range was developed and began to replace open fireplaces. It radiated more heat and burned less fuel than typical

fireplaces. Cast iron stove built from a material consisting of iron mixed with carbon, in which a solid fuel such as wood or coal is burned to produce heat. The first round cast-iron stoves with grates for cooking food on them were manufactured by Isaac Orr at Philadelphia in 1800.

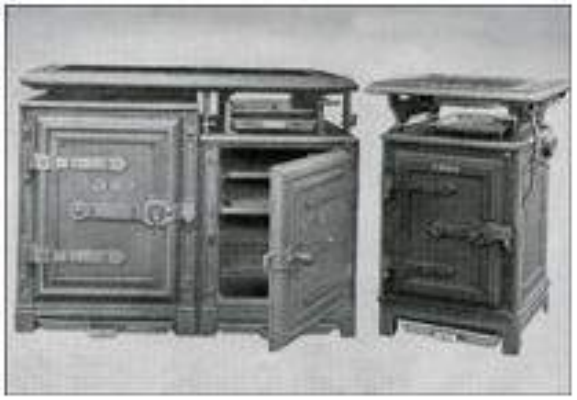
Refrigerator:
The first instance of cooling was recorded in 1748 when William Cullen at the University of Glasgow tried to produce refrigeration. Cullen used a pump to create a partial vacuum over a container of diethyl ether, which then boiled, absorbing heat from the surrounding air. The experiment even created a small amount of ice, but had no practical application at that time.



In 1758, Benjamin Franklin and John Hadley, professor of chemistry, investigating the principle of evaporation as a means to rapidly cool an object at Cambridge University, England. They confirmed that the evaporation of highly volatile liquids, such as alcohol and ether, could be used to drive down the temperature of an object past the freezing point of water.
The first refrigeration machine, however, was developed in the US in 1844 by John Gorrie.

Gas in cooking:
At early stage the gasification of coal by heating is used to produce Gas. Gas was first used for cooking during the 19th century. Since then, the use of gas in

the kitchen has been popular. According to the Gas Museum, in Leicester, England, the first recorded use of gas for cooking was by a Moravian named Zachaus Winzler in 1802. But it took another three decades for the first commercially produced gas stove, designed by Englishman James Sharp, to hit the market. Gas stove is fuelled by combustible gas like syn gas, natural gas, propane, butane, liquefied petroleum gas etc.



INVENTION OF FOOD INDUSTRY

The 1700s and the 1800s brought us out fast food favourites.

Sandwich:

The sandwich was invented by John Montagu, the 4th Earl of Sandwich in 1762.

Carbonated water: The English chemist Joseph Priestley experimented with putting gases in liquids in 1767, producing the first artificially-produced carbonated water.
In 1770, the Swedish chemist Torbern Bergman invented a device for making carbonated water from chalk and sulfuric acid.

Can & can opener: A metal can for preserving food was invented in 1810 by a Peter Durand, of London. To open a can, a person had to use a hammer. The can opener was invented in 1858 by Ezra Ezra Warner of Waterbury, USA.

Baking powder:

Alfred Bird was first who created a form of baking powder in 1843. It formed by bicarbonate of soda and tartaric acid, mixed with starch.

Potato chips: The potato chip was invented in 1853 by George Crum in New York, USA.

Coca Cola: An American pharmacist Dr. John Stith Pemberton invented Coca-Cola on May 8th, 1886 in Atlanta. He changes the formula of his French Wine of Coca, omitting the French wine. He added sugar, citric acid and essential oils of many fruits to the drink, and the original Coca-Cola was created.

Pizza: The Margherita pizza, the first relative of the pizza we know today, was invented in 1889.

Hamburger: Meanwhile, the first hamburger and steak sandwich were sold in 1895.

Cotton candy: Cotton candy made from sugar that is heated and spun into slim threads that look like a mass of cotton. It was invented in 1897 by William Morrison and John C. Wharton, from Nashville, Tennessee.

In this period, we can also found some other innovation in cooking world. Some of the most notable chefs were appeared in that time.
In 1765, the first modern version of the restaurant appeared in Paris and was opened by a soup salesman named Boulanger.

MODERNIST CUISINE IN 20th CENTURY

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INTRODUCTION

Food is our most important weapon to survive in this world. From ancient day we have fight each other for food. Now a days those fighting for food convert into fighting for new generation various type of food.

WHAT IS MODERN CUISINE?

A cuisine is a style of cooking characterized by distinctive ingredients, techniques and dishes, and usually associated with a specific culture or geographic region. Regional food preparation traditions, customs and ingredients often combine to create dishes unique to a particular region. Cuisine dates back to the Antiquity. As food began to require more planning, there was an emergence of meals that situated around culture. Now we talk about the modern process of food making in our modern lifestyle.

MODERN STYLE OF COOKING

In main cities, where space is limited, people have to deal with small kitchens. Therefore, smart and incredibly compact appliances are a must. More and more companies are focusing in the production of cooking tools and appliances that can perform more than one task. Sleek and multi tasker appliances have become best sellers and essentials to many. It's the ultra-modern style of cooking. Although, all the way back in the 1800's cooks and scientists were interested in understanding food chemistry. But it was not until 1988 that the term "Molecular Gastronomy" was coined by French chemist Hervé This and Hungarian physicist Nicholas Kurti. They began holding workshops to investigate the transformation that occurs when food is cooked.

MOLECULAR GASTRONOMY

The molecular or modernist cuisine movement really began when chefs took those scientific discoveries and applied creativity to that body of knowledge. They take the basics of classic cooking and craftsmanship then apply chemical compounds and elements such as liquid nitrogen for instantaneous freezing and techniques such as spherification. It should be mentioned here that

'Spherification' is a culinary process that employs sodium alginate and either calcium chloride or calcium glucate lactate to shape a liquid into squishy spheres, which visually and texturally resemble roe.

CHEMISTRY IN COOKING

Cooking itself is really just chemistry. Heating, freezing, mixing and blending are all processes used in the laboratory and the kitchen.

When we cook food, a myriad of different physical and chemical processes simultaneously take place to transform the ingredients (i.e., chemicals) involved. Carbohydrates are an interesting case study. Simple sugars combine with proteins in the Maillard reaction, which is responsible for browning food when it's cooked. Add a little more heat and caramelisation takes over, while too much heat for too long leads to burnt flavours.

STYLES OF CUISINE

Fusion cuisine: It is cuisine that combines elements of different culinary traditions that originate from countries, regions, or cultures.

Gobi Manchurian is an Indian-Chinese fusion dish, consisting of fried cauliflower. This dish is popular throughout India and Indian restaurants as well as South Asian restaurants around world. Also, an example of fusion dish is combination of smoked salmon wrapped in rice paper, with avocado, cucumber and crab sticks.

Haute Cuisine: Haute cuisine is the cuisine of "high level" establishments, gourmet restaurants and luxury hotels. Haute cuisine is characterized by the meticulous preparation and careful presentation of food at a high price. This is a presentation of French Haute Cuisine.

Nouvelle Cuisine:

This is a new approach to cooking and food presentation in French Cuisine. Vegan Cuisine and vegetarian cuisine: These are vegetarian dishes for vegetarians as follows.

Vegan Cuisine and vegetarian cuisine:

These are veg dishes for vegetarians as follows.

Conclusion:

As for the conclusion of this writing, the traditional food culture should not be forgotten by every generation as it shows the identity of the people itself in terms of culture and norms. Each of the instruments has its own tales and sentimental values along with it. Without them, the food will not have its own distinctiveness and cannot achieve the accomplishment that can be seen nowadays.

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CHAPTER-C

METHODS OF COOKING

WHEN THE CHEF IS A CHEMIST

CHEMQUEST, VOL-1, ISSUE-2, **2020**, PAGE-C1-C11

PRELUDE

There is a similarity between performing experiments in the chemistry laboratory and cooking food in the kitchen.

To get the perfect experimental result in the laboratory, you need to practice and follow few techniques. You need to learn perfect heating, boiling, shaking, mixing, extracting techniques to make a reaction to happen in the lab. You should have a good observation capability and sometimes need to use your eyes and nose to notice the progress of the reaction. A skilled researcher acquires all these techniques with time.

On the other hand, a good chef follows the exact mixing, heating or boiling process during making a delicious food.

The taste of the same food is different, if the cooking procedure is changed. It is as interesting as performing experiments in the chemistry lab.

During cooking the food, we usually apply heat. So, what happens to food when it is heated? Heat is a form of energy and when a food is heated, some changes occur in the food or we can say some chemical reaction occur in side the food. The process of heating the food depends on the nature of the food that we cook and taste that we want. So, it is very important to learn the scientific principle of cooking method to prepare tasty food. In this section, various cooking methods have been discussed with special reference to chemical change that occurs in the process.

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METHODS OF COOKING-FRYING

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Introduction

Cooking makes many foods, such as tough meats and starchy vegetables, easier to eat, and often improves the taste. It may also make food more easily digestible. Cooking stops the action of enzymes and sterilizes the outside of the food particles, thus aiding in preservation. The method of cooking must be appropriate for the type and quality of the food in order to enhance its flavor and texture. All cooking destroys some of the nutrient value of natural food, especially the vitamins.

In cooking, there are some basic methods of cooking that are used. These commonly used basic cooking methods are divided into two general groups. The groups are- Dry heat cookery methods and moist heat cookery methods. The methods of cooking are divided into these two groups because of the way food is cooked and the type of heat that is used.

Cooking Methods

Choosing the correct cooking method will depend on the type of food you are preparing. For example, when cooking meat products, it is necessary to consider the type of cut you are cooking as tough meat products require different cooking techniques than tender cuts do in order to break down the fibers and create a palatable dish. All cooking methods fall under two categories- Moist and Dry Heat.

Dry heat Cookery Methods:

In dry heat cooking methods, the food being cooked does not use water to cook the food. The food is left dry and heat is applied to cook the food. Such methods of cooking are: baking, steaming, grilling, and roasting. When heat is applied to the food, the food cooks in its own juice or the water added to the food during its preparation evaporates during the heating process and this cooks the food. Heat is applied directly to the food by way of convection thus making the food to get cooked. The action or movement of air around the food cooks it.

Moist Heat Cookery Methods:

In a moist heat cookery methods liquid is used as a medium to cook the food. Such medium could be

water, coconut cream or oil. These liquids are added to the food before heat is applied to it or sometimes heat is applied to the liquid before the food is added into the cooking utensils to be cooked. The moist heat cookery methods include: boiling, stewing, shallow frying, deep frying, barbequing and basting. Here Frying method is described-

Cooking Method-Frying

Frying is a quick method of cooking food in hot oil or fat. Frying gives a good flavour and colour to food. It is of following two type-

1. Shallow frying
2. Deep fryin.

(1) Shallow Frying:

Shallow frying is the cooking of food in a small quantity of pre-heated fat or oil in a shallow pan or flat surface. This is of following type: Shallow frying, Sauté, Griddle, Stir fry.

Shallow Frying: Food is cooked in small amount of fat/oil in a fry/sauté pan. This is used to cook small cuts of fish, meat and poultry.

Sauté: Tender cuts of meat and poultry are cooked by this method. After cooking fat is discarded and pan is deglazed with stock or wine to prepare sauce.

Griddle: Food can be cooked on a girdle (a solid metal plate).

Stir Fry: Vegetables, strips of beef, chicken etc. are fast fried in wok with little oil or fat.

(2) Deep Frying:

This is the cooking of food in pre-heated deep oil/fat/clarified butter. Fried foods are often coated before frying.

Coating improves-(a) the appearance of food, (b) food retains it's shape, (c) prevents fat soaking by forming crust, (d) enhances the taste of food, (e) prevents direct contact of hot fat/oil to food

Principles of Shallow Frying-

Preheat the cooking utensil before adding the food This seals the food and prevents the absorption of fat by food and reduce the risk of stickling of food. The side to be presented for the service is fried first The best colour and finish occurs on the side fried first. Foods which are thick are cooked at lower frying temperature

• Different foods to be fried in same pan should be cooked in order of relative cooking time, that is food which will take longer time to cook are placed in the pan first (this allows food to be prepared at time of service)
• Frying pan is moved and turned during cooking (this helps in even distribution of heat and results even browning and cooking of food)
• Tongues are used to move and turn food
• Foods are turned over when moisture appears on surface
• Food should be seasoned before shallow frying
• All fried foods are well drained before service
• Food should never be crowded in frying pan

Principles of Deep Frying-

• Food should be of uniform size
• Food should be chilled after crumbing, loose crumbs shaken free and the surface patted.
• If coated in butter, any excess should be drained off and the food slowly lowered into the fryer.
• Very cold or frozen food, should be added in small pieces and quantities
• Residues of crumbs, batter or food should be skimmed form frying medium
• Frying medium should be at correct temperature before adding food
• The temperature of cooking medium should not exceed the cooking temperature of the food.
• Food should be dried before immersing in hot frying medium.
• When removing drain the fat over the fryer.
• All fried foods should be drained on absorbent kitchen paper before serving
• Food should be seasoned away from the fryer
• Fried food should be served immediately after frying

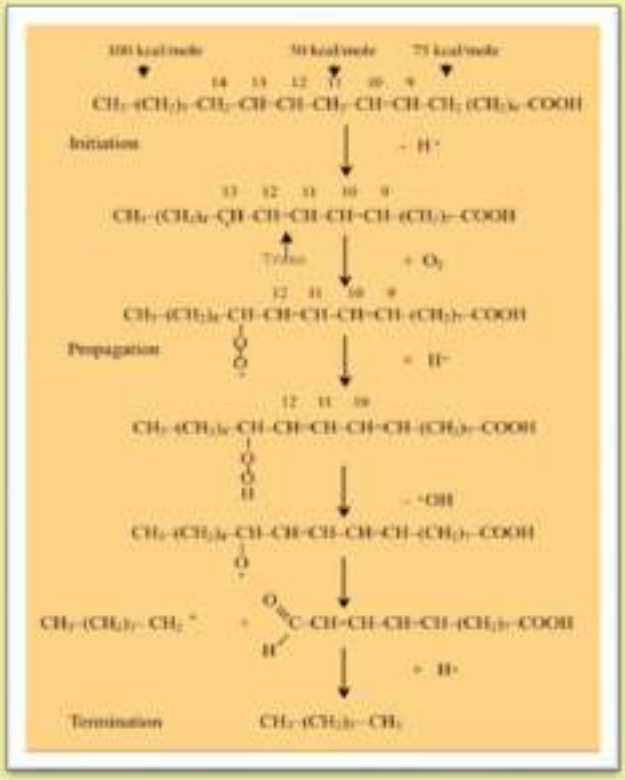
TEMPERATURE CHART			
Type of Fat/Oil	Approximate		
	Flash Point (°c)	Smoke Point (°c)	Flash Point (°c)
Peanut Vegetable Oil	324 °c	230 °c	160 °c
Peanut Vegetable Fat	321 °c	226 °c	180 °c
High Class Vegetable Oil	324 °c	204 °c	160 °c
Pure Vegetable Fat	318 °c	215 °c	170 -182 °c
Pure Vegetable Oil	330 °c	226 °c	170 -182 °c
Peanut Maize Oil	224 °c	215 °c	160 °c
Peanut Fat	321 °c	202 °c	160 °c
Peanut Quality Dripping	300 °c	165 °c	170 -182 °c
Peanut Olive Oil	250-277c	148 -165°c	175 °c

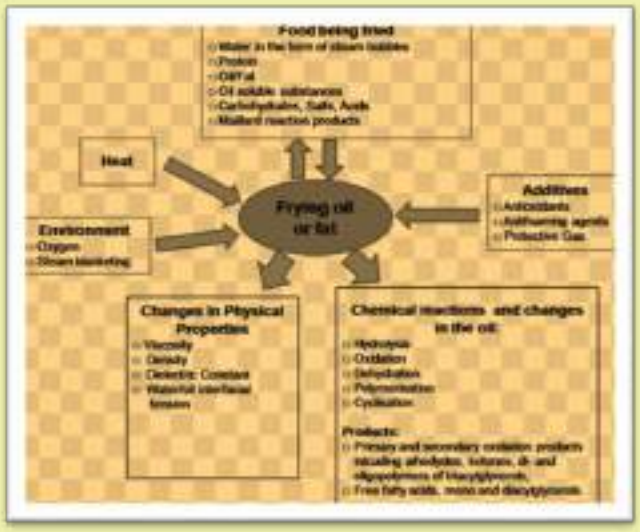
Chemical Reactions of oil during deep fat frying:

Hydrolysis of oil: When food is fried in hot oil, the moisture forms stem, which evaporates steam, which evaporates with a bubbling action and gradually subsides as the foods are fried. Water, steam and the oxygen initiate the reactions in the frying oil and food. Water, a weak nucleophile, attacks the ester linkage of triacylglycerols and produces di and mono-glycerols, glycerol, and free fatty acids, which contents in frying oil increase with the number of fryings.

Oxidation of oil: Fried foods absorb the frying oil and oxidation products in the oil, during frying. Hydroperoxides and other oxidation products in the oil can catalyze further lipid oxidation; thus, fried foods are highly susceptible to oxidation during transport and storage. When oils undergo oxidation, they react with oxygen to form free radicals and harmful compounds that you definitely don't want to be consuming. Saturated fats and monounsaturated fats are pretty resistant to heating, but oils that are high in polyunsaturated fats should be avoided for cooking.

Chemical Reactions during Frying Process:





So in conclusion, from this chapter, we learned about various frying techniques and the chemistry associated with it.

TABLE 1. Main changes in the composition of foods during the frying process

Component	Changes during frying
Fat	Increased concentration and change in composition
Water	Significant loss
Reducing sugars	Maillard reaction
Starch	Gelatinization
Proteins	Alteration of the composition
Amino acids	Formation of heterocyclic flavoring substances
Flavoring substances	Formed by oxidative and Maillard reactions
	Interaction with frying oil
Vitamins	Moderate loss
Minerals	Small loss
Antioxidants	Moderate loss

Source: Adapted from Pokorny (66)

METHODS OF COOKING-STEAMING

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Introduction: Cooking is a great way to demonstrate chemical changes and the three phases of matter. There are lots and lots of things you could investigate in the kitchen, since cooking usually involves some chemical process. Basically cooking itself is really just chemistry– heating, freezing, mixing and blending are all the process used in the laboratory and the kitchen.

Methods of cooking: There are a lots of method which used to different cooking. Different cooking methods are used to prepare different kinds of food. Cooking methods are basically two types– Moist heat method and Dry heat method.

- **Moist heat method:-** Poaching, simmering, steaming and boiling are all moist cooking methods. They are essentially different stages of the same cooking process. Each method cooks food by immersing it in liquid, usually water or stock.
- **Dry heat method**:- It is a cooking techniques where the heat is transferred to the food item without using extra moisture. This method typically involves high temperature 300°F or hotter.

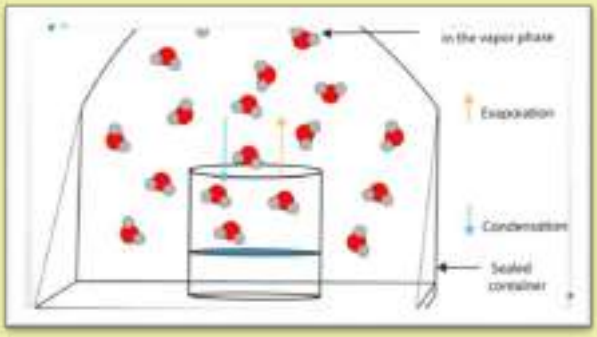
Now, we are going to discuss about one of the most popular cooking method– steaming which is basically a moist heat method.

Steaming: It is one of the best cooking method for preserving nutrients including water-soluble

vitamins, which are sensitive to heat and water. There are three ways that we can steam foods, the first one is by placing food in a saucepan filled with water, the second one is by putting the food into pressure- less steamer and the last one is a pressurized steamer with some certain fixed temperature and heat required. Some food which

are made by steaming process- Momos, steamed rice, Idli , streamed sea food, palak vada, Dhokla etc.

Process of steaming:
Steaming refers to the process of cooking in steam from boiling water. The heat is created by boiling water which vaporizes into steam. The steam brings heat to the food and cooks it. Unlike boiling the food is separate from water and only comes into direct contact with the steam. Once the water reaches about 212 degrees Fahrenheit the steaming process begins.



Water boils at 212 degrees Fahrenheit so the highest temperature the food cooks is at 212° F. Steam cooking can also be done through the use of high pressure. However this type of cooking requires specialized equipment.

Some chemical and physical changes occurs when water is steaming:

The evaporation of water is a physical change when water evaporates it changes from liquid state to the gas state but it is still water it has not changed into any substance.
Steaming is an exothermic reaction. Liquid water had to have energy put into it to become steam and that energy is not lost instead, it is retained by the gaseous water molecules. When this molecules condense to from liquid water again the energy put into the system must be released and this stored energy is let out as exothermic heat.

Type of steaming:

There are two types of steaming process–

(1) Atmospheric or low pressure steaming:

• **Direct steaming:-**cooking food in steamer of a pan of boiling water.

• **Indirect steaming:** Between two plates over a pan of boiling water.

(2) High pressure steaming:
There is an equipment built such that it does not allows steam to escape therefore pressure of steam is built up.

Advantage of Steaming process:

•Less loss of nutrients from food.
•Food retains maximum colour and flavour.
•Cooking time is reduced.
•Fuel saving.
•Make some foods lighter and easier to digest.
•Low pressure steaming reduces risk of over cooking.
•There is no liquid movement to break food.
•No straining of food is required after cooking.

Steaming has several advantage over other method of cooking. This doesn't mean steaming does not have disadvantage .

Disadvantage of steaming process:
• Steaming is slow (if pressure cooker is not used)
• Steaming does not allow much development of flavour.

METHODS OF COOKING- BAKING

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Who thinks about science while cooking? But science is involved in every aspect of our lives. Whatever you cook in kitchen, science is there. The connection between cooking and chemistry is eternal. In baking, there is huge role of Chemistry too.

No matter which food you bake, the basic ingredients of the recipe are involved in several chemical reactions that hold on diverse ingredients together to form the final edible dish.

Baking in ancient times: In ancient ages, human took wild grass grains, soaked them in water and mixed everything together, mashing it into a kind of broth-like paste. Later the paste was cooked by pouring it onto a flat, hot rock, resulting in a bread-like substance. It is the first evidence of Baking.

Later human discovered fire. Then baking became much easier. The oldest oven is discovered in Croatia in 2014, dating back 6500 years ago. The Egyptians used yeast for baking.

Around 600 BC, the beginning of bread baking in Ancient Greece lead to the invention of enclosed ovens. Ovens and worktables have been discovered in archaeological digs from Turkey (Hacilar) to Palestine [Jericho (Tell es-Sultan)] and date back to 5600 BC.

Around 300 BC, the pastry cooking became an occupation for Romans (known as Pastillarium). The Romans baked bread in an oven with its own chimney, and had mills to grind grain into flour. A bakers' guild was established in 168 B.C. in Rome.

Heat Transference:- Baking is a combination of two types of heat transfer method i.e. conduction and convection. As the combined heat comes in contact with the food, it is directed through the baked goods. Radiation heat from equipment sources will also be absorbed by food in large quantities. So, this method of cooking also uses all the methods of heat transfer.

Temperature Range:- It is difficult to determine the exact temperature for baking. The temperature range can range 100°C to 250°C. Temperature of

100°C is used for drying most specific products such as drying etc.

Points of Baking:- While baking, we need to keep in mind the following points-

(1). Food is mostly baked open on trays, rarely covered.
(2). It is usually associated with flour-based products.
(3). The oven is preheated before baking items are kept inside.
(4). After baking, the products need to be cooled on top of the wire rack to cool without absorbing any moisture, which can result in mold later.
(5). Baking products must have to be fresh and should not be stored for long.

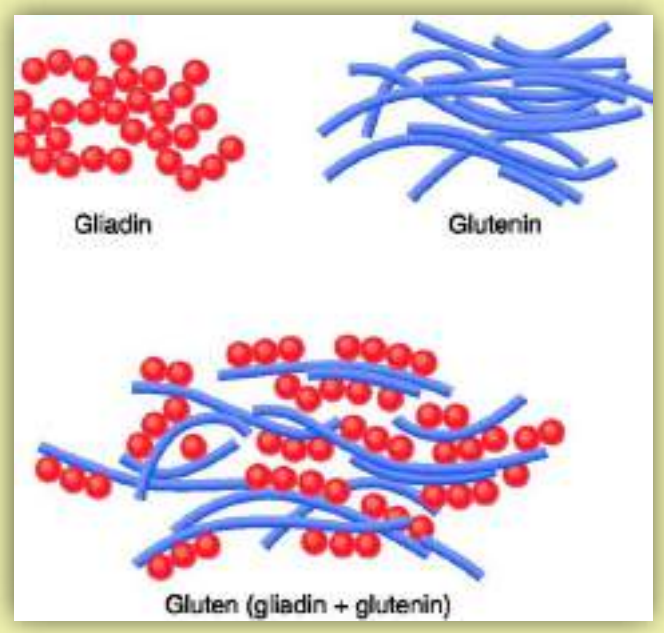
Equipment used in Baking:-

Baking Ingredients:-

Let's have a look in the Reactions of Baking:

Gluten Formation And Protein Bonding:

The most common type of flour used in baking is wheat flour. Flour, Grain powders, Nuts, Beans, Raisins are used for baking. Flour contains two types of protein– Glutenin and Gliadin. When water is added to make dough, these two protein form bond together and forms a new protein called Gluten. The Gluten bond is consolidated by kneading the dough. The dough is heavy and it expands greatly under hot temperature. By heating, the gluten bond strength rises and it gives a good structure to the well-baked dough.



Leaving Agents:

Leaving agents like Baking soda, Baking Powder and Yeast, lightens the baked dough like a pillow. Baking soda reacts with acids in the dough to produce Carbon dioxide gas and puffs the dough up. Baking powder releases Carbon dioxide twice during the whole process, once it hits water and another time, when it reaches a certain temperature in the oven. Baking powder produces Carbon dioxide with the help of heat which makes cake light and fluffy. When yeast is added to the dough, it also releases carbon dioxide bubbles, giving the dough a light and delicate texture.

Browning Reaction:

When the baking temperature reaches 300°F, sugar undergoes a reaction between amino acids, protein and reducing sugar. It is known as Maillard Reaction. It occurs when proteins and sugars are broken and rearranged by high temperatures. This sugars and proteins can be derived from flour by itself, or they can be enhanced with the addition of sugars and eggs. The reactions produce ring-shaped organic compounds that darken the surface of baking dough. Maillard reactions also produce toasty and savory aromas and flavor compounds.

These compounds also react among each other, producing even more complex aromas and flavors. Sugar also provides the food supply for yeast to enhance it's activity.

Emulsification And Binding: Eggs in a cake mixture can perform one or more of three functions. The egg whites are used in the batter just like baking powder, giving the flour a light, fluffy consistency. This is possible because egg whites (albumin) contain lecithin, a protein that covers the air bubbles created during beating, which prevents the cake from sinking during baking. Lecithin also acts as a binder to hold the cake together. When egg is used as a glaze, it also acts as a source of protein for the sugar's Maillard reaction.

Flavors of Caramelization: Caramelization is the last chemical reaction during the Baking process. It occurs at 356°F. When high heat causes sugar molecules to break down and release water, which turns into steam, then the reaction occurs. Diacetyl, which gives caramel it's butterscotch flavor, is produced during the first stages of caramelization. Then ester and lactones, which have a rum-like flavor, are produced. Finally, the production of furan molecules imparts a nutty flavor, and a molecule called maltol imparts a toasty flavor.

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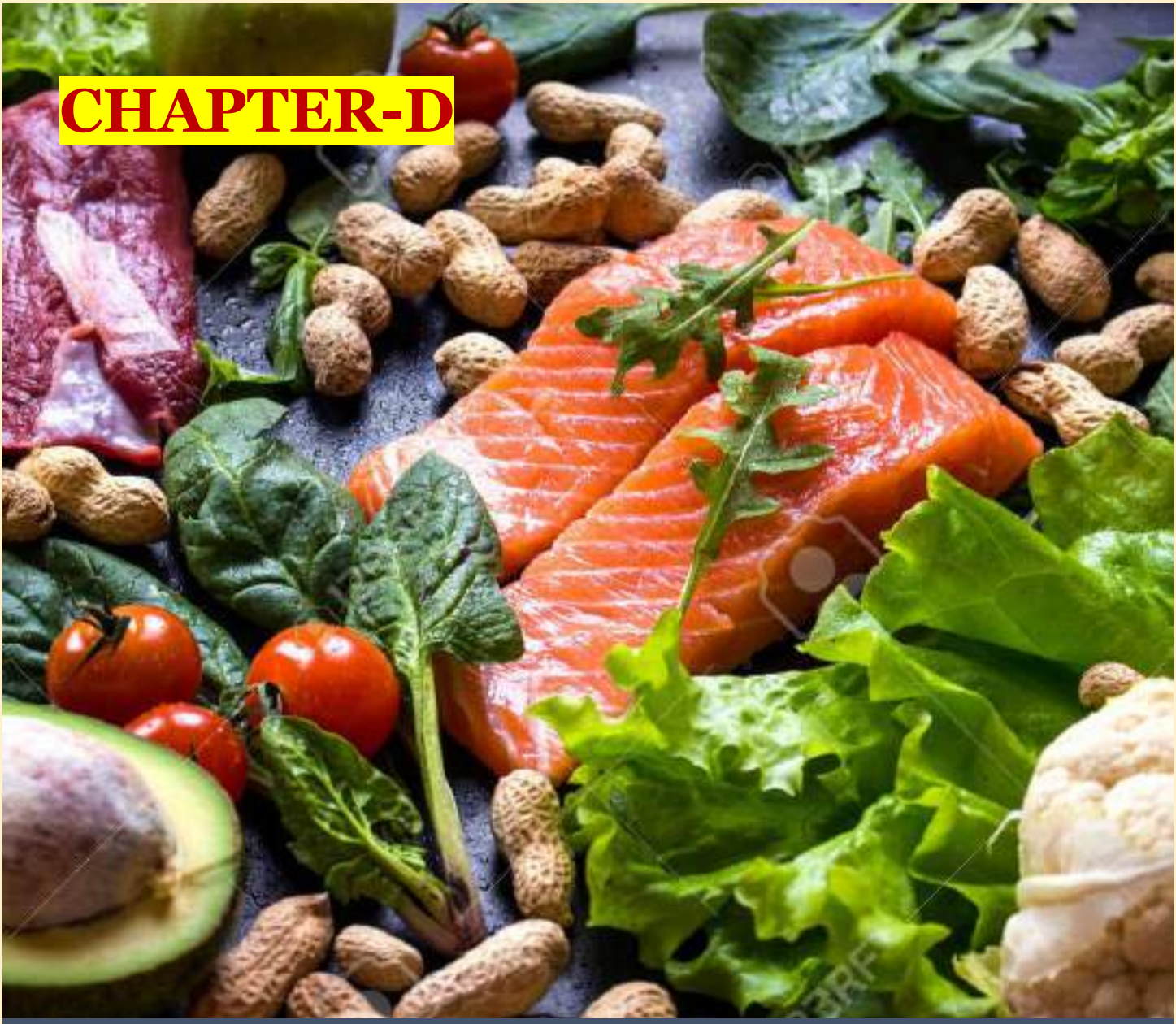


CHAPTER-D

MYTH VS FACT OF COOKING

WHAT DOES A CHEMIST SAY?

CHEMQUEST, VOL-1, ISSUE-2, **2020**, PAGE-D1-D10

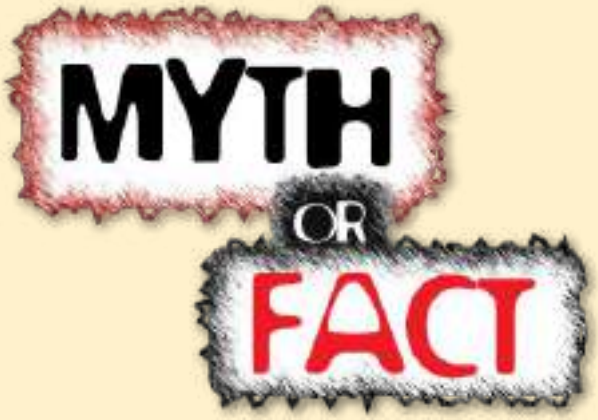
PRELUDE

Kitchen is the heart of our home.

A definite reason is there for it. Food is the source of energy which nurtures not only our bodies but also cherish our minds and souls.

Kitchen is a place where food is prepared and stored. It is a place from where we get the nutrients that our bodies need. So, we survive!

Cooking is an art and the people practice very hard to be a master of it. With times, so many myths have been evolved about cooking. There are few myths about cooking which is absolutely false. So, a master chef should not fall in this trap. Some of the myths are-microwave cooking destroys the food nutrients, marinades tenderize the meat, use of aluminium utensils are bad for health, all the fats are bad and should be avoided in the kitchen and there are many more.



As a learner of chemistry subject, we wanted to look back few facts about cooking and then tried to offer a justification on it.

In this chapter few interesting facts about cooking have been discussed.

ALUMINUM COOKWARE SHOULDN'T BE USED FOR COOKING: MYTH OR FACT?

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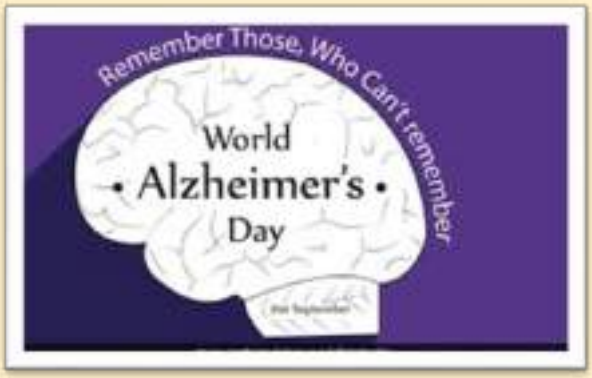
Aluminum is an element of Group-13 with Atomic Number-13 in the well-known Periodic Table. It is the 3rd most abundant mineral (8.3%) found in earth's crust.

Besides these, it is present everywhere from our municipal water supply to antiperspirant. Aluminum have been used as cookware since 19th century, and it became a popular choice for use now a days. Use of aluminum has so many advantages such as- lightweight (for its low density *i.e.* 2.7 g/cm), great conductor of heat being a metal and it is also inexpensive. However, there is an assertion outspread among us that ***aluminum cookware should not be used for cooking***. Is it correct? Or it's just a rumor? Let us dig a little deeper, what science tells about this.

In late 70s, there was a study which reveals the fact that people with Alzheimer's disease had increased concentration of aluminum in their brain. Alzheimer's disease is a disorder that causes brain cells to destroy and die. Alzheimer's disease is a common cause of dementia- a continuous decline in thinking, behavioral and social skills that disrupts a person's ability to function independently. The exact mechanism of aluminum toxicity is not known. However, accumulating evidence suggests that the metal can potentiate oxidative and inflammatory events, leading to tissue damage. At present there is no direct treatment for this, but medication and management strategies may temporarily improve symptoms. However, according to WHO (World Health Organization) there is no direct link between aluminum metal and Alzheimer's diseases. WHO says that an adult can consume more than 50 mg of aluminum, whereas on an average aluminum pots add about 1-2 mg of aluminum to our daily intake. Now, if we compare it with the antacid tablets, which contains ~100-200 mg of aluminum, it seems negligibly small. On the other hand, FDA (Food and Drug Administration) reports 'daily intake of aluminum for a man from all dietary sources can range from 10 to 100 mg per day'. This is the quantity that the human body is able to excreting and getting out of the system in various ways easily.



From these data, it is clear that though there is no direct evidence between Alzheimer's disease and usual aluminum intake in daily routine. But, we should be aware that high intake of aluminum may be harmful to people suffering from bone disease or renal impairment. So, we should minimize our aluminum intake on daily basis.

We must have a basic knowledge that how aluminum leaches to our food from cookware. During cooking aluminum is leached into food more extensively if the pan or pot is very old or pitted or worn. Again, longer the food is cooked or stored in aluminum pot, greater the amount of that get into food. Acidic foods such as tomatoes and citrus products are highly prone to absorb the most aluminum.

Besides this there is another use of aluminium for the purpose of cooking i.e. aluminium foil. Wrapping of food in aluminium foils is a common practice in western countries and in our country too, as it keeps the food warm for longer time because it acts as a protective layer from light as well as oxygen. A study done be Ghada *Bassioni et al.* from Ain Shams University, shows the bad effects of using aluminium foils while cooking.

Keeping food wrapped in aluminium should be avoidable, this is especially for acidic foods. The research conducted by Ghada and associates tells that "the migration of aluminium into food during the cooking process of food wrapped in aluminium foil is above the permissible limit set by the WHO" Thus, we should avoid the wrapping of food with the aluminium foil, as its harmfulness is too much compared to cooking food in aluminium utensils.

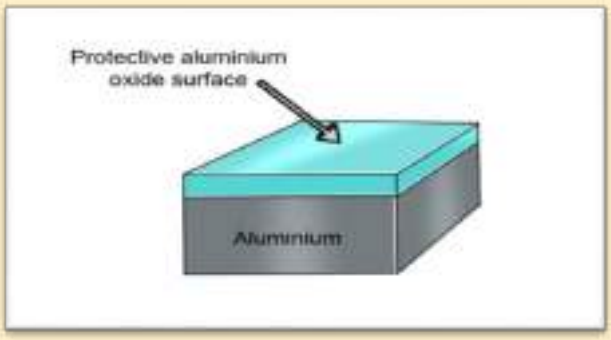
So, the way out from these problems can be as follows:

(1) In developed countries aluminium cookware usually has a non-stick or Teflon Coating (Teflon is a brand name of a chemical coating, polytetrafluoroethylene) on it to prevent the aluminium to dissolving into the food. However, there is some drawbacks of this method as heating of Teflon pans for a longer time or in high fire releases PFOE (per-fluoro-octanoic acid) or C8 which is very harmful for human health. Besides this in developing countries, this protection is available at a price which makes it unaffordable for a large section of the population.

(2) Another way out can be to use Anodized aluminium cookware. When aluminium is placed in acid solution and exposed to electric current, a layer of Aluminium Oxide (Al_2O_3) is deposited on the surface of aluminium. This process is known as anodization. The chemical reaction occurred during this process is as follows:

$$2Al + 3H_2O \rightarrow Al_2O_3 + 6H^+ + 6e$$

Anodized aluminium conducts heat in same extent as ordinary aluminium conducts, but has a hard, non-stick surface, which makes it scratch resistant and thus lowers the quantity of leaching of the metal in food.



(3) It will be safer if we avoid to cook or store acidic food in aluminium cookware of pots, as normally aluminium is consumed by it in more amount than that of the normal foods, beside this, acidic foods are able to leach aluminium even from anodized aluminium according to following reaction:

$$2Al_2O_3(s) + 6H^+(aq) \rightarrow Al^{+}_{3}(aq) + 3H_2O(l)$$

Thus, during cooking we have to use another cookware such as stainless steel etc. except aluminium.

(4) As longer the food is kept in aluminium pot, greater the amount of it leaches into food thus we should not store or keep food into aluminium pots for longer time. Instead, we can use glass, stainless steel or ceramic ones.

(5) Besides these, we also should avoid the wrapping of food with the aluminium foil, as it is harmful in comparison to cooking food in aluminium cookware.

So, from the above discussion the we can conclude as follows:

There are some studies which indicate that there might be a link between Alzheimer's disease and aluminium intake, although no direct satisfactory evidence to support this fact has been discovered so far. Both WHO or FDA says that the amount of aluminium intake from the cookware via the food is very low from the limit of harmful-quantity for us. None the less, aluminium is a non-essential element for our human body, and high intake of it can cause some other diseases. Then, we have learned how to minimize the intake of aluminium on daily basis, even if we use aluminium cookware.

Thus, if we can maintain above-mentioned points for way out, it can be easily said that we can use aluminium cookware in the kitchen when it needs.

ALL FATS ARE BAD AND SHOULD BE AVIODED IN THE KITCHEN?

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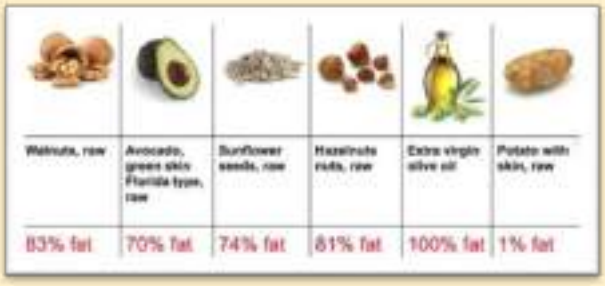
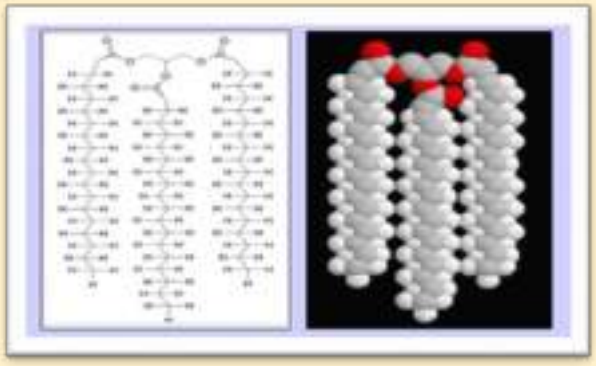
"All the fat are bad for health. Don't take too much fats".

OKAY!! So this particular misconception is really very complex. Neither of us are registered nutritionists, dieticians nor food scientists but some facts are also meaningful. In our daily life we cook many dishes to add fats on it.



However, first of all we have to know what is fat? Fat means a long chain of carbon and hydrogen atoms. In chemical term, we can say fats are the esters of long chain fatty acids.



As like carbohydrates and protein, fats are also a type of nutrients. Our body needs some energy from fat also. Because it protects our brain and heart absorbing such of minerals, vitamins etc. But it is also harmful for our health. Now a days, cholesterol is the common problem, it's increasing the risk of heart attack or stroke !!

Classification of Fats: There are four main types of fats-(1) Saturated Fats (2) Unsaturated Fats (3) Trans Fats (4) OMEGA -3 -6- Fatty Acids

We will discuss about all these in brief.

(1) Saturated Fats: The term saturated means filled to capacity. It has carbon-carbon single bond and linear structure. For this reason, saturated fat is usually solid in room temperature because the fatty acids pack together tightly here. Now, let us discuss whether these types of fats are good or bad for our health. This is really a very tough question. To make many delicious dishes, we add such of saturated fats. That is coconut oil, butter, ghee. It makes our dishes yummy! Even to make many snacks we use cheese, chocolates, sausages etc. But it is notified from many investigation that the average man aged 19-64 years, he should not eat more than 30 gm saturated fats per day and the woman is same aged 19-64 years she should not eat more than 20 gm saturated fats per day. So we have to be concerned about our health.

(2) Unsaturated Fats: Unsaturated fats have at least one double bond(Carbon-Carbon) and it has bent structure also. There are two types of unsaturated fats, *i.e* (1). Mono unsaturated Fats and (2). Poly unsaturated Fats. In our daily cooking, oil is very essential. But, it raises our bad cholesterol level, so we should avoid mainly coconut oil, instead of it we should go for olive oil, sunflower oil, safflower oil etc. And it also helps to increase good cholesterol. Here is no doubt that unsaturated fats are good for health. It also reduce the risk of heart attack or stroke and also others problems.

(3) Trans Fats: Trans fat usually are generated through the process of hydrogenation. They are liquid in room temperature (unsaturated fats) and turns into solid fat (saturated fats) after hydrogenation reaction. This fat can be found in

stored foods, that is meat, many types of junk foods, dairy products etc. This fat is really dangerous for our health, we see that unsaturated fat increase good cholesterol but trans fat is totally opposite, it raises bad cholesterol and decreases good cholesterol. As a result, it affects in our body organs, heart disease can be must also we can suffer from diabetes. In U.S the FOOD AND DRUG ADMINISTRATION (FDA) has totally banned trans fat and WORLD HEALTH ORGANIZATION (WHO) also called to other governments in the world and told to eliminate this by 2023. But still this type of products are available in market, before buying any products for cooking else have to be concerned. Suppose there is written "zero trans fat" but even if they contain up to 0.5 gm of trans fat, it will be harmful for our body. However, if our country still sell this types of stored foods, we should eliminate it from our diet and also from our kitchen as soon as possible.

(4) OMEGA-3 Fatty Acids (Alpha Linolenic Acids): Omega-3 is a polyunsaturated fatty acid. And it is very beneficial for our health. There are many types of omega-3 that is EPA, DHA, ALA . Here we can consume EPA and DHA by cooking fatty fish like salmon, mackerel. ALA comes from plants, like vegetables. From many research, it is found that omega-3 fatty acid is really helpful, it reduces the depression, bipolar disorder, protect against memory loss, also cut off risk of cancer, heart disease and helps going with a healthy pregnancy. We should follow diet with Omega -3. Eventually the sources of this fatty acids are

flaxseeds, walnuts, flaxseed oil, soybean oil etc.

(5) OMEGA-6 Fatty Acids (Gamma Linoleic Acids): As omega-3, omega-6 also is a polyunsaturated fat. In cooking many people use vegetable oil, almond oil and this helps to reduce

bad cholesterol and triglycerides, increases good cholesterol. Besides other many types of oils such as soybean, corn, sunflower oil even veggies, fish, olive oil, garlic are all omega-6 fats which are used in cooking delicious foods. We all know oil is very essential for our daily life. However, it is told that it reduces insulin resistance and mainly provide energy to our body. According to the FOOD AND NUTRITION BOARD of the U.S institute of medicine asked that a man aged 19-50 years can intake omega-6 fat 17 grams per day and a woman same aged can intake 12 grams per day.

As a conclusion of this myth, we can say that all fat is not really bad for our health. Here we can see many types of fats and also their use in our cooking. We are not any food scientist or any researcher but we have to remember that we should follow a healthy diet that helps to reduce our health problems. However, in other words it is that "DON'T GO NO FAT, GO GOOD FAT" that's it.

MARINATION TO TENDERIZE THE MEAT SHOULD BE AVOIDED?

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Meat is a very delicious and nutritious food. We use to eat animal's meat as food. From the starting of human civilization, daily practice of primordial humans to survive was to hunt and kill animals for their meat. With the progress of time, civilized people used to keep cattle like cow, sheep etc. Mainly water, protein and fat are present in meat. In present day, it is cooked by various innovative processes to make it tastier. Among the various followed processes, the common technique is marinating the meat to impose tenderness to eat. Marinating is a process of soaking meats in a seasoned liquid, which is called a marinade, before cooking. Marinades often use an acid or an enzyme to enhance flavors and change the surface texture. And tenderness means a quality of meat to be easily chewed and cut.

During last few years, we are witnessing some information about this marinating process. These information tell us that due to marinating, the inner protein structure of the meat is changed and it makes the meat harmful for our health.

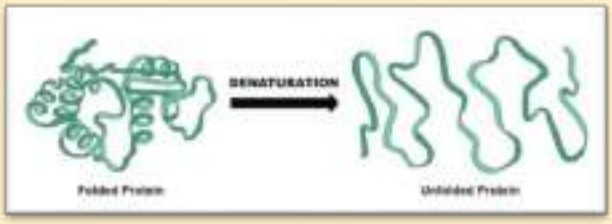
However, we do not know whether it is a myth or a fact. So, let us check few scientific reasoning to understand the chemistry of marination of meat.

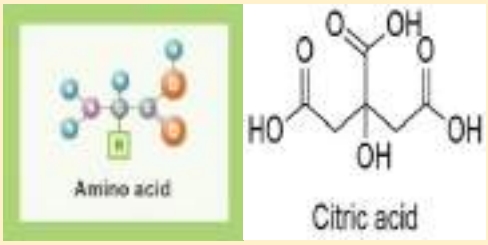
Marinate with acid:

Usually citrus juice (pH= 3 to 6), vinegar (pH= 2.4), yogurt (pH= 4 to 4.5), buttermilk (pH= 4.4 to 4.8) and materials like wine are used for marinating.

'pH' is the quantity that measures the acidic character of an organic or inorganic substance. pH less than 7 of a substance indicates that it is acidic in nature. Thus, the above mentions ingredients are acidic in nature. If we tenderize meat with acid- muscle fiber, collagen, connective tissue of the meat will be broken down. It will make meat softy. But its effect is limited up to meat's surface only. Acid can weaken the protein structure of meat too much, making it too softy & mushy. Acid can denature protein on the surface and make the surface of the meat mushy.

Due to denaturation some week linkages or bonds e.g. Hydrogen bonds breaks in a protein molecules for which proteins have a loser and random structure. Proteins structure contains amino acids as building blocks. When these proteins come in acidic environment, the amino acid are ionized for which the weak bonds breaks and denaturation of protein occurs.





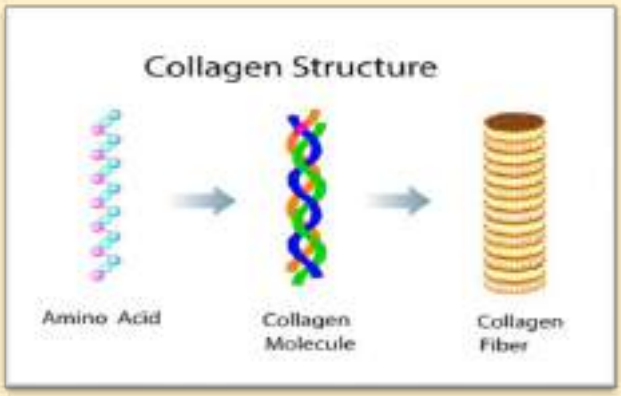
Citric acid

However, during use of acid, we should maintain some optimum condition, as for example, when citric acid is used as marinade it should not be kept more than two hours, otherwise it will tighten the protein bonds on the surface of meat due to some enzymatic actions.

Marinate with enzymes:

Various fruits like kiwi, pineapple, papaya and Asian pear contains certain enzymes which are really helpful to tenderize meat. Collagen in meat can be broken down by bromelain which is present in pineapple. The enzyme 'papain' which is present in papaya also help to tenderize meat efficiently.

Collagen is the most abundant protein present in mammals. The impact of Enzymes is limited to the meat's surface. They make meat softy and mushy too much as acids do.



Salt it:

Almost, 1-2 hours before the cooking, the meat should be marinated by heavily salting and as a result of it muscle fiber of the meat will be broken down. Salt (sodium chloride NaCl) causes the removals of water and coagulates the protein of the meat. It controls the hydrolytic action for which the meat becomes stiff and allows to control within desire limits. When you are ready to cook, the meat should be rinsed off the salt, otherwise the salt

content will be higher in test. Then, we should make the meat dry and add it to a hot skillet.

Slice it right:

There are several knife tricks which are used to make meat tenderer. For relatively thin cuts like chicken breasts, pork chops, cutlets, steaks we reserve marinades. For kebabs and stir fries, meats are cut into chunks or slices. It shreds the hard meat and makes it softy too much.

Slow -cook it:

It's a good way to tenderize the meat in less heat for the long time. In this process hard fiber, collagen, connected tissues will be broken down and the meat will be softy.

Thus, in the time of marinating the meat, marinade materials do not change the structure of the meat's inner part. It can't go deeper from the meat's surface. Some ingredients in a marinade do penetrate only by a few millimeters. The main reason behind marinating is to make the meat tasty and softy. Therefore, the meat doesn't become harmful for our health if we follow proper marination procedure.

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CHAPTER-E

HERBS AND SPICES

A TASTY JOURNEY

CHEMQUEST, VOL-1, ISSUE-2, **2020**, PAGE-E1-E24

PRELUDE

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HERBS AND SPICES

No meal or snack should be naked. Herbs and spices make food tastier while boosting our health. Herbs, like basil, are the leaves of a plant, while spices, like cinnamon, are usually made from the seeds, berries, bark, or roots of a plant. Both are used to flavor food, but research shows they are chock-full of healthy compounds and may have health benefits. Herbs and spices fight inflammation and reduce damage to your body's cells.

Each one of them is rich in phytochemicals, which are healthful plant chemicals. Adding herbs and spices to our diet has another benefit: they are so flavorful, that they make it easier to cut back on less healthy ingredients like salt, sugar, and added fat. Food is an army in real sense and compounds from herbs and spices as well as from the other foods we eat work together to provide health benefits.

CULINARY HERBS

Culinary herbs are distinguished from vegetables in that, like spices, they are used in small amounts and provide flavor rather than substance to food. Herbs can be perennials such as thyme, sage or lavender, biennials such as parsley, or annuals like basil. Perennial herbs can be shrubs such as rosemary or trees such as bay laurel this contrasts with botanical herbs, which by virtue of definition cannot be woody plants. Some plants are used as both herbs and spices, such as dill weed and dill seed or coriander leaves and seeds. There are also some herbs, such as those in the mint family, that are used for both culinary and medicinal purposes. Emperor Charlemagne (742–814) long age compiled a list of 74 different herbs that were to be planted in his gardens. Name of some of those herbs are given below:

POPULAR HERBS & SPICES

allspice (Pimenta dioica)
asafoetida (Ferula assa-foetida)
bay leaf (Laurus nobilis)
basil (Ocimum basilicum)
black cumin (Nigella sativa)
black mustard (Brassica nigra)
black pepper (Piper nigrum)
brown mustard (Brassica juncea)
cardamom (Elettaria cardamomum)
celery seed (Apium graveolens, variety dulce)
chili pepper (Capsicum species)
cilantro (Coriandrum sativum)
cinnamon (Cinnamomum verum)
clove (Syzygium aromaticum)
coriander (Coriandrum sativum)
cumin (Cuminum cyminum)
fennel (Foeniculum vulgare)
fenugreek (Trigonella foenum-graecum)
ginger (Zingiber officinale)
lemon grass (Cymbopogon citratus)
lemon verbena (Aloysia citrodora)
nutmeg (Myristica fragrans)
oregano (Origanum vulgare)
paprika (Capsicum annuum)
parsley (Petroselinum crispum)
peppermint (Mentha ×piperita)
poppy seed (Papaver somniferum)
rosemary (Rosmarinus officinalis)
saffron (Crocus sativus)
sesame (Sesamum indicum)
star anise (Illicium verum)
spearmint (Mentha spicata)

thyme (Thymus vulgaris)
turmeric (Curcuma longa)
vanilla (Vanilla planifolia and V. tahitensis)
white mustard (Sinapis alba)

SOME ESSESNTIAL HERBS & SPICES

Here are some standouts to think about adding to your next meal:

Cardamom. A sweet, pungent spice. Of all spices, it is especially high in minerals like magnesium and zinc.

Chili Pepper. Fresh, dried, or powdered, chilies give our food a kick. One possible reason is capsaicin, the compound that makes them spicy.

Cinnamon. This is great as it is sweet but extremely low in calories and sugar-free.

Cumin. Used worldwide, rich in iron. It may play a role in weight loss, too. Good for managing body weight.

Garlic. Contains a powerful compound allicin. But to get the benefits, the cloves must be cut or chopped

as Allicin is formed only after the cells are cut or crushed.

Ginger. It has anti-inflammatory and antioxidant properties and may play a role in preventing diseases like cancer. Good for digestive system.

Turmeric. A good source of curcumin, an antioxidant that eases inflammation and help prevent the brain plaques that lead to dementia.

Here in this section some selected spices and herbs from the whole garden that are generally found in Indian kitchen cabinets and widely used in cooking would be discussed in detail. Let us study them one by one.

CARDAMOM

INTRODUCTION

Cardamom is a spice made from the seeds of several plants in the genera Elettaria and Amomum in the family Zingiberaceae**.** Cardamom has a strong, sweet, pungent flavour and aroma, with hints of lemon and mint. Black cardamom has a smoky note and a cooling menthol one as well.

NUTRITION FACTS

100 grams of cardamom contains 311 Calories. 77% iron, 57% Magnesium, 38% Calcium, 35% Vitamin C and 10% Vitamin B-6

TYPES

There are two types one is black another is green.

USES IN COOKING

Cardamom can quickly overpower other ingredients, so gradually add it in. Cardamom pairs well with poultry, red meat, lentils, oranges, rice, and other warm spices, It is ideal in curries, teas, baked goods (like this gorgeous bread) and sausages.

MEDICINAL BENEFIT

Cardamom seeds are sometimes chewed to refresh the breath and as a digestive aid· Cardamom has various uses ascribed in traditional medicine. Helps in weight loss, liver problem, nausea, acid reflux, anxiety, inflammation, skin disease, teeth problem diabetes etc.

CLOVE

INTRODUCTION

Clove (Syzygium aromaticum), tropical evergreen tree and its small reddish brown flower buds used as a spice. Strong of aroma and hot and pungent in taste, cloves are used to flavour many foods, particularly meats and bakery products.

NUTRITIONAL FACTS

Nutrition Facts

Serving Size	**100 g**
Amount Per Serving	
Calories	**274**
	% Daily Value *
Total Fat 13g	17 %
Saturated Fat 4g	20 %
Sodium 277mg	12 %
Total Carbohydrate 66g	24 %
Dietary Fiber 34g	121 %
Sugar 2.4g	
Protein 6g	12 %
Vitamin D 0.00mcg	0 %
Calcium 632.00mg	49 %
Iron 11.83mg	66 %
Potassium 1020mg	22 %

* The % Daily Value (DV) tells you how much a nutrient in a serving of food contribute to a daily diet. 2,000 calories a day is used for general nutrition advice.

CHEMICAL COMPOSITION

The clove buds' essential oil is extracted by hydro distillation method. The major constituents obtained from the oil includes 3-Allyl-6-methoxyphenol, i.e., m-Eugenol (69.44%), Eugenol acetate (10.79%), 4-hydroxy-4-mehtylpentan-2-one i.e., Tyranton (7.78%), Caryophyllene (6.80%), 1,4,7-Cycloundecatriene, and trace amounts (<1%) of other constituents.

USES IN COOKING

Whole or ground cloves are used to flavour soups and rice dishes, and it's one of the components of garam masala. Whole cloves are either removed before serving or picked out of the dish. Even when cooked, whole cloves have a quite hard, woody texture that would be unpleasant to bite into. Cloves also feature in any number of desserts, especially ground cloves, and particularly around the holidays.

HEALTH BENEFITS

It has wide range of medicinal value such as antiseptic and anaesthetic analgesic, antioxidant, anti-inflammatory, and antimicrobial activities. The Carotene pigments of clove are important antioxidants and provitamins, which keeps our eyes healthy.

The Eugenol is responsible for anti-inflammatory nature of clove, which reduces risk of arthritis. Also, antioxidants of cloves can help reduce risk of heart disease, diabetes, and certain cancers. Clove oil is used in dental care and it can relieve toothache temporarily.

CINNAMON

INTRODUCTION

Cinnamon is a spice obtained from the inner bark of several tree species. Cinnamon is mainly used as an aromatic condiment and flavouring additive in a variety of cuisines, sweets, and savoury dishes.

NUTRITIONAL FACTS

Ground cinnamon is composed of around 11% water, 81% carbohydrates, 4% protein, and 1% fat.

CATEGORIES

Cinnamons are separated into two categories: Cassia Cinnamon and Ceylon Cinnamon.

Cassia cinnamon are further of three types—Indonesian, Chinese and Saigon.

CHEMICAL COMPOSITION

Cinnamon contains a variety of resinous compounds, including cinnamaldehyde, cinnamate, cinnamic acid, and numerous essential oils.

USES IN COOKING

Cinnamon is used as condiment and flavouring additive in wide variety of cuisines, sweet, savouries, snack foods, masala tea, and traditional foods.

HEALTH BENEFITS

Cinnamon is loaded with powerful antioxidants, such as polyphenols. It has anti-inflammatory properties, and might also help with heart disease, Alzheimer's disease, cancer, HIV, infection, tooth decay, allergies, etc. Cinnamon oil is also used.

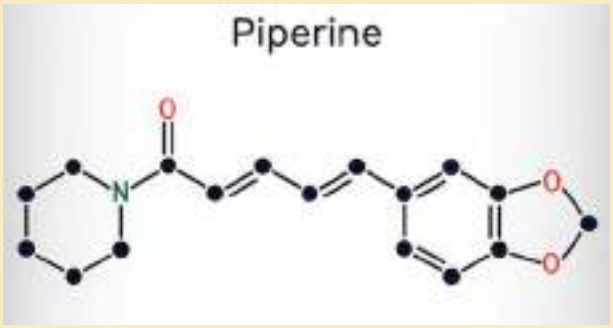
BLACK & WHITE PEPPER

INTRODUCTION

Black pepper is a flowering vine in the family Piperaceae, cultivated for its fruit, known as a peppercorn, which is usually dried and used as a spice and seasoning. White pepper consists solely of the seed of the ripe fruit of the pepper plant, with the thin darker-coloured skin (flesh) of the fruit completely removed. White pepper lacks certain compounds present in the outer layer of the drupe, resulting in a different overall flavour.

CHEMICAL CONSTITUENTS

Alkaloids: Piperine (5-9%) and Piperidine Volatile oil (1-2.5%)
Pungent resin (6.0%)
Starch about 30%)
Pepper volatile oil contains: α-phellandrene and Caryophyllene.



USES IN COOKING

Black pepper is a versatile ingredient that can be added to a variety of recipes, including meats, fish, eggs, salads, and soups.

TYPES

Peppers, more generally, chilli peppers are of five types. Black Pepper, White Pepper, Green Pepper, Red Pepper Corn and Pink Pepper. Here we have however discussed about black and white peppers only.

HEALTH BENEFITS

Black pepper is one of the most popular spices in the world and may offer impressive health benefits. Piperine is the active ingredient in black pepper, may fight free radicals and improve digestion and the absorption of beneficial compounds. It helps for healthy skin, to ride cold, to improve digestion, in treatment of ulcers, for tooth ache. It also prevents cancer, helps in weight loss, helps to fight depression, to treat asthma and cure sinus problems.

NUTMEG

INTRODUCTION

Pleasantly aromatic, nutmeg (Myristica fragrans) is a seed (kernel) of the fruit from the Myristica fragrans tree. It is one of the highly prized spices known since antiquity for its aromatic, aphrodisiac, and curative properties.

NUTRITIONAL FACTS

Nutmeg is rich in many vital B-complex vitamins, including vitamin-C, folic acid, riboflavin, niacin, vitamin-A and many flavonoid antioxidants like beta-carotene and cryptoxanthin that are essential for optimum health.

Folates	**76 µg**	**19%**
Niacin	**1.299 mg**	**8%**
Pyridoxine	**0.160 mg**	**12%**
Riboflavin	**0.057 mg**	**4%**
Thiamin	**0.346 mg**	**29%**
Vitamin-A	**102 IU**	**3.5%**
Vitamin C	**3 mg**	**5%**

USES IN COOKING

In Indian cuisine nutmeg is used in many sweet, as well as savory dishes. Grated nutmeg is used in meat preparations and sparingly added to desserts for the flavor. It may also be used in small quantities in garam masala.

HEALTH BENEFITS

Nutmeg is rich in antioxidants, including phenolic compounds, essential oils, and plant pigments, all of which helps to prevent the cellular damage and may protect against chronic disease. It also has an excellent anti-inflammatory and anti-bacterial properties. It also helps to control the blood sugar level and reduces the risk of heart disease. Nutmeg powder and nutmeg oil is also used.

BAYLEAVES

INTRODUCTION

Pleasantly aromatic bay leaf or bay-laurel (Laurus nobilis) is one of the well-recognized culinary leaf-spices in use since the earliest times. In the legends, bay laurel is depicted as the tree of the Sun god, under the celestial sign of Leo.

NUTRITIONAL FACTS

See the table below for in depth analysis of nutrients:

Bay leaf (Laurus nobilis), Nutritional value per 100 g.
(Source: USDA National Nutrient data base)

Principle	Nutrient Value	Percentage of RDA
Energy	313 Kcal	15.50%
Carbohydrates	74.97 g	57%
Protein	7.61 g	13%
Total Fat	8.36 g	29%
Cholesterol	0 mg	0%
Dietary Fiber	26.3 g	69%
Vitamins		
Folates	180 mcg	45%
Niacin	2.005 mg	12.50%
Pyridoxine	1.740 mg	133%
Riboflavin	0.421 mg	32%
Vitamin A	6185 IU	206%
Vitamin C	46.5 mg	77.50%
Electrolytes		
Sodium	23 mg	1.50%
Potassium	529 mg	11%
Minerals		
Calcium	834 mg	83%
Copper	0.416 mg	46%
Iron	43 mg	537%
Magnesium	120 mg	30%
Manganese	8.167 mg	355%
Phosphorus	113 mg	16%
Selenium	2.8 mcg	5%
Zinc	3.70 mg	33%

USES IN COOKING

In Indian cuisine, bay laurel leaves are sometimes used in place of Indian bay leaf although they have a different flavour. They are most often used in rice dishes like biryani and as an ingredient in garam masala Bay (laurel) leaves are frequently packaged as tez pattā creating confusion between the two herbs.

USES AS AN INSECT REPELLANT

Bay leaves can also be used scattered in a pantry to repel meal moths, flies, cockroaches, mice and silverfish.

HEALTH BENEFITS

Bay leaf helps in improving digestive health, treats respiratory conditions, improves hair health, has anti-inflammatory activity, and improves heart health. It also helps in cancer prevention, reduces anxiety and stress, and helps in diabetes management.

STAR ANISE

INTRODUCTION

Star anise is a spice generally obtained from Illicium verum which is a medium-sized evergreen tree native to northeast Vietnam and southwest China. It's aptly named for the star-shaped pods from which the spice seeds are harvested and has a flavor that is reminiscent of liquorice. Because of similarities in their flavor and names, star anise is often confused with anise, though the two spices are unrelated. Star anise is famed not only for its distinct flavor and culinary applications but also for its medicinal benefits.

CHEMICAL COMPOSITION

Star anise contains anethole, cinnamaldehyde, o-methoxycinnamaldehyde, p-methoxy-cinnamaldehyde, cinnamic acid, p-methoxycinnamaldehyde, cinnamyl alcohol, trans-anethole, beta-caryophyllene, citronellol, estragole, eugenol methyl ether, myrcene, p-methoxy phenylacetone, terpinen-4-ol gamma-terpinene, anisaldehyde, astragalin, kaempferol, kaempferol-3-O-alpha-L-galactoside, kaempferol-3-O- beta -D-rutinoside, quercetin, quercetin-3-O-alpha-L-galactoside, quercetin-3-O-alpha-L-rhamnoside, quercetin-3-O-alpha-D-glucoside, quercetin-3-O-alpha-D-rutinoside, quercetin-3-O-alpha-D-xyloside, benzoic acid-4- beta -D-glucoside, caffeic acid, p-coumaric acid, and cineol. It also contains neurotropic sesquiterpenoids, veranisatins A, B and C, phenylpropanoids, two lignans.

USES IN COOKING

Star anise contains anethole, the same compound that gives the unrelated anise its flavour. Recently, star anise has come into use in the West as a less expensive substitute for anise in baking, as well as in liquor production, most distinctively in the production of the liqueur Galliano. Star anise enhances the flavour of meat.

It is used as a spice in preparation of biryani and masala chai all over the Indian subcontinent. It is widely used in Chinese cuisine, and in Malay and Indonesian cuisines. It is widely grown for commercial use in China, India, and most other countries in Asia. Star anise is an ingredient of the traditional five-spice powder of Chinese cooking. It is also a major ingredient in the making of phở, a Vietnamese noodle soup. It is also used in the French recipe of mulled wine, called vin chaud (hot wine). If allowed to steep in coffee, it deepens and enriches the flavor. The pods can be used in this manner multiple times by the pot-full or cup, as the ease of extraction of the taste components increases with the permeation of hot water.

HEALTH BENEFITS

Star anise is rich in antioxidants and vitamin A and C, which help fight free radicals that are responsible for early ageing and diabetes. The oil produced from star anise contains thymol, terpineol and anethole, which is used for treating cough and flu. Anise also helps improve digestion, alleviate cramps, and reduce nausea. Consuming star anise tea after meals helps treat digestive ailments such as bloating, gas, indigestion, and constipation. Anise is one of the main ingredients in your favourite masala chai also.

SAFFRON

INTRODUCTION

Saffron is a spice derived from the flower of Crocus sativus, commonly known as the "saffron crocus". The vivid crimson stigma and styles, called threads, are collected and dried for use mainly as a seasoning and colouring agent in food. Saffron has long been the world's most costly spice by weight. Although some doubts remain on its origin, it is believed that saffron originated in Iran. C. sativus is possibly a triploid for of Crocus cartwrightianus, which is also known as "wild saffron".

NUTRITIONAL FACTS

Dried saffron is 65% carbohydrates, 6% fat, 11% protein (table) and 12% water. In one tablespoon (2 grams; a quantity much larger than is likely to be ingested in normal use) manganese is present as 29% of the Daily Value, while other micronutrients have negligible content.
Dried Saffron

CHEMISRY BEHIND

Saffron contains some 28 volatile and aroma-yielding compounds, dominated by ketones and aldehydes. The the main aroma-active compounds were safranal, 4-ketoisophorone, and dihydrooxophorone.

Saffron also contains many other non-volatile phytochemicals, including carotenoids. Its yellow-orange colour of is primarily the result of α-crocin. This crocin is an ester; named 8,8-diapo-8,8-carotenoic acid. The α-crocin is a carotenoid pigment that may make up more than 10% of dry saffron's mass. The two esterified gentiobioses make α-crocin ideal for colouring water-based and non-fatty foods such as rice dishes. The bitter glucoside picrocrocin is responsible for the pungent flavour of saffron. This is a union of safranal and a carbohydrate. It has insecticidal and pesticidal properties.

USES IN COOKING

Saffron's aroma is often described by connoisseurs as reminiscent of metallic honey with grassy or hay-like notes, while its taste has also been noted as hay-like and sweet. Saffron also contributes a luminous yellow-orange colouring to foods. Confectioneries and liquors also often include saffron. It is indispensable in Indian biriyani, polao, kheer, sewai etc.

HEALTH BENEFITS

Saffron can act on mental depression, on cardiovascular risk factors, such as lipid profile, blood glucose, weight, and in erectile dysfunction, however no strong supporting high-quality clinical evidence exists, as of 2020.

TURMERIC

INTRODUCTION

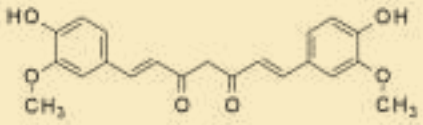
Turmeric (Curcuma longa) as a dried rhizome of a herbaceous plant, is closely related to ginger. It is also sometimes called “Indian saffron”. Turmeric is used in a wide variety of food of the cuisines of the Southern Asia.

NUTRITIONAL FACTS

One tablespoon of turmeric powder contains: 29 calories,0.91 g of proteins, 0.31 g of fat, 6.31 g of carbohydrates, 2.1 g of fibres, 0.3 g of sugar, 26% Manganese, 16% Iron, 5% Potassium, 3% Vitamin C.

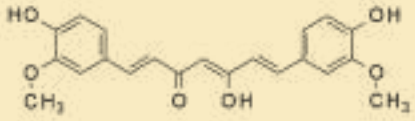
PHYTOCHEMISTRY

Phytochemical components of turmeric include diarylheptanoids. Curcuminoids, such as curcumin, demethoxycurcumin and bisdemethoxycurcumin.



Curcumin (keto form)

⇅



Curcumin (enol form)

CULINARY USES

Turmeric is one of the key ingredients in most of the Asian Cuisines. Most of the savoury dishes, some sweet dishes, canned beverages, baked products, dairy products, ice cream, etc., are incomplete without turmeric.

HEALTH BENEFITS

Curcumin is the main active ingredient in the turmeric. It has powerful anti-inflammatory effects and is an extraordinarily strong antioxidant that boosts our immunity and heals wounds. Apart from this, curcumin has many scientifically proven health benefits, such as potential to prevent heart disease, Alzheimer’s disease, and cancer. Reduces joint pain, cholesterol level, maintains blood sugar balance and is an antidepressant, acting as a digestive aid, helping in liver detoxification too.

ASAFOETIDA

INTRODUCTION

Asafoetida is sulfurous smelling gum-resin that is extracted from *Furula* plants. This is a spice. It is traditionally ground into a powder and used either for its proposed medicinal qualities or as a spice to add a savory flavor to food. It is yellow in colour and has pungent smell.

CHEMISTRY BEHIND

Typical asafoetida contains about 40–64% resin, 25% endogeneous gum, 10–17% volatile oil, and 1.5–10% ash. The resin portion is known to contain asaresinotannols A and B, ferulic acid, umbelliferone and four unidentified compounds. The volatile oil component is rich in various organosulfide compounds, such as 2-butyl-propenyl-disulfide, diallyl sulfide, diallyl disulfide (also present in garlic) and dimethyl trisulfide, which is also responsible for the odor of cooked onions. The organosulfides are primarily responsible for the odor and flavor of asafoetida.

CULINARY USES

This spice is used as a digestive aid, in food as a condiment, and in pickling. It plays a critical flavoring role in Indian vegetarian cuisine by acting as a savory enhancer.

Used along with turmeric, it is a standard component of lentil curries, such as dal, chickpea curries, and vegetable dishes, especially those based on potato and cauliflower.

Asafoetida is used mainly in vegetarian dishes, where it is quickly heated in hot oil before sprinkling on the food. It is an essential ingredient of Mutton Rogan Josh too. It is sometimes used to harmonize sweet, sour, salty, and spicy components in food too. The spice is added to the food at the time of tempering. Sometimes dried and ground asafoetida can be mixed with salt and eaten with raw salad.

NUTRITIONAL VALUE

It has been found to be a good source of antioxidants. Specifically, asafoetida has been shown to contain high amounts of phenolic compounds, such as tannins and flavonoids, which are known for their potent antioxidant effects. It has also been shown to help boost digestion by increasing the appetite.

BLACK CUMIN

INTRODUCTION

Black cumin, (*Nigella sativa*), also called black seed, black caraway, Roman coriander, kalonji, or fennel flower, annual plant of the ranunculus family, grown for its pungent seeds, which are used as a spice and in herbal medicine. The black cumin plant is found in southwestern Asia and parts of the Mediterranean and Africa. It is a popular specie. In Bengali it is called kala zeera.

CHEMISTRY BEHIND

Nigella sativa seeds contain protein (26.7%), fat (28.5%), carbohydrates (24.9%), crude fiber (8.4%), and total ash (4.8%). Nigella sativa seeds also contain a good number of various vitamins and minerals like Cu, P, Zn, and Fe. Many active compounds have been identified in N. sativa. The most important active compounds of N. sativa are thymoquinone.

CULINARY USE

It is used in tagines (meat stews) of North Africa and in lamb roasts, couscous, sausages, vegetables, and ground meat dishes (kibbeh) of the Middle East. In India they are used to make curries, lentils-based dishes especially for making yellow lentils. They are also used to make vegetable stir fries. Black seeds will add aroma, taste, and texture to your dish. Due to the healing properties, it is an immensely popular pickling spice along with mustard seeds and fennel seeds.

NUTRITIONAL VALUE

Black cumin seeds have been regarded as an effective means to treat cancer, destroying free radicals. Also, these seeds are good antibodies for diabetes, MS, hepatitis C and Alzheimer's disease.

WHITE CUMIN

INTRODUCTION

Cumin is a flowering plant in the family Apiaceae, native to a territory including the Middle East and stretching east to India. Cumin also spelled as cummin, (Cuminum cyminum), small, slender annual herb of the family Apiaceae (Umbelliferae) with finely dissected leaves and white or rose-coloured flowers. Native to the Mediterranean region, cumin is also cultivated in India, China, and Mexico for its fruits, called seeds, which are used to flavour a variety of foods. This is a specie known a zeera.

CHEMISTRY BEHIND

Cumin seeds are nutritionally rich; they provide high amounts of fat (especially monounsaturated fat), protein, and dietary fibre. Vitamins B and E and several dietary minerals, especially iron, are also considerable in cumin seeds.

CULINARY USE

Cumin blends well with coriander and with spice mixtures, as in Garam Masala, Curry Powder and Dhania Jeeru. The white cumin seeds Matches well with beans, chicken, couscous, curry, eggplant, fish, lamb, lentils, peas, pork, potatoes, rice, sausages, soups, stews, eggs.

NUTRITIONAL VALUE

Cumin contains key nutrients such as iron and copper, which are needed for healthy red blood cells. Just one teaspoon of cumin seeds contains around 2mg of your daily iron intake (that is 14% of daily iron intake for women and 23% for men).

DIFFERENCE BETWEEN BLACK & WHITE

The black cumin, also called kala jeera, is a relative of the brown cumin, but produces much smaller seeds that are thinner and less pungent. The black seeds are more reminiscent of fennel with a sweeter lemony caraway flavor. Black cumin is not as widely used around the world in cooking as the brown seeds.

THYME

INTRODUCTION

Thyme (Thymus vulgaris) is an herb whose small leaves grows on clusters of thin stems. Thyme is used to season all kinds of dishes.

NUTRITIONAL FACTS

100g of thyme contains 101 calories, Total Fat 2%, Sodium 0%, Potassium 17%, Total Carbohydrate 8%, and protein 12%.

PHYTOCHEMISTRY

The active compound present in thyme is thymol. The essential oil of thyme also contains 20-54% thymol, p-cymene, myrcene, borneol, and linalool.

VARIETIES

There are mainly two types. Common and Lemon.

COMMON THYME

LEMON THYME

CULINARY USES

Thyme leaves can be added to a dish at any stage of cooking either as a whole or in a chopped manner. If using for baking purpose, it is better to use dried thyme. Apart from this, it is also used for garnishing and seasoning.

HEALTH BENEFITS

Thyme has an excellent antiseptic and antibacterial properties; it is also beneficial in aromatherapy. Thymol is used in most of the commercially produced mouthwashes. Thyme oil was used to medicate bandages in older days.

BASIL

INTRODUCTION

Basil is known as Ocimum basilicum. Basil is an herb in the mint family. It adds flavor to meals, and its nutrients may provide health benefits. Basil is an herb in the mint family. It adds flavor to meals, and its nutrients may provide health benefits.

Sweet Basil

NUTRITION FACTS

Vitamin A 105%, Vitamin C 30%, Calcium 17%, Iron 17%, Vitamin D 0%, Vitamin B-6 10%, Cobalamin 0%, Magnesium 16% etc.

CULINARY USES

Basil is an herb in the mint family that is essential in cooking. It is known for being the main ingredient in traditional pesto and is also a favourite seasoning in tomato-based pasta sauces. It has a fragrant, sweet smell and peppery taste.

MEDICINAL BENEFITS

Great for healing skin problems and dental health. Helps cure fever, eye problem. Boosts immunity and health.

TYPES

The type used commonly as a flavour is typically called sweet basil, as opposed to Thai, Lemon and holy basil .

Thai Basil

Lemon Basil

Holy Basil

CILANTRO

INTRODUCTION

Cilantro (**leaf coriander**) is one of the traditional Mediterranean herbs which commonly recognized as leaf-coriander in Asia. Scientific name is **Coriandrum sativum**.

CHEMICAL ASPECTS

Its leaves and seeds contain many essential volatile oils such as *borneol, linalool, cineole, cymene, terpineol, di-pentene, phellandrene, pinene and terpinolene*. The herb is a good source of minerals like potassium, calcium, manganese, iron, and magnesium. It is also rich in many vital vitamins, including folic acid, riboflavin, niacin, vitamin-A, beta carotene, vitamin-C, which are essential for optimum health.

NUTRITIONAL ASPECTS

Vitamins		
Folates	62 µg	15.5%
Niacin	1.114 mg	7%
Pantothenic acid	0.570 mg	11%
Pyridoxine	0.149 mg	11%
Riboflavin	0.162 mg	12%
Thiamin	0.067 mg	5.5%
Vitamin A	6748 IU	225%
Vitamin C	27 mg	45%
Vitamin E	2.50 mg	17%
Vitamin K	310 mcg	258%

CULINARY USES

Cilantro stems are tender, flavorful, and most importantly edible. This green **cilantro** sauce is best when served up at cookouts, right along with whatever you are throwing on the flame.

HEALTH BENEFITS

This herb is extremely low in calories and contains no cholesterol. Its deep-green leaves possess good amounts of antioxidants, essential oils, vitamins, and dietary fiber, which may help reduce **LDL** or "bad cholesterol" levels in the blood. This is also a good source of minerals like potassium, calcium, manganese, iron, and magnesium. Cilantro is one of the richest herbal sources for **vitamin K.** It also has an established role in the treatment of Alzheimer's disease patients by limiting neuronal damage in their brain.

MINT

INTRODUCTION

Peppermint has been one of the favorite herbs known since antiquity for its distinctive aroma and medicinal value. Botanically, the herb belongs to the *Lamiaceae* family, in the genus; *Mentha,* and botanically named as Mentha piperita. It is actually a natural cross hybrid between the water mint (*Mentha aquatica*) and spearmint (*Mentha spicata*).

CHEMICAL ASPECTS

The herb parts contain many essential volatile oils like menthol, menthone, menthol acetate and is rich in many antioxidant vitamins, including vitamin-A, β- carotene, C, and E. With many essential B-complex vitamins the herb is an excellent source of vitamin-K also.

NUTRITIONAL ASPECTS

Vitamins		
Folates	114 µg	28%
Niacin	1.706 mg	10.5%
Pantothenic acid	0.338 mg	6.5%
Pyridoxine	0.129 mg	10%
Riboflavin	0.266 mg	20%
Thiamin	0.082 mg	7%
Vitamin A	4248 IU	141%
Vitamin C	31.8 mg	53%

CULINARY USES

Fresh mint leaves are usually cut in ribbons (chiffonade) and added to recipes. Dried mint leaves can be added to a sauce or stew as it simmers. Mint extract is used to give mint flavor baked goods or confections, or to flavor hot chocolate.

HEALTH BENEFITS

The essential oil, menthol present in mint is an analgesic (painkiller), local anesthetic and has counter-irritant properties. The compounds present in peppermint relax intestinal wall and sphincter smooth muscles through blocking calcium channels at cell receptor levels. This property of mint has been exploited as an anti-spasmodic agent in the treatment of "irritable bowel syndrome" (IBS) and other colic pain disorders.

OREGANO

INTRODUCTION

Oregano is a wonderful perennial culinary and medicinal herb. It has long been recognized as one of the "functional foods" for its nutritional, antioxidants and disease preventing properties. The herb, whose name means "delight of the mountains" in Greek, is native to the Mediterranean region. Botanically, it belongs to the mint (Lamiaceae) family, in the genus; Origanum, and is known scientifically as Origanum vulgare.

CHEMICAL COMPONENTS

Oregano contains much health benefiting essential oils such as carvacrol, thymol, limonene, pinene, ocimene, and caryophyllene.

CULINARY USES

People can use the leaves dry or fresh to add a “Mediterranean” flavor to a range of dishes. People also add it to baked good, vegetable dishes, legumes, such as lentils and chickpeas, fish, chili dishes

HEALTH BENEFITS

The active principles in the herb may improve gut motility, besides, increasing the digestion power by facilitating copious secretion of gastrointestinal juices. Also, fresh herb is an excellent source of antioxidant vitamin, vitamin-C. Vitamin-C helps the human body develop resistance against infectious agents and scavenge harmful, pro-inflammatory free radicals. Its leaves and the flowering stem have antiseptic, antispasmodic, carminative, cholagogues (empties gallbladder collection of bile juice), diaphoretic (sweat production), expectorant, stimulant, and mildly tonic properties. Its decoction is taken by mouth for the treatment of colds, influenza, mild fevers, indigestion, stomach upsets, and painful menstruation conditions.

GINGER

INTRODUCTION

Ginger (Zingiber officinale) is a flowering plant that originated in Southeast Asia. It is among the healthiest spices on the planet. The rhizome (underground part of the stem) is the part commonly used as a spice. It is often called ginger root or, simply, ginger. Ginger can be used fresh, dried, powdered, or as an oil or juice. It is a quite common ingredient in recipes.

NUTRITIONAL FACTS

Raw ginger is composed of 79% water, 18% carbohydrates, 2% protein, and 1% fat (table). In 100 grams (a standard amount used to compare with other foods), raw ginger supplies 80 Calories and contains moderate amounts of vitamin B6 (12% of the Daily Value, DV) and the dietary minerals, magnesium (12% DV) and manganese (11% DV), but otherwise is low in nutrient content (table). When used as a spice powder in a common serving amount of one US tablespoon (5 grams), ground dried ginger (9% water) provides negligible content of essential nutrients, except for manganese (70% DV).

CHEMICAL COMPOSITION

The characteristic fragrance and flavour of ginger result from volatile oils that compose 1-3% of the weight of fresh ginger, primarily consisting of zingerone, shogaols, and gingerols with [6]-gingerol (1-[4'-hydroxy-3'-methoxyphenyl]-5-hydroxy-3-decanone) as the major pungent compound. Zingerone is produced from gingerols during drying, having lower pungency and a spicy-sweet aroma. Shogaols are more pungent and have higher antioxidant activity but not found in raw ginger, but is formed from gingerols during heating, storage or via acidity. Fresh ginger also contains an enzyme zingibain which is a cysteine protease and has similar properties to rennet.

CULINARY USES

Ginger is an immensely popular spice used worldwide; whether it be used to spice up meals, or as a medicine, the demand for ginger all over the world has been consistent throughout history. Ginger can be used for a variety of food or medicine items such as vegetables, candy, soda, pickles, and alcoholic beverages. Ginger is a fragrant kitchen spice. Young ginger rhizomes are juicy and fleshy with a mild taste.

They are often pickled in vinegar or sherry as a snack or cooked as an ingredient in many dishes. They can be steeped in boiling water to make ginger herb tea,

to which honey may be added. Ginger can be made into candy or ginger wine.

In Indian cuisine, ginger is a key ingredient, especially in thicker gravies, as well as in many other dishes, both vegetarian and meat based. Ginger has a role in traditional Ayurvedic medicine. It is an ingredient in traditional Indian drinks, both cold and hot, including spiced masala chai. Fresh ginger is one of the main spices used for making pulse and lentil curries and other vegetable preparations. Fresh ginger together with peeled garlic cloves is crushed or ground to form ginger garlic masala. Fresh, as well as dried, ginger is used to spice tea and coffee, especially in winter. In south India, "sambharam" is a summer yogurt drink made with ginger as a key ingredient, along with green chillies, salt, and curry leaves.

Ginger powder is used in food preparations intended primarily for pregnant or nursing women, the most popular one being katlu, which is a mixture of gum resin, ghee, nuts, and sugar. Ginger is also consumed in candied and pickled form.

HEALTH BENEFITS

Following are the health benefits of ginger:

- It helps relieve vomiting and many forms of nausea, especially morning sickness.
- It helps with weight loss.
- It can help with osteoarthritis.
- It may drastically lower blood sugars and improve heart disease risk factors.
- It can help treat chronic indigestion.
- It significantly reduces menstrual pain.
- It helps lower cholesterol levels.
- It lowers risk of cancer.
- It improves brain function and protect against Alzheimer's disease.
- It can help fight infections.
- It Can Kill Bad Bacteria, also Reduces Cold and Flu.
- It consists of anti-inflammatory components and antioxidants that can cure inflammation.
- It is also particularly good for skin and hair also.

GARLIC

INTRODUCTION

Garlic (*Allium sativum*) is a *species* in the onion *genus, Allium*. It is native to *Central Asia* and north-eastern *Iran* and has long been a common seasoning worldwide, with a history of several thousand years of human consumption and use. Garlic is widely used around the world for its pungent flavour as a seasoning or condiment.

NUTRITIONAL FACTS

Nutritionally speaking, garlic is most useful as a spice or to bring out the flavours of other healthy foods, like vegetables. It is also thought to be a source of amino acids (the building blocks of proteins) and enzymes, which can help your body build muscles and protect your gut health, respectively.

CHEMICAL COMPOSITION

Fresh or crushed garlic yields the sulphur-containing compounds like allicin, ajoene, diallyl sulphide etc. different enzymes, saponins, flavonoids, and Maillard reaction products, which are not sulphur-containing compounds. The phytochemicals responsible for the sharp flavour of garlic are produced when the plant's cells are damaged. When a cell is broken by chopping, chewing, or crushing, enzymes stored in cell vacuoles trigger the breakdown of several sulphur-containing compounds stored in the cell fluids (cytosol). The resultant compounds are responsible for the sharp or hot taste and strong smell of garlic. Some of the compounds are unstable and continue to react over time. Many sulphur compounds contribute to the smell and taste of garlic.

SHARP TASTE AND STRONG SMELL

Allicin has been found to be the compound most responsible for the "hot" sensation of raw garlic. This chemical opens thermo-transient receptor potential channels that are responsible for the burning sense of heat in foods. The process of cooking garlic removes allicin, thus mellowing its spiciness. Allicin, along with its decomposition products diallyl disulphide and diallyl trisulfide, are major contributors to the characteristic odour of garlic, with other allicin-derived compounds. Because of its strong odour, garlic is sometimes called the "stinking rose". When eaten in quantity, garlic may be strongly evident in the diner's sweat and garlic breath the following day. This is because garlic's strong-smelling sulphur compounds are metabolized, forming allyl methyl sulphide. Allyl methyl sulphide (AMS) cannot be digested and is passed into the blood. It is carried to the lungs and the skin, where it is excreted. Since digestion takes several hours, and release of AMS several hours more, the effect of eating garlic may be present for a long time.

CULINARY USES

Garlic is widely used around the world for its pungent flavour as a seasoning or condiment. They have a characteristic pungent, spicy flavour that mellows and sweetens considerably with cooking. Other parts of the garlic plant are also edible. The leaves and flowers (bulbils) on the head (*spathe*) are sometimes eaten. They are milder in flavour than the bulbs and are most often consumed while immature and still tender. Green garlic is often chopped and stir-fried or cooked in soup or hot pot in Southeast Asia.

Garlic may be applied to different kinds of bread, usually in a medium of butter or oil, to create a variety of classic dishes, such as garlic bread, garlic toast, bruschetta, crostini, and canapé. The flavour varies in intensity and aroma with the different cooking methods.

HEALTH BENEFITS

Lab studies have shown that it may lower chances of getting heart disease and eating garlic regularly may help with high cholesterol and high blood pressure. But to get the benefits, you must chop or crush the clove: Allicin is formed only after the cells in the garlic have been cut or crushed. Apart from this, it also has powerful antibiotic properties. It is also found helpful in the reducing the risk of various cancers, hip osteoarthritis, alcohol-induced injuries, common cold and many more.

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CHAPTER-F

BEVERAGE CORNER

AN ENCHANTING LOOK THROUGH

PRELUDE

BEVERAGE

A beverage is a liquid intended for human consumption. In addition to their basic function of satisfying thirst, drinks play important roles in human culture. Common types of drinks include plain drinking water, milk, coffee, tea, hot chocolate, juice, and soft drinks. In addition, alcoholic drinks such as wine, beer, and liquor, which contain the drug ethanol, have been part of human culture for more than 8,000 years.

HISTORY

Drinking has been a large part of socializing throughout the centuries. In Ancient Greece, a social gathering for the purpose of drinking was known as a symposium, where watered down wine be drunk. The purpose of these gatherings could be anything from serious discussions to direct indulgence. In Ancient Rome, a similar concept of a convivial took place regularly. Many early societies considered alcohol as a gift from the Gods, leading to the creation of Gods such as would Dionysus. Other religions forbid, discourage, or restrict the drinking of alcoholic drinks for various reasons. In some regions with a dominant religion the production, sale, and consumption of alcoholic drinks is forbidden to everybody, regardless of religion.

WHY WE TAKE IT

Beverages not only provide essential hydration but can also be a source of other nutrients. As well as energy some beverages can be a source of vitamins and minerals, protein, fats, and other carbohydrates. The Nutrition Information Panel on the back of every beverage package states what nutrients each beverage contains. There is wide variation in the energy content of different beverages even though they may appear to be almost the same.

TYPES OF BEVERAGE

Alcoholic and Non-alcoholic

ALCOHOLIC: A drink is considered "alcoholic" if it contains ethanol, commonly known as alcoholic (although in chemistry the definition of "alcohol" includes many other compounds).

Beer has been a part of human culture for 8,000 years. In many countries, imbibing alcoholic drinks in a local bar or pub is a cultural tradition. Alcoholic beverages can be divided into two categories.

1. FERMENTED (WINE, BEER, CIDER, PERRY)

2. DISTILLED (WHISKY, VODKA, RUM, GIN, TEQUILA, BRANDY)

NON-ALCOHOLIC: A non-alcoholic drink is one that contains little or no alcohol. This category includes non-alcoholic wine and apple cider if they contain a sufficiently low concentration of alcohol by volume (ABV). Non-alcoholic beverages can be divided into three categories.

REFRESHING (JUICE, SQUASH, CORDIAL)

STIMULATING (TEA, COFFEE, COCOA)

NOURISHING (MILK BASED DRINKS)

Let us start our journey now towards the beverage corner with refreshing drinks first.

REFRESHING JUICE & SQUASH

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WHAT IS JUICE

Juice is a drink made from the extraction or pressing of the natural liquid contained in fruit and vegetables. It can also refer to liquids that are flavoured with concentrate or other biological food sources, such as meat or seafood, such as clam juice.

Juice is commonly consumed as a beverage or used as an ingredient or flavouring in foods or other beverages, as for smoothies. Juice emerged as a popular beverage choice after the development of pasteurization methods enabled its preservation without using fermentation

WHAT IS SQUASH

Squash, sometimes known as cordial in English, is non-alcoholic concentrated syrup used in beverage making.

It is usually a fruit-flavoured drink, made from fruit juice, water, and sugar or a sugar substitute. Modern squashes may also contain food colouring and additional flavouring. Some traditional squashes even contain herbal extracts, most notably of elderflower and ginger and spices too. It is not at all a pure juice obtained from fruits directly but some type of cocktail.

HISTORY

JUICE: Groups of grape pits dated to 8000 BCE show early evidence of juice production, although it is thought that the grapes may have been

alternatively, used to produce wine. One of the first regularly produced juices was lemonade, appearing in 16th-century Italy, as an import, after its conception in the Middle East.

Orange juice originated in the 17th century. In the 18th century, James Lind linked citrus fruits to the prevention of scurvy, which, a century later, led to the popularity of citrus-based juices. In 1869, a dentist by the name Thomas B. Welch developed a pasteurization method that allowed for the storage of juice, without the juice fermenting into alcohol. This method killed the yeast responsible for fermentation. After that consumption of juices increased.

SQUASH: The original name for Squash was "Lemon Squash" but the name was shortened to include other flavours too. The first cordials were tonics in Renaissance Italy, booze-based medicines flecked with pearls or poppies. These placebos supposedly treated any number of ailments, especially of the heart.

Composition of squashes has evolved over the years. Traditional cordials used to contain only three ingredients: sugar, juice or plant extract and some water, sometimes with an acidifier or even some spices. Those traditional preparations often contained a preservative especially sulphur dioxide, although sugar alone could keep it fresh for quite a long time. Modern squash drinks however have become more complex and sugar free squashes are even more so; the ingredients are usually water, sweetener, juice in low proportion, flavouring agents in large amount with preservatives and sometimes a colour too.

PREPARATION

JUICE: Juice is prepared by mechanically squeezing or macerating cold pressed fruit or vegetable flesh without application of any heat or solvents. For example, orange juice is the liquid extract of the fruit of the orange tree, and tomato juice is the liquid that results from pressing the fruit of the tomato plant.

Commercial juices are filtered to remove fibre or pulp, but high-pulp fresh orange juice is also a popular beverage. Additives are put in some juices, such as sugar and artificial flavours, savoury seasonings (e.g., in Clamato or Caesar tomato juice drinks). Common methods for preservation and processing of fruit juices include canning, pasteurization, concentrating, freezing, evaporation and spray drying. Although processing methods vary between juices, the general processing method of juices includes:

- Washing and sorting food source
- Juice extraction
- Straining, filtration, and clarification
- Blending pasteurization
- Filling, sealing and sterilization
- Cooling, labelling, and packing

SQUASH: Squash is aconcentrated syrup, that becomes less strong, the more it is diluted. Squash is prepared by combining one-part concentrate with four or five parts water (carbonated or still).

Double-strength squash and traditional cordials, which are thicker, are made with two parts concentrate. Some squash concentrates are quite weak, and these are sometimes mixed with one-part concentrate and two or three parts water. It is usually made with cold water, but old-fashioned cordials are often made with warm water. In convenience stores and supermarkets, ready-diluted squash is sold in cans, cartons, and plastic bottles.

INGREDIENTS AND CHEMISTRY

JUICE: Juice is made by reconstituting concentrate only can be called juice. A product described as fruit "nectar" must contain at least 25% to 50% juice, depending on the fruit. Blend of fruit juice(s) with other ingredients, such as high-fructose corn syrup, is called a juice cocktail or juice drink.

SQUASH: As our taste is changing day by day, squashes have also evolved over the years. Traditional squashes used to contain three main ingredients: sugar, fruit extract and water.

According to the FDA, the term "nectar" is generally accepted for a diluted juice that contains fruit juice or puree, water, and artificial sweeteners. Though "No added sugar" is commonly printed on labels of

juice containers, but the products may contain large amounts of naturally occurring sugars; however, sugar content is listed with other carbohydrates on labels in many countries.

Depending on trends and regulations, beverages listed as 100% juice may contain unlisted additives. For example, most orange juice contains added ethyl butyrate (to enhance flavour), vitamin C (as ascorbic acid), and water (if from concentrate). When fruit juice is too sour, acidic, or rich to consume, it may be diluted with water and sugar to create an -ade (such as lemonade, limeade, cherryade, and orangeade). The 'ade' suffix may also refer to any sweetened, fruit-flavoured drink, whether it contains any juice.

But modern squash drinks are generally more complex. The ingredients are water, sweetener such as aspartame or sodium benzoate, saccharin, flavouring agents, preservatives, and food colour

such as anthocyanin.

Modern squashes usually have flavours, such as orange, apple, blackcurrant, apple, peach, pineapple, mango, lemon etc. Squashes labelled "no added sugar" are artificially sweetened. Chemicals like Aspartame Acesulfame K, Saccharin are mainly used in the place of natural sugar. Those compounds are cheap and low in calories. There are natural and artificial flavouring to make up for the lack of fruit juice taste and look. Most squashes contain preservatives such as potassium sorbate or sulphites, as they are designed to be stored on shelves.

ARTIFICIAL FLAVOURS

In juices generally the natural flavour is enough but for squashes to give real feel we need flavouring

agents. They are additives designed to mimic the taste of natural ingredients.

They are a cheap way for manufacturers to make something taste like strawberry, for example,

without using any real strawberry. There are many chemical flavouring agents used in squash manufacturing. Traditional squashes may be flavoured with elderflowers, lemon, pomegranate, apple, strawberry, chokeberry (often with spices such as cinnamon or cloves added), orange, pear, or raspberry.

Modern squashes usually have simpler flavours, such as orange, apple, summer fruit (mixed berries), blackcurrant, apple and blackcurrant, peach, pineapple, mango, lime, or lemon. Isoamyl acetate also known as Banana oil is a popular flavouring agent. Isoamyl acetate has a strong odour which is described as like both banana and pear. Isoamyl acetate is used to confer banana flavour in squashes.

For the delicious orange flavour manufacturers uses Octyl acetate. Octyl acetate is naturally found in oranges, grapefruits, and other citrus products. It also can be artificially synthesized by the Fischer

esterification of 1-octanol and acetic acid. Another artificial flavouring agent is allyl hexanoate. Allyl hexanoate is employed principally in the formulation of pineapple flavours; it can also be used for peach and apricot essences. Ethyl methyl-phenyl-glycidate, commonly known as strawberry aldehyde, is an organic compound used in the artificial fruit flavours, in particular strawberry.

EDIBLE COLOURS

For juices only the natural colour is enough, but for squashes, not only flavouring substances but also colour additives are widely used in squash manufacturing. We associate certain colours with certain flavours, and the colour of squash can influence the perceived flavour.

Both natural and synthetic colours are used to make the beverage more attractive, appealing, appetizing and informative. Synthetic colours such as Allura Red AC and Sunset Yellow FCF are occasionally used in squash. Allura Red AC is a red azo dye (usually supplied as its sodium salt), mainly used for cherry flavoured squashes. Most

companies are gradually aiming to use natural colours such as beta carotene and anthocyanins. Beta carotene is a red-orange pigment found in plants and fruits, especially carrots and colourful vegetables. Beta carotene is responsible for the orange colour and widely used for orange flavoured products. Anthocyanin is another natural colour. Colour of anthocyanin depends on their pH level (it may appear red, purple, blue or black).

Food plants rich in anthocyanins include the blueberry, raspberry, black rice, and black soybean, among many others that are red, blue, purple, or black. Raspberry, Blueberry flavoured squashes got their colour from anthocyanin.

HEALTH AND NUTRITION

Juices are often consumed for their perceived health benefits, for example, orange juice with natural or added vitamin C, folic acid, and potassium. Juice provides nutrients such as carotenoids, polyphenols and vitamin C that offer health benefits. However, high consumption of fruit juice with added sugar may be linked to weight gain, but not all studies have shown this effect. If 100% from fruit, juice can help meet daily intake recommendations for some nutrients. This is not associated with increased risk of diabetes, but it increases the risk of tooth decay in children. Due to high sugar and low fibre content compared to fruit, overconsumption of juices may reduce nutrient intake compared to eating whole fruits, and may produce diarrhoea, gas, abdominal pain, bloating etc. too. As the requirement growing rapidly, many Indian and foreign companies manufacture squash.

Squash is an example of how an instant, fruity, sweet beverage hides a lot. It is a good source of fibres, potassium, and several other key nutrients. The nutritional content of squash makes it beneficial for digestion, blood pressure, and for healthy skin and hair, among others. So this much about refreshing drinks. Let us now move on to the next section for exploring a completely different field i.e., stimulating beverages.

STIMULATING COCOA

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STIMULATING COCOA

Cocoa (Theobroma cacao L) is a major cash crop of the tropical world. It is known worldwide for its beans used in the manufacture of chocolate.

FOOD OF THE GODS

The story of chocolate is a long one but starts with a tree, strange looking pods in a hot rain-soaked patch

of tropical land 20^{o} north and south of equator. The cacao tree is known as Theobroma cacao L, is the plant responsible for one of the greatest tasting candy and beverage ingredients on the planet.

STORY OF COCOA TREE

These tiny, scared trees start their life in a fiber basket as a seed. After 6 months, they are ready to be transplanted. Then, at least 3-5 years needed of pruning and pampering to produce pods filled with cocoa beans.

Beans are made up of a seed coat, a kernel, and a germ. Thus, they are helping mankind for 1000 years.

THE TRUE HOME

1000 of years ago, Amazonia (new central America)

the vibrantly alive landscape where wild cocoa flourished. According to the best estimates of archaeologists, Olmec or maya are believed to have cultivated the plant around 1000 B.C. The tree is now cultivated in virtually every tropical area in the world due to its testimony.

SPICES INVOLVED

Theobroma includes 22 species of which only T. cacao and T. grandiflora have economic values.

SWITCH TO CHEMISTRY

NUTRITIONAL BRAGS

1. It has a great source of magnesium of any field.
2. It works to support the heart, boost mental focus & relieve constipation.
3. Raw cocoa contains approx. 31.4% of RDA of Fe /ounce serving.
4. Antioxidants, polyphenols, catechins, Zn, Mn, Cu, omega6 fatty acid are largely present in cocoa.

CHEMICALS INVOLVED

Theophylline: It is also known as dimethyl xanthine, is a methylxanthine drug used in therapy for respiratory disease.
Theobromine: known as xanthoses (C_7 H_8 N_4 O_2), a bitter alkaloid of the cocoa plant. Act as mild stimulant.
Caffeine: It is xanthine alkaloid substance found in cocoa beans. It is consumed due to psychological problems.
Polyphenols: Cocoa beans are huge source of polyphenols. It has extensive affection due to health benefits such as anti-inflammatory, anti-carcinogenic etc.

GOOD FOR BRAIN?

One of the most fascinating scientific challenges is to enhance human confide abilities. Cocoa beans are one of the richest sources of flavonoids. Metabolite which is associated with severed cognitive benefits (lower risk of cognitive decline & dementia). Flavonoids interact directly with cellular molecular structures involved in memory function.

THE BOTTOM LINE

Cocoa has captivated the world for 1000 years & is a big part of modern cuisine in the form of chocolate. So this much about cocoa. Let us now move on to the next section for exploring another most popular stimulating beverage, our all-time favourite coffee.

STIMULATING COFFEE

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THE CAFFEINE CRAZE

Coffee, beverage brewed from the roasted and ground seeds of the tropical evergreen coffee plant of American origin Coffee is one of the three most popular beverages in the world. Probably one of the most researched components on diet.
Sad Me + Coffee = Happy Me

A LOOK BACK

Culturally, coffee is a major part of Ethiopian and Yemenite history. This cultural significance dates back as a many as 14 centuries, which is when coffee was discovered in Yemen.

SPECIES

Coffee Arabica

Coffee Canephora Robasta

BEAN TYPES

Beans are mainly classified into four main coffee species. Arabica, Robusta, Liberia, and Colombian Excelso. Among these, Arabica and Robusta are the most popular.

COFFEE TYPES

There are so many different brews, beans, and types, that you probably will not be able to taste them in one lifetime. But that does not mean that we should not try.In this section we will investigate the three most consumed types of coffee drinks and a wide range of their subtypes.

BLACK COFFEE

Simply put, black coffee is a combination of water and coffee without any milk. You should serve it without any added flavour's such as honey, cream, and milk. The addition of these products changes the aroma and colour of the coffee, turning it lighter-brown or white.This might seem simple, but you should know that there are various ways to serve this coffee, and each of them influences the taste in different ways. Let us take closer look at the most notable black coffee types.

Espresso: The most popular type of coffee from Italy. You make it by forcing high-pressure steam through grounded coffee beans. The final product is a thick coffee with creamy foam on top. Due to its thickness and high level of caffeine per unit, it is often a **base** for most other coffee types.

Rostrate: Rostrate, Italian for short, is an espresso shot made like regular espresso but with half the amount of water. The final product is thus a **more concentrated** shot of espresso with a slightly different taste.

Americano: Café Americano is an Italian term for American coffee. It is believed that the name comes from the U.S. soldiers in Italy during the 2nd World War, who used water to ration the scarce amounts of espresso available at the time.The base of this type is espresso. A larger amount of hot water is poured over it to make the espresso weaker, turning a small shot of espresso into a large cup of coffee.

Long Black: This has a stronger taste than Americano. You can make it by pouring two shots of ristretto or espresso over a smaller amount of water, thus enhancing the taste.

Pour Over: This is a technique that continuously refreshes the water surrounding the grounded coffee. It includes a filter, a 'pour over dripper', and freshly ground coffee. The process comprises three phases, each adding to the coffee's distinctive quality and taste. These include wetting, dissolution, and diffusion. Read our beginners guide to pour over coffee here.

Drip Coffee: As the name suggests, drip coffee involves dripping boiling water over ground coffee. The water passes through the filter and into the pot. It is a slower process than making a regular espresso. However, you will get a stronger coffee in the end.

Batch Brew: This Batch brew method is the most recent way to serve dark coffee. Instead of old-timer filter coffee machines, modern technology allows cafés to make higher quality filter coffee cheaply and

easily. We need to use methods that allow us to make as much coffee as possible for as many people as possible without compromising quality.

Instant Coffee: This is one of the simplest coffees to make. You just pour the desired amount of hot water over the coffee powder or crystals and stir until it dissolves. Instant coffee is not that great, but it can be used to make special drinks like Dalgona Coffee.

Vacuum Coffee: The vacuum coffee pot, used to make this coffee type, has a tradition that spans over more than two centuries. The vacuum maker has a lower and upper vessel. Water boils in the lower vessel while the grounds remain in the upper part. The vacuum and the pressure from the heat push the water up and brew the coffee. Once the heating stops, the product falls into the bottom vessel and is ready for serving.

Immersion Coffee: This is made by dipping the grounds into boiling water where they steep for some time, thus enriching the taste. French press coffee is one of the most popular variants of immersion coffee. It is made from coarsely ground beans which are soaked in near-boiling water for no more than five minutes like tea.

MILK BASED COFFEE

Despite a lot of people opting for one of the black varieties, adding milk to your coffee can provide a special type of aroma. Other than that, baristas enjoy milk-based coffee due to the use of foamed milk which allows them to decorate their coffee in stunning ways. Milk-based coffee also contains lower concentrations of caffeine and acidity, making it the best coffee for the evening hours. Like black, milk-based also includes many different types of coffee.

Flat White: This is a popular milk-based coffee consisting of espresso with a lower amount of steamed milk. The espresso flavour still dominates the aroma, while the milk serves as a supporting taste. It is not the same thing as a white coffee however (which is a coffee bean originating from Yemen.) They have much less foamed milk/bubbles.

Cappuccino: This also consists of espresso and milk. However, there are two types of milk here. The beverage contains 1/3 of espresso, 1/3 foamed milk, and 1/3 steamed milk. You can serve it iced, hot, with cream instead of milk, and in various other ways.

Café latte: This is a different from cappuccino because it contains a lot of milk, while cappuccino preserves the stronger espresso taste. It generally has the 'milkiest' aroma out of all milk-based coffees.

Macchiato: This is a strong coffee shot with just a bit of milk. Originally from Italy, it is safe to assume that macchiato is an espresso shot with a small dash of milk. Over time, the macchiato has evolved and generally 'topped up' with steamed milk, like a little mini foamy flat white.

Cortado: This is an even combination of espresso and steamed milk, with a texture that is flat compared to the frothy latte, cappuccino, and the likes. It does not have as much foam, and the ratio of coffee to milk can be between 1:1 and 1:2. It is traditionally served in a unique glass with a metal wire handle and base.

Gibraltar: This is the most popular variation of Cortado coffee. It is a cult coffee from San Francisco served in the famous 'Gibraltar' glasses. It is a bit colder than a typical Cortado with a wealthier texture.

Iced & Cold Coffee: This represents a perfect balance of refreshing beverage and soothing coffee aroma. You can make it in two different ways. One way is to brew it cold, which will give it a different flavour, and the other is to make it hot and then cool it with ice, cold milk, or even ice cream.

Nitro Coffee: This is a unique cold-served coffee that has a creamy, beer-like feel, especially since it is typically served in a beer keg. The thickness comes from nitrogen, which is infused into the coffee. The infused Nitrogen makes it creamy and thick.

Japanese Iced Coffee: This coffee has a special way of brewing. You brew it in hot water and immediately pour it over ice. The contact with ice will help release all the flavour's that usually take hours to produce.

STRANGE AND UNIQUE COFFEES

The aforementioned coffees are most popular, but they mainly originate from the cuisines and cafés of United States and Italy. However, there are various other cultures that brew unique and distinctive aromas. Here are some of the strangest and most unique coffees in the world.

Espresso Tonic: To make this refreshing drink, you should brew two shots of espresso and leave them to cool. Later, you need to fill up a glass with ice, squeeze out some lime juice, and then slowly pour tonic water and espresso shots together.

Turkish Coffee: To prepare a proper Turkish coffee, you need finely ground coffee beans and a traditional Turkish pot called cezve. Heat the water and sugar in the cezve until it boils, and then put the ground coffee inside. You can quickly reheat it to achieve the desired froth. It is unfiltered, which means that the remnants of coffee powder also end up in the cup.

Geisha Coffee: This is an Ethiopian coffee with a unique aroma and flavour. It is currently one of the most expensive coffees in the world.

Irish Coffee: This type mixes hot coffee, whiskey, and sugar. It is one of the most popular derivatives

of regular coffee in the world.

THE NUTRITIONAL PROFILE

Micronutrient	Composition /100ml
Sodium	92mg
Potassium	8mg
Magnesium	0.05mg
Manganese	0.01mg
Riboflavin	0.03ng

CHEMISTRY BEHIND COFFEE

The main Constituents of coffee are caffeine, tannin, fixed oil, carbohydrate, and protein. It contains 2-3%caffeine, 3-5% tannins, 13% protein and 10-15% fixed oils. All these contribute not only to the unique flavour but also to the well-researched physiological effects of Coffee. Let us have a quick look on the chemicals found in coffee.

Caffeine C8H10N4O2) is an alkaloid that is chemically known as 1, 3, 7trimethyl -1H -Purine-2. Consumption of caffeine increases the ability of exercise and other positive effects.

Chromogenic Acid is an ester that is formed from the reaction of caffeic acid with L-quince acid, hence, the name 5-caffeoylquinic acid which is responsible for bitterness of Coffee.

Triterpenes are a group of terpenoids, responsible for antimicrobial activities.

Niacin is vitamin B3. This forms after the break down of trigonellaine.

Acrylamide is asuspected carcinogen.

Dimethyl Disulphides: A natural product of roasting the green coffee bean, this compound is just at the threshold of detectability in brewed java.

Quinic Acid: It gives rise to coffee's acidity. Responsible for its slightly sour taste.

Trigonellaine: This molecule is a nitrogenous one. which breaks down into pyridines gives sweet, earthly taste.

Furan: It is a heterolytic important organic compound.

FINAL THOUGHTS

All these types of drinks are only the tip of the iceberg. With coffee being an important part of worldwide cultures and history, you will always get to find a new variation that you have never heard before. Hopefully, this article has helped you discover some new varieties of your favouritedrink. Butrememberthis is just a start only.

So this much about coffee. Let us now move on to the next section for exploring another most popular stimulating beverage, our all-time favourite tea.

STIMULATING TEA

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WHAT IS TEA

Tea is an aromatic beverage commonly prepared by pouring hot or boiling water over cured or fresh leaves of the camellia sinensis, an evergreen shrub native to East Asia. After water, it is the most widely consumed drink in the world.

HISTORY

There are legends from china and India. According to Chinese legend, the history of tea began in 2737 B.C.E. when the emperor Shen Nong, a skilled ruler and scientist, accidentally discovered tea. While boiling water in the garden, a leaf from an overhanging wild tea tree drifted into his pot.

CHEMICALS

The major flavanols present in tea areCatechin (c), epicatechin (ec), epicatechin gallate (ecg), gallocatechin (gc), epigallocatechin (egc), and epigallocatechin gallate (egcg). Egcg is the most active of the catechins, and this flavanol is often the subject of studies regarding tea antioxidants.

VARIETY

Most of the teas come from only one plant called *Camellia sinensis*. However, based on the type of tea leaves picked and the level of oxidation or processing, tea is classified into five main types: **Black, Green, Oolong, White and Pu-erh**. However, some teas do not actually come from tea leaves at all! There are many varieties of each tea type, and it is common for other flavours to be blended with all these varieties.

VARIATION DUE TO FERMENTATION AND OXIDATION: BASIC TYPES

Some types of teas are fermented and oxidized, while others are not. To ferment tea, leaves need to wither or be bruised by hand. This process allows enzymes on the leaves to interact with the air, oxidize, and change the chemical compound and colour of the

leaves. The tea flavour can change greatly depending on temperature, humidity, and other air conditions. Heat treatments, like pan-firing or steaming stops the oxidation process. The variation arising due to differential oxidation and fermentation are given below. The tea producer may choose when the oxidation should be stopped, which depends on the desired qualities in the final tea as well as the weather conditions (heat and humidity). For light oolong teas this may be anywhere from 5–40% oxidation, in darker oolong teas 60–70%, and in black teas 100% oxidation. Oxidation is incredibly important in the formation of many taste and aroma compounds, which give tea its liquor colour, strength, and briskness. Depending on the type of tea desired, under or over-oxidation can result in grassy flavours, or overly thick winey flavours. This process is sometimes referred to erroneously as fermentation in the tea industry**.**

Green Tea: This is an 'unoxidized' tea. All tea starts out green. The green tea process is defined by preventing oxidation. Shortly after picking, the leaves are “fired” (rapid heating) to arrest natural

enzymatic oxidation and keep the leaf “green”. They are typically steeped for shorter amounts of time and at lower temperatures which will produce a lighter cup with less caffeine. This type of processing preserves a high level of antioxidants, vitamins and minerals accounting for the various health benefits of green tea.

Yellow Tea: This is also known as haunches in Chinese, a lightly fermented tea unique to China, exceedingly rare and expensive. The processing is like that of green with an added step of encasing and steaming.

This allows the tea to oxidize at a slow rate for a brief period before denaturation of oxidizing enzymes, producing a far more mellow taste than green teas; this also gives the leaves slightly yellow coloring during the drying process.

White Tea: This is the least processed of all teas. Only the unopened buds and young leaves covered in silver fuzz are used, and they are merely withered, rolled, and dried.

Since the leaves are not shaped by rolling the finished product tends to be quite bulky, but because they are not pan-fired there will be some incidental oxidation.
It produces a very light-coloured infusion with mild flavour and has caffeine content is even lower than that of green tea and is considered to have an extremely high level of antioxidants.

Oolong Tea: This tea is roughly defined as any tea that undergoes partial oxidation (10-90%), but this fact is not useful by itself. “Baking”is also a common technique in making this tea, so it is impossible to

summarize categorically. The regional styles and cultivars used tend to define them more than anything else. For example, we refer to both Ti Kwan Yin and Big Red Robe as oolong tea, but they have nothing in common.

Black Tea: This is the most common type of tea accounting for up to 85% of total tea consumption in the western world. This tea is fully 100% oxidised and has darker appearance, stronger flavour and higher caffeine content compared to other teas. Although the caffeine content in this tea is still around half the level of coffee. Often black teas can be consumed with sugar, milk or lemon and offer some of the same health benefits as other teas.

Post Fermented/Dark Tea: These teas are allowed to undergo a second oxidation after fixation of the tea leaves, such as Pu-erh, Liu'an, and Liubao, are collectively referred to as secondary or post-fermentation teas in English.Pu-erh, also known as Póuléi (Polee) in Cantonese is the most common type of post-fermentation tea in the market. All puer tea comes from the southwest region of Yunnan, China. There are two types of Puer: sheng puer and shupuer. Sheng puer is a simple non-oxidized tea whose finished product change naturally over time. Shu puer starts out as a sheng puer but goes through one more deliberate and accelerated "post fermentation" process to speed up this change into a matter of weeks as opposed to years. This is an aged tea that steeps up smooth with a natural sweet note. Dark teas are often compressed into shapes, most commonly as cakes or bricks.

Pu-erh tea is a special type of dark tea that is known for its earthy flavour. It is made from tea plucked from wild tea trees rather than cultivated bushes and the leaves go through microbial fermentation by pressing the raw leaves together and then storing them for maturity. Pu-erh tea can be either black or green depending on the level of oxidation allowed in the process and also subject to their aging process with time.

BLENDING OF TEA AND OTHER TYPES

The tea available in the markets generally is not found in their pure forms. Perfect blending of different teas together actually produces the final product. This occurs chiefly with black tea that is blended to make most tea bags but can also occur with such teas as Pu-erh, where leaves are blended from different regions before being compressed. The aim of blending is to **create a well-balanced flavour using different origins and characters**. This also allows for variations in tea leaf quality and differences from season to season to be smoothed out. The one golden rule of blending is this: Every blend must taste the same as the previous one, so a consumer will not be able to detect a difference in flavour from one purchase to the next.

There are various teas which have additives or different processing than "pure" varieties. Tea can easily receive any aroma, which may sometimes cause problems in processing, transportation, or storage of tea, but can be also advantageously used to prepare scented teas. Tea can be flavoured in large blending drums with perfumes, flavouring agents, or essential oils added. Although blending and scenting teas can add an additional dimension to tea, the process may also sometimes be used to cover and obscure the quality of sub-standard teas.

VARIETIES OF BLENDED TEA

Breakfast

Generally, a blend of different black teas that are robust and full-bodied and go well with milk. Some types are English breakfast, Irish breakfast and Scottish breakfast.

Afternoon tea

These blends (of black teas) are generally lighter than breakfast blends. Both breakfast and afternoon blends are popular in the British Isles, for example, Prince of Wales tea blend.

Russian Caravan

A popular blend.It often contains a bit of smoky lapsang souchong, though its base is typically Keemun or Dian Hong. Some also contain oolong.

Flavoured and Herbal Teas

Although many teas are still flavoured directly with flowers, herbs, spices, or even smoke, teas with more specialized flavours are produced through the addition of flavourings or perfumes. This is particularly true for tea blends with pronounced fruit or flower aromas, which cannot be achieved with the original ingredients. Some firms such as Mariage Frères and Kusmi Tea have become quite famous for their perfumed teas. Due to the number of scents that can be produced by the mentioned artificial methods, the section will concentrate on teas flavoured directly with the original scent materials.

The world of flavoured tea is limited only to the imagination of tea blenders. Some of the more creative examples of flavoured teas include our Divine Elixir which is a blend of green and white tea with lychee and peach flavours or our Lemon Ginger tea which is black tea with natural dried pineapple, lemongrass, ginger pieces, calendula and sunflower petals."Herbal tea" is a catch-all term for most any tea that does not consist of tea plant leaves. Instead, an herbal tea is created by steeping spices, herbs, and other plants. Common ingredients for herbal infusions include chamomile, ginger, lemongrass, peppermint, rosehips, hibiscus, and dried fruits.

FLAVOURING AGENTS

FLOWERS

A variety of flowers are used to flavour teas. Although flowers are used to scent teas directly, most flower-scented teas on the market use perfumes and aromas to augment or replace the use of flowers. The most popular of these teas include the flowers of the following: Jasmine, Osmanthus, Rose, Hibiscus, Chrysanthemum, Lotus etc.

HERBS

A variety of herbs are used to flavour teas and they are most of the time greatly beneficial for health. Mint, Pandan, Citrus peel, Smoke, Spice (ginger, cardamom, cinnamon, cassia, black pepper, clove, anise, fennel, Indian bay leaf and sometimes vanilla, nutmeg and mace) etc are used.

SPECIAL MENTION

Jagertee: This is a tea with added rum.

Genmaicha: A Japanese tea with roasted rice added to green tea. Wheat and barley are also sometimes used to blend with this tea.

Lemon tea: The polyphenols of tea generally bindwith iron and calcium and thus prevent these minerals from being absorbed, however adding lemon juice inhibits this binding and makes the minerals available for the body to use, lemon juice added to black tea increases iron and calcium solubility and absorption in the body.

Matcha: This is a little peculiar. You will not find matcha leaves as this green tea comes as a stone-ground powder and is so beloved in Japan that there is a ceremony cantered around how to prepare and serve it. If you see green-tea ice cream, that is derived from matcha.

Sencha: Sencha is also one of the most-popular Japanese teas, but it differs from matcha in that it is served as leaves, not as a powder, and grown in the sunlight (whereas matcha is grown in shaded areas).

Masala chai tea: This is a black tea mixed with traditional Indian spices like cardamom, cloves, cinnamon, and ginger. It is usually prepared by boiling water and milk along with tea and spices and sweetened with sugar. It is the most popular way of

drinking tea in India. However, this was not always the case. When tea was first grown in India, it was not a popular beverage among the locals. Hence some Indian vendors began adding it to a local drink called 'kadha' which was water and milk boiled with spices. This is how Masala chai or Chai tea as it is known in Britain was born!

Earl Grey: This is the most popular flavoured tea of Britain. It is prepared by adding extract of bergamot, a citrus fruit to black tea. It was created in the 1800s to mask the flavour of cheap tea and to pass it off as expensive tea. Premium Earl Grey is created by infusing the finest blend of black tea with best Italian bergamot.

Jasmine tea: This is tea infused with the aroma of jasmine blossoms. It is the most popular scented tea of China. The method of infusing the scent of jasmine flowers into the tea is very laborious and takes several days. The tea is stored with the flowers in a special room with controlled humidity. This is done during night as that is when the jasmine flowers bloom. The process is repeated over several nights to get the right level of scent.

HERBAL INFUSIONS (TISANES)

In addition to the above, herbal infusions from other plants are also sometimes referred to as tea, although not to the purists. The correct term for any non-tea beverage is **tisane** or just herbal infusion. Examples include chamomile, peppermint, rooibos, etc.

Fruit teas are made from natural unprocessed fruits. They are naturally sweet but do not have the overpowering sweetness of sugar. Fruit teas are high in antioxidants and vitamin C and do not contain any caffeine, making them ideal for drinking before going to bed. They can also be drunk as iced tea, making them a healthy alternative to fizzy drinks and even some fruit juices.

Some examples of fruit teas include Moringa Passion Fruit which contains apple bits, raisins, carrots, beetroot, candied pineapple, candied papaya, natural flavouring, moringa leaves & lemon peel; and Golden Pear which contains dried apple, pear, rose blossoms, vanilla pieces and natural flavours.

Flower teas: In addition to their wonderful aroma and natural beauty, a lot of flowers have therapeutic properties and calming effect. One of the most common herbal tea made out of flowers is Camomile

tea which is made of dried camomile flowers and is proven to be an effective antioxidant.

Another example is the Blue Butterfly Pea Flowers made of gorgeous blue flowers are grown in

Thailand and are full of antioxidants (anthocyanin). Adding a few drops of lime juice to this tisane turns the blue into a beautiful purple.

Leaf teas: Leaves of some non-tea plants make excellent herbal tea. Examples include Yerba Mate which is made from the leaves of the holly tree of the South American rainforests and one of the few

herbal teas that has the caffeine content of Arabica coffee.

Another immensely popular herbal tea made from

non-tea leaves is the Rooibos tea. Grown exclusively in South Africa, the leaves of the Rooibos plant turn red after processing and are caffeine free.

PROCESSING OF TEA LEAVES

Plucking: Tea leaves and flushes, which include a terminal bud and two young leaves, are picked from Camellia sinensis bushes typically twice a year during early spring and early summer or late spring.

Withering / wilting: The tea leaves begin to wilt soon after picking, with a gradual onset of enzymatic oxidation. Withering is used to remove excess water from the leaves and allows a very slight amount of oxidation.

Disruption: The teas are bruised or torn to promote and quicken oxidation. The leaves may be lightly bruised on their edges by shaking and tossing in a bamboo tray or tumbling in baskets.

Oxidation: For teas that require oxidation, the leaves are left on their own in a climate-controlled room where they turn progressively darker. This is accompanied by agitation in some cases. In this process the chlorophyll in the leaves is enzymatically broken down, and its tannins are released or transformed.

Fixation / kill-green: Kill-green is done to stop the tea leaf oxidation at a desired level. This process is accomplished by moderately heating tea leaves, thus deactivating their oxidative enzymes, and removing unwanted scents in the leaves, without damaging the flavour of the tea.

Sweltering / yellowing: Unique to yellow teas, warm and damp tea leaves from after kill-green can be lightly heated in a closed container, which causes the previously green leaves to turn yellow due to transformations of the leaf chlorophyll.

Rolling / shaping: The damp tea leaves are then rolled to be formed into wrinkled strips, by hand or a rolling machine which causes the tea to wrap around itself. This rolling action also causes some of the sap, essential oils, and juices inside the leaves to ooze out, which further enhances the taste of the tea.

Drying: Drying is done to finish the tea for sale. This can be done in a myriad of ways including panning, sunning, air drying, or baking. Baking is

usually the most common. Great care must be taken to not over-cook the leaves. The drying of the produced tea is responsible for many new flavour compounds particularly important in green teas.

Aging / curing: While not always required, some teas require additional aging, fermentation, or baking to reach their drinking potential. Prior to curing into a post-fermented state, tea is often bitter and harsh in taste, but becomes sweet and mellow through fermentation by age or dampness.

Sorting: Tea sorting can help remove physical impurities, such as stems and seeds. Using sorting equipment to improve tea production efficiency is quite common in tea processing plants, especially in black tea processing. A Colour sorter may also be used to classify final product grades according to colour and shape.

TEA LEAF GRADING

In the tea industry, this is the process of evaluating products based on the quality and condition of the tea leaves themselves. The highest grades are referred to as **"orange pekoe"**, and the lowest as **"fannings"** or **"dust"**.

Pekoe tea grades are classified into various qualities, each determined by how many of the adjacent young leaves (two, one, or none) were picked along with the leaf buds. Top-quality pekoe grades consist of only the leaf buds, which are picked using the balls of the fingertips. Fingernails and mechanical tools are not used, to avoid bruising. When crushed to make bagged teas, the tea is referred to as "broken", as in **"broken orange pekoe"** ("BOP"). These lower grades include fannings and dust, which are tiny remnants created in the sorting and crushing processes. Orange pekoe is referred to as "OP". The grading scheme also contains categories higher than OP, which are determined primarily by leaf wholeness and size. Broken, fannings and dust orthodox teas have slightly different grades. CTC teas, which consist of leaves mechanically rendered to uniform fannings, have yet another grading system.

GOODNESS OF TEA

People all over the world have been drinking tea for thousands of centuries, and for good reason. Numerous studies have shown that a variety of teas may boost your immune system, fight off inflammation, and even ward off cancer and heart disease.

IS TEA A DRUG?

Tea contains four substances that have stimulatory effects on our brain. The most well-known is caffeine, a potent stimulant that you can also get from coffee and soft drinks. Tea also contains twoother substances related to caffeine: theobromine and theophylline.

MILK TEA AND HEALTH

Tea, especially black and green varieties, are rich in compounds that act as antioxidants and may help lower blood pressure and cholesterol levels, among other benefits.

Some studies suggest that adding milk to tea may inhibit the activity of these compounds, loss of antioxidants, while others have observed the opposite effect, hence a debatable issue. So this much about stimulating drinks. Let us now move on to the next section i.e., nourishing beverage.

NOURISHING BEVERAGE

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NOURISHING BEVERAGE

Nourishing drinks are high in protein, energy, vitamins, and minerals. They include ready-to-drink nutritional supplements, as well as drinks that you can make at home. Getting more out of your fluids Nourishing drinks provide you with extra energy and calories as well as fluid to keep you hydrated. Why do I need nourishing drinks? You may have lost weight due to illness. You may need extra nourishment. Generally, it is a milk-based drink.

WHEN DO WE NEED?

If you may have lost weight due to illness, you may need extra nourishment. If you have a poor appetite and find fluids easier to take.

LOW-FAT AND SKIM MILK AND SOY BEVERAGE

For children, milk is a key source of calcium and vitamin D. Fortified soy milk is also a good alternative source of calcium and vitamin D for those who prefer not to drink's cow's milk. Both are also good sources of protein and other essential micronutrients.

Low-fat milk, sold as 1% or 1.5% milk, or skim milk, which is virtually fat-free, are the best choices because they contain much less saturated fat than

reduced-fat milk or whole milk, which contain 2% and 4% milk fat, respectively.

HEALTH AND NUTRITION

Even low-fat milk is high in calories, and high levels of consumption may increase the risk of prostate and ovarian cancer. So, it is best for adults to limit milk and all dairy products to a glass or two a day. Less is fine if you get enough calcium from other sources. For growing children, the ideal amount of milk and calcium is less clear, but not pushing beyond two glasses of milk per day appears to provide sufficient nutrition without being excessive.

NONCALORICALLY SWEETENED BEVERAGE

So-called diet sodas and other diet drinks or soft drinks are sweetened with calorie-free artificial sweeteners such as aspartame, saccharin, or sucralose. A new addition to the market is drinks sweetened with stevia, a calorie-free sweetener made up from the leaves of a South and Central American shrub. These diet drinks are a better choice than sugar-sweetened soft drinks because they are lower in calories.

DISCLAIMER

The possibility that these types of drinks may contribute to weight gain suggests that they are not an innocuous alternative to water and should be drunk as occasional treats rather than as a daily beverage. For those who find it difficult to give up full-calorie soda, these may be useful in making the transition to healthier beverages, like a nicotine patch can do for smokers.

So this much about nourishing beverage and we are at the very end of the current chapter Beverage Corner. Let us now move on to the next chapter for exploring important and fascinating facts about another aspect of culinary world.

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CHAPTER-G

BAKING CLUB

AN ALLURING JOURNEY

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PRELUDE

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WHAT IS BAKING

Baking is a method of preparing food that uses dry heat, typically in an oven. The most common baked item is bread, but many other types of foods are baked. Heat is gradually transferred from the surface of cakes, cookies, and breads to their centre.

As heat travels through, it transforms batters and doughs into baked goods and more with a dry crust and a softer centre. Baking can be combined with grilling to produce a hybrid barbecue variant.

CAKE

Because of historical, social, and familial roles, baking has traditionally been performed at home by women for day-to-day meals and by men in bakeries and restaurants for local consumption. When production was industrialized, baking was automated by machines in large factories. The art of baking remains a fundamental skill and is important for nutrition, as baked goods, especially breads, are a common and important food, both from an economic and cultural point of view.

HISTORY OF BAKING

The first evidence of baking occurred when humans took wild grass grains, soaked them in water, and mixed everything together, mashing it into a kind of broth-like paste. The paste was then cooked by pouring it onto a flat, hot rock, resulting in a bread-like substance.

Later, humans mastered fire, the paste was roasted on hot embers, which made bread-making easier, as it could now be made any time fire was created. The world's oldest oven was discovered in Croatia in 2014 dating back 6500 years ago. The Ancient Egyptians baked bread using yeast, which they had previously been using to brew beer. Bread baking began in Ancient Greece around 600 BC, leading to the invention of enclosed ovens.

Baking flourished during the Roman Empire. Beginning around 300 B.C., the pastry cook became an occupation for Romans and became a respected profession because pastries were considered decadent, and Romans loved festivity and celebration. Thus, pastries were often cooked especially for large banquets, and any pastry cook who could invent new types of tasty treats was highly prized.

Around 1 AD, there were more than three hundred pastry chefs in Rome, and Cato wrote about how they created all sorts of diverse foods and flourished professionally and socially because of their creations. Cato speaks of an enormous number of breads including libum (sacrificial cakes made with flour), placenta (groats and cress), spira (modern day flour pretzels), scibilata (tortes), savaillum (sweet cake), and globus apherica (fritters). The Romans baked bread in an oven with its own chimney and had mills to grind grain into flour. A bakers' guild was established in 168 B.C. in Rome.

COMMERCIAL BAKING

Eventually, the Roman art of baking became known throughout Europe and eventually spread to eastern parts of Asia. By the 13th century in London, commercial trading, including baking, had many regulations attached. Beginning in the 19th century, alternative leavening agents became more common, such as baking soda.

Bakers often baked goods at home and then sold them in the streets. In London, pastry chefs sold their goods from handcarts. This developed into a delivery system of baked goods to households and greatly increased demand as a result.

In Paris, the first open-air cafe of baked goods was developed, and baking became an established art throughout the entire world.

Baking eventually developed into a commercial industry using automated machinery which enabled more goods to be produced for widespread distribution. Some makers of snacks such as potato chips or crisps have produced baked versions of their snack products as an alternative to the usual cooking method of deep frying to reduce their calorie or fat content.

BAKING AGENT

In cooking, a leaven, often called a leavening agent / (and known as a raising agent), is any one of several substances used in doughs and batters that cause a foaming action (gas bubbles) that lightens and softens the mixture.

An alternative or supplement to leavening agents is mechanical action by which air is incorporated (i.e., kneading). Leavening agents can be biological or synthetic chemical compounds. The gas produced is often carbon dioxide, or occasionally hydrogen.

When a dough or batter is mixed, the starch in the flour and the water in the dough form a matrix (often supported further by proteins like gluten or polysaccharides, such as pentosans or xanthan gum). The starch then gelatinizes and sets, leaving gas bubbles that remain.

Baking powder is a dry chemical leavening agent, a mixture of a carbonate or bicarbonate and a weak acid. The base and acid are prevented from reacting prematurely by the inclusion of a buffer such as corn-starch. Baking powder is used to increase the volume and lighten the texture of baked goods. It works by releasing carbon dioxide gas into a batter or dough through an acid-base reaction, causing bubbles in the wet mixture to expand and thus leavening the mixture. The first single-acting baking powder was developed by food manufacturer Alfred Bird in England in 1843. The first double-acting baking powder was developed by Eben Norton Horsford in the United States of America in the 1860s.

Baking powder is used instead of yeast for end-products where fermentation flavours would be undesirable, where the batter lacks the elastic structure to hold gas bubbles for more than a few

minutes, and to speed the production of baked goods. Because carbon dioxide is released at a faster rate through the acid-base reaction than through fermentation, breads made by chemical leavening are called quick breads. The introduction of baking powder was revolutionary in minimizing the time and labour required to make breadstuffs. It led to the creation of new types of cakes, cookies, biscuits, and other baked goods.

BAKER'S YEAST

Baker's yeast is the common name for the strains of yeast commonly used in baking bread and bakery products, serving as a leavening agent which causes the bread to rise (expand and become lighter and softer) by converting the fermentable sugars present in the dough into carbon dioxide and ethanol.

Baker's yeast is of the species Saccharomyces cerevisiae and is the same species (but a different strain) as the kind commonly used in alcoholic fermentation, which is called brewer's yeast. Baker's yeast is also a single-cell microorganism found on and around the human body.

The use of steamed or boiled potatoes, water from potato boiling, or sugar in a bread dough provides food for the growth of yeasts; however, too much sugar will dehydrate them. Yeast growth is inhibited by both salt and sugar, but more so by salt than sugar. Some sources say fats, such as butter and eggs, slow down yeast growth; others say the effect of fat on dough remains unclear, presenting evidence that small amounts of fat are beneficial for baked bread volume. Saccharomyces exiguus (also known as S. minor) is wild yeast found on plants, grains, and fruits that is occasionally used for baking; however, in general, it is not used in a pure form but comes from being propagated in a sourdough starter.

So this much about introduction. The detail baking agents, products etc. would be discussed in detail in the next sections of this chapter.

HOME-MADE CAKE & BREAD

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MAKING HOME-MADE CAKE

When kids get interested in helping their parents in the kitchen, one of the first things they want to do is to help bake a home-made cake. It is a good choice because cake baking is often an easy, direct process and many recipes follow the same basic steps every time.

MINIMUM INGRIDIENTS OF CAKE

- all-purpose flour
- egg
- pinch of teaspoon baking soda
- few drops vanilla essence
- powdered sugar
- melted butter
- milk

Step 1: Cream together butter-sugar and then blend with beaten eggs. Whisk well until light and fluffy with a manual whisker or a fork. Once done, add the beaten eggs and blend well. Beat further so that the mixture turns white and creamy.

Step 2: Combine flour mix and beaten eggs. Sift together the all-purpose flour and baking soda. It is done to evenly distribute the baking soda in flour.

Gradually, add this to the egg mixture. If required, add a little milk, and mix till the batter is fluffy and soft. Add vanilla essence and blend well. Vanilla essence is important to camouflage the smell of eggs.

Step 3: Bake the cake as per your convenience. Sprinkle some Maida on a greased baking tin. It will prevent sticking of the cake to the base.

You can also line it with a butter paper. Pour the prepared mixture into the tin and place it on a stand in a pressure cooker.

Do not add water in the cooker and ensure that the tin does not touch the base of the cooker. You can also keep the baking dish on an inverted steel plate. Increase the flame and pressure cook for two minutes. Now remove the whistle and cook on low flame for 35-40 minutes. You can bake it in a oven on high power for 30 minutes too.

Step 4: Check with a knife or skewer if it is cooked and serve. Insert a knife or a metal skewer into the cake and if it comes out clean, then the cake is ready. Remove from the oven/cooker and allow to cool on a wire rack.

Step 5: Further decoration of cake if required.

MAKING HOME-MADE BREAD

Bread is one of the most favourite foods to all of us. It can be prepared at home easily through a few interconnected steps.

INGREDIENTS

- warm water (45° C)
- white sugar
- active dry yeast
- salt
- vegetable oil
- all-purpose flour/bread flour.

STEPS TO FOLLOW

DISSOLVE THE YEAST AND ACTIVATE BY PROOFING

This is a simple process that takes about 5 minutes. It is possible to kill yeast if you use too hot of water, so aim for slightly warmer than Luke-warm, or about 105°F.

Combine warm water, yeast, and granulated sugar in your mixing bowl. Give it a quick stir and then let it sit for 5 minutes. You will begin to see the yeast puff up until it covers the entire surface of the water.

ADD REMAINING INGREDIENTS AND MIX

Add the rest of the sugar, the oil, salt, and flour then mix using an electric mixer until it is well combined, about 2 minutes. You can mix by hand, but it will take longer.

KNEAD THE BREAD

You might be thinking, “Wait! It’s already mixed!” Ha! Not so fast! Going through the process of kneading bread dough is crucial for bread with great texture.

Kneading dough allows gluten to form which enables dough to rise better, be lighter and fluffier. you can knead by hand or with a mixer.

FIRST RISE

Place your lovely smooth, elastic bread dough in an oiled bowl and cover it with plastic wrap or a clean towel. Be sure to spray the side of the plastic wrap that will touch the dough with oil! If your house is cool, your bread will take longer to rise.

PUNCH DOUGH AND SHAPE IT

Punching the dough down quickly releases any air pockets that have developed and helps your bread have a more consistent rise and texture.

Now you can shape your dough by rolling it gently into a ball and rolling it 2 or 3 times on the countertop so that the ball is more oblong.

SECOND RISE

The second rise is done in a warm oven that is not turned on.

Turn the oven on just before punching the dough down, then turn it off once you place the dough in the oven for the second rise.

BAKE THE BREAD AND COOL IT

Bread is them baked for about 30-40 minutes. Fully cooked bread will be at 190-200 degrees F. The top will be golden brown.

BAKE A CHEMISTRY CAKE

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INTRODUCTION

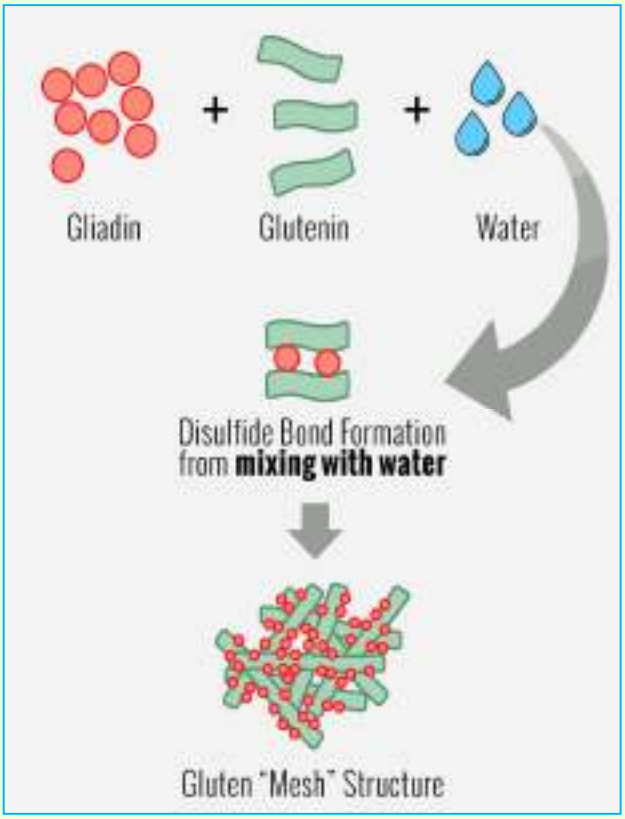
There are many people whose mouth goes watering when they face the delicious aroma of baking. This delicious smell and the appetizing baking are produced by the interactions of various chemical and physical processes that can be adjusted by the chef to create a variety of products.

Baking is not usually thought of a chemical industry, but it depends on the interactions of various chemicals present in flour and other constituents used in it, thus is chemically based. Mixing flour, eggs, sugar, water, and other ingredients together to make a batter, then baking that, in an oven, can look like a simple yet magical process.

The delicious result seems to be mesmerizing. It is not magic, however, but a series of complex chemical reactions that is behind this cooking process, which has been around for thousands of years.

GLUTEN FORMATION

Gluten is a water-insoluble protein i.e., formed when water is mixed with wheat flour. Gluten does not exist until flour becomes wet. Flour contains a mixture of two proteins namely, Glutenin and Gliadin. To make a cake batter, water is added to flour, the two protein combine and form Gluten.



Gluten formed by the chemical cross linking of glutenin and gliadin. Gluten is a very elastic substance. Neither protein alone is as elastic and stretchable as gluten. More bonds formed between the proteins; stronger gluten becomes. After the dough/batter is placed into the oven, it begins to rise, and the gluten network expand. This network gets harden during the baking process, giving the fluffy texture to the bread or cake.

MAGIC LEAVENERS

Leavening agents—such as yeast, baking powder and baking soda, give baked dough its airy, fluffy texture. Baking soda ($NaHCO_3$) bring off this by reacting with acids in the dough, releasing carbon dioxide gas, which puffs up the dough:

$2NaHCO_3 = Na_2CO_3 + H_2O + CO_2$

Baking soda is cheap, stable to storage and is an excellent agent for the formation of CO_2. In the above equation, it also illustrates the disadvantage of this product. When used, it only produces half of the available CO_2 is released and the sodium carbonate (Na_2CO_3) formed is strongly alkaline and gives a soapy (bitter) taste to the baked product. For the above reasons, sodium bicarbonate is not used on its own, but generally baking powder is used. Baking powder is a very widely used ingredient in baking. Baking powder is a mixture of NaHCO3 and a weak solid acid or acid salt. The most common acids used are cream of tartar (potassium hydrogen tartrate), tartaric acid, etc. When water is added and the temperature is raised, CO_2 is released accordingly:

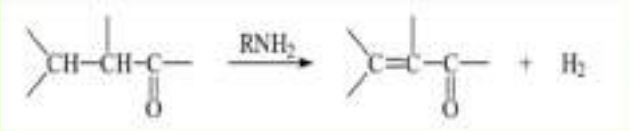
$NaHCO_3 + H^+$ (from the acid) = $Na^+ + H2O + CO_2$

Baking powder releases carbon dioxide nearly twice than baking soda, during the baking process, once it hits water, and again when it reaches a certain temperature in the oven. Heat helps baking powder produce tiny bubbles of CO_2, giving the dough a light, delicate texture When baking powder is used over baking soda alone, the by-products are less alkaline than Na_2CO_3 so, it has no undesirable effects on the taste of the cake or bread.

BROWNING REACTION

Sugar is most thought of as a sweetener but, does much more than just sweeten a cake. When the baking temperature reaches 300 degrees Fahrenheit, sugar undergoes Maillard reaction, a chemical reaction between amino acid, proteins and reducing sugars. The result is browning, which forms the brown crust of many baked goods, such as bread.

The Maillard reaction is not the same as caramelization, but both works together to create appetizing golden-brown surfaces and an array of flavours. Maillard reactions occur when proteins and sugars are broken down and rearranged by high temperatures. These sugar aldehyde or ketone is converted to an unsaturated aldehyde or ketone:



These sugars and proteins can be derived from flour itself, or they can be enhanced with the addition of sugars and eggs. The reactions produce ring-shaped

organic compounds that darken the surface of baking dough. Maillard reactions produce toasty and savoury aromas and flavour compounds.

Generally, the sugar used is in pure form as castor sugar (sucrose), 1A sugar or icing sugar. Often to give baking a particular flavour, impure form such as golden syrup, honey and brown sugar are used.

EMULSIFICATION & BINDING

Eggs in a cake mixture may fulfil one or more of three functions. Beaten egg white is used, similarly like baking powder, to give the dough a light, fluffy consistency.

This is possible because egg white (albumen) contains lecithin, a protein which lines the outer surface of the air bubbles created when the egg is beaten and to prevent them from collapsing during baking. In unbeaten egg the lecithin acts as a binder to hold the cake together. In addition, eggs are used as an emulsifier, moisteners and nutritionally, as a source of fat and all the essential amino acids. Egg is used as a glaze; it also acts as a source of protein for the sugar's Maillard reaction.

CONCLUSION

To conclude, most people think that bakers are just people who put together some ingredients and throw them in the oven. But the truth is bakers are educated scientists. Bakers must know how much of each ingredient to use, how long to blend, how long to bake, what temperature the oven should be at, etc. To be a good baker you must have a lot of education as well as experience. Overall, baking is a science just as much as it is an art.

So this much about chemistry of baking. In the next section we would discuss about the leavening agents that help in rising the dough, the baking powder and soda and the baker's yeast specially.

BAKING POWDER & BAKING SODA

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LEAVENING AGENT

While most home cooks have used baking powder and baking soda, in all sorts of recipes - from pancakes and pies, to cookies and cakes – many people do not really know why they are different and how they should be used. Baking soda and baking powder are both chemical leaveners, which means they make our breads and cakes rise. They do this by causing a chemical reaction that releases carbon dioxide and creates the lift in baked good. But they are not same things.

Baking Soda: This is nothing but **sodium bicarbonate,** which can be denoted by the chemical formula $NaHCO_3$. It is quite useful in baking as a leavening agent- a substance that causes foaming, leading to the softening of mixture. It is also referred to as sodium hydrogen carbonate.

Baking soda is alkaline, which means it has a higher pH value than acid likes lemon juice, butter milk, vinegar, and other common baking ingredients. So, when it interacts with an acid which has a lower pH value, it creates a chemical reaction, releasing carbon dioxide, as it tries to get to a neutral pH value. But baking soda still needed to be mixed with an acid. Since it was cheap and widely available, bakers often use sour milk.

This process was unpredictable, since it was hard to control how acidic the sour milk was, meaning it was difficult to know how much baking soda to use or how long to bake for.

When carbon dioxide releasing the cakes or breads is rise and makes flaky and soft.

Baking Powder: This is mixture of baking soda and mild edible tartaric acid and some other bicarbonates and some acid salts. Baking powder is made up of bases, acids, and some buffering

materials which help in the prevention of early acid-base reaction. Generally, baking powder contains baking soda or sodium bicarbonate alone with one or many salts that can produce acidic reactions when dissolved in solvents.

Baking powder is a leavening agent produced by the mixture of a dry acid reacting with alkali reacting one. These baking acids are tartrate, phosphate and sodium aluminum sulfate used alone or in combination.

The reaction is occurring between sodium bicarbonate ($NaHCO_3$) and cream of tartar ($KHC_4H_4O_6$) is:

$NaHCO_3 + KHC_4H_4O_6 \rightarrow KNaC_4H_4O_6 + H_2O + CO_2$

Sodium bicarbonate and sodium aluminum sulfate [$NaAl(SO_4)_2$] react in a similar manner:

$3NaHCO_3 + NaAl(SO_4)_2 \rightarrow Al(OH)_3 + 2Na_2SO_4 + 3CO_2$

In this way, the baking powder works, and the doughs are rise. In shorts, when sodium bicarbonate mixes with water, then it reacts with tartaric acid to evolve carbon dioxide gas to make cakes, breads rise.

Although, they both make batters and dough rise. They have different chemical makeup. Making one for another can cause some baking mishaps. But. baking soda has much stronger leavening power than baking powder.

So, this reason, the cake or breads swells or rises well. So as a measurement, 1 teaspoon of baking powder is equivalent to ¼ teaspoon of baking soda. If mix up, baking soda and baking powder, we can see an incorrect rise because baking powder also contain an acidic component when the baking soda is used instead of the baking powder, the flower would sour, and having the wrong one in the wrong quantities may result in an incorrect rise.

CONCLUSION

So far, we have learnt about chemical leaveners, their two categories, how they work in breaking process, which one works better and so on. Although it is not ideal always, but you can sometimes substitute one for other. Now let us move on to another popular leavener reagent Baker's Yeast.

BAKERS YEAST

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INTRODUCTION

The baker yeast is a common name for the strains of yeast. Commonly, it is used in baking bread and bakery product. Bakery yeast is a commercial preparation consisting of dried cells of one or more strains of the fungus Saccharomyces cerevisiae used as a leavening in baking. The word "yeast" comes from the Sanskrit "YAS" meaning to "Seethe or boil". Yeast is a microscopic organism which converted sugar or starch into alcohol and carbon dioxide, ethanol and makes lighter and tastier. Baker's yeast is also a single cell micro-organ found on and around the human body.

The art of bread making goes back to early stages of different historical years. Bread is an important part of human diet. Many people enjoy creating beautiful and unique breads from yeast dough.

There is no information when yeast used to make bread, but it is discovered from ancient Egypt. IN 19th century, bakers obtained their yeast from beer brewers from which they made sweet-fermented breads. This process is known as a 'Dutch process'. This process spread to Germany and yeast is known as "Cream". In 1825, Tebbenhaf found a way to make a yeast into a cake followed by the way of extracting moisture. In 1867, Reiminghaus used the filter process and the recently this process follow for making baker's yeast.

TYPES

Baker's yeast is available in several different forms, including compress, dried/granular, cream, or liquid instant, encapsulated and frozen.

Dry yeasts are good choices for longer-term storage, but the liquid yeast are not good choices for the long storage at room temperature Different types of baker's yeast:

Cream yeast: Cream yeast in the closest form to the yeast of the 19th century. It is basically a suspension of yeast cell in liquid, taken from growth medium. Its primary used is in industrial bakeries

with high volume dispensing and mixing equipment. It is not good choices for the small bakeries.

Compress yeast: is made from cream yeast from which most of the liquid is drained. It is used for industrial and for home use.

Instant yeast: Looks like active dry yeast, but granules are smaller in diameter. It also lasts much shorter time. It does not have to be rehydrated before use. It is also used for ho

Rapid-rise yeast: It is a type of dried yeast that is of a smaller granular size and can be dissolved faster in dough. It gives more carbon dioxide than other yeast types and raises the dough much faster. Rapid-rise yeast is often used in bread machines.

Active dry yeast: Active dry yeast is of the type of yeast most commonly available to non-commercial bakers. It consists of coarse oblong granules of yeast, with live yeast cell encapsulated in a thick jacket of dry, dead cells, with growth medium. It must be rehydrated before use. It started at room temperature for year, while frozen, it can last 10 years and used for home.

CONCLUTION

There are five types of Baker yeast which are used for bakery industry but some of them cannot use for small bakery. When consider the value of different nutrients versus the nutrients provided by baker yeast in use, at 3% /ft, except for vitamin-D and folate. Yeast play an important role to converted sugar or starch into flavour and alcohol synthesis, where yeast act as a catalyst for breaking of sugar in fermentation process. Different types of yeast change the dough behaviour and fermentation, which help in generating different types of baked products.

So this much about Baker's Yeast. Now let us move on to the next section of this chapter i.e., roti, chapati and dosa that are also baked but without much visible rise.

ROTI, CHAPATI AND DOSA

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INTRODUCTION

Roti, chapati and dosa are some well-known meal in Indian subcontinental food. Chapati is a type of roti and these are popular (chapati and roti) in northern India and Dosa in southern India. Chapati and roti are **unleavened flatbread** mainly prepared in the Indian subcontinent. Let us know how they are prepared. Chapatis are made using a soft dough by mixing wheat flour (known as atta), salt and water.

Chapati dough is now moulded with the hand made into a fist and left for at least 10 or 15 minutes for the gluten in the dough to develop. After that, the dough becomes softer and more pliable.

Small portions of the dough are pinched off and formed into round balls that are pressed between the two palms to form discs which are then dipped into flour and rolled out on a circular rolling board and by using a rolling pin (known as belan), into a thinner circular shape.

Now-a-days there are also roti-makers which automate the whole process. The rolled-out dough is then thrown on the preheated dry tawa and cooked

on both sides. The hot tawa cooks the chapati rapidly from the inside. It is also possible to puff up the roti directly on the tawa.

Once cooked, chapattis are often topped with butter or ghee.

In Eastern India, it is known as Roti. Roti and chapati are the source of carbohydrates, fat, vitamins, and minerals. So, most time it us served as meal. Parathas are also some variety of these roti and chapatis. And there may be so many versions of paratha with different stuffing.

So this much about the unleavened flat-bread versions i.e., roti and chapati and to some extent paratha, the speciality of north Indians. Let us now move on to the south Indians favourite Dosa.

DOSA

Dosa is one of the most demanded food in southern India. Dose/dosai is a rice pancake, originating from South Indian states, made from a fermented batter predominantly consisting of lentils and rice. Dosa is the Anglicized name because it is named differently in some states, example, 'dosai' in Tamil, 'dose' in Kannada and 'dosa' in Malayalam. Its main ingredients are rice and black gram. Dosas are a common dish in South Indian food. But now-a-days have become popular all over the Indian subcontinent.

INGREDIENTS

PREPARATION

A mixture of rice and black gram that has been soaked in water is grinded finely to form a batter. The proportion of rice to lentils is generally 3:1 or 4:1. After that, the batter can ferment overnight, before being mixed with water.

The batter is then ladled onto a hot tawa greased with oil or ghee.

It is spread out with the base of a ladle or bowl to form a pancake. It can be made either to be thick like a pancake, or thin and crispy.

A dosa is served hot, either folded in half or rolled like a wrap. It is usually served with chutney and sambar. Dosa is a healthy protein rich food. It makes a great food to start our day.

Dosa can be stuffed with fillings of vegetables and sauces to make a quick meal.

SERVING

Dosas are typically served with a vegetarian side dish which varies according to regional and personal preferences. Common side items are:

- Sambar
- Chutney: examples include coconut chutney (a semi-solid paste made up of coconut, dal (lentils), green chilli and mint or coriander) etc.
- Idli podi or milagaipodi: a lentil powder with spices and sometimes desiccated coconut, mixed with sesame oil or groundnut oil or ghee
- Indian pickles

TYPES OF DOSA

The most popular version is the masala dosa, with a filling of the potato masala. Mysore masala is the spicier version of it. Sada (plain) is without filling; paper dosa is a thin and crisp version. There is another version named Set dosa that is very spongy, soft, and light, served in a set of 3 dosa per serving. Though dosa typically refers to the version made with rice and lentils, many other versions exist. Rava dosa is made crispier using semolina. Newer recipes have been developed that use fusion, like Chinese dosa, cheese dosa, paneer dosa and many more.

MASALA DOSA

PAPER DOSA

PLAIN DOSA

SET DOSA

SPONGE DOSA

NUTRITION

The main ingredients of dosa are rice (Oryza sativa) and black gram (Phaseolus mungo). White rice, which is normally used for dosa, contains about 90% carbohydrates, 8 percent proteins and 2% fat. It is also a good source of calcium, magnesium, phosphorus, manganese, selenium, iron and vitamins, folic acid, thiamine, and niacin. It has low fiber content and contains pro-inflammatory omega-6 fatty acids. Black gram or Mungo bean is rich in carbohydrates (about 60%) and proteins (about 25%), It also contains about 18% of dietary fiber and is a good source of minerals, potassium, calcium, iron and vitamins, niacin, thiamine, and riboflavin. Black gram has been found to be especially useful in controlling cholesterol levels.

FERMENTATION

Fermentation gives the characteristic texture (leavening), aroma and taste to the dosa batter along with improved digestibility and nutritional value (Fig. 2). Fermentation is the process of converting carbohydrates to alcohol or organic acids with the help of microorganisms, under oxygen free conditions. The science of fermentation is known as zymology or zymurgy too.

The microorganisms that are responsible for the fermentation are naturally present in the ingredients of dosa batter, black gram and rice. Some of the fermentation bacteria/microbes are also provided by water and air. A temperature of 25°-30° C is found to be highly favourable for the microorganisms to boost the fermentation process.

CHEMISTRY BEHIND

Fermentation of dosa batter is carried out mainly by Lactobacillales or lactic acid bacteria (bacteria that convert milk to yogurt), recognized as lactobacillus delbrueckii, L. lactis, Strptociccus lactis, S. faecalis, Leuconostoc mesenteroides and Pedicococcuscerevisiae. Wild yeasts, recognized as Saccharomyces cerevisiae, Debaryomyces hansenii and Trichosporon beigelli, on the other hand, are found to produce flavour compounds and help in the saccharification (hydrolysis) of starch. In the early stages of fermentation, the 'heterofermentative' type bacteria like Leuconostoc mesenteroides are found to predominate, producing carbon dioxide and alcohol along with the lactic acid (the mucilaginous

property of dosa batter helps to trap the carbon-dioxide evolved during fermentation which results into leavening of the batter).

During the later stages of the fermentation the homofermentative lactic acid bacteria like Lactococcus lactis dominate and produce only lactic acid. Due to this batter starts turning sour over the time. Starch in the rice and black gram (or in general) contains two types of homopolysaccharides, amylose and amylopectin. Amylose is an unbranched homopolysaccharide consisting of about 5-600 glucose units, linked by α-(1→4) glycosidic bonds. It forms a helix structure with six glucose units in each helix. Amylopectin is a branched molecule formed by several glucose units ranging from several hundreds to fifty thousand in a main chain, which are joined by α-(1→4) glycosidic bonds.

Lateral chains of about 20-30 glucose units are linked to the main chain by a α-(1→6) glycosidic bond. Glucose units on the lateral chain are linked again, joined with themselves by α-(1→4) glycosidic bonds. These branches provide a spongy fibre-like structure to the amylopectin and prevent the formation of a helical structure. During the fermentation process the starch content of the dosa batter is hydrolysed (broken down) yielding maltotriose and maltose from amylose, or maltose, glucose, and limit dextrin from amylopectin, with the help of amylases, the calcium metalloenzymes. These amylase enzymes (mainly α-amylase, β-amylase, and γ-amylase) are provided by the microorganisms (yeasts and bacteria) naturally present in the ingredients of dosa batter and the atmosphere.

The glucose, and other sugar molecules, then undergo a splitting process called glycolysis, a multistep metabolic pathway which involves a sequence of about ten enzyme-catalyzed reactions. Glycolysis can occur either in presence or absence of oxygen. This is carried on in two slightly different ways, depending on the microorganisms (enzymes) and conditions involved in the process. In Embden–Meyerhof–Parnas pathway (homolactic process), glucose is gradually split into two molecules of pyruvate (3 carbon sugar) and yields two molecules of ATP (free energy containing molecule) and two "high energy" electron carrying molecules of NADH. So, this is the chemistry behind fermentation.

CONCLUSION

Hence from this section, we knew about different types of dosa, how they are made and what kind of nutrients we can gain from them. The chemistry behind fermentation also tried to be understood. Last, but not the least, healthy foods provide nutrition that gives us not only physical health but also immunity to prevent disease.

So this much about baking. Let us now move on to the next chapter to explore about a different sector of the culinary world.

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CHAPTER-H

DAIRY MAGIC

A MILKY ADVENTURE

CHEMQUEST, VOL-1, ISSUE-2, **2020**, PAGE-H1-H13

PRELUDE

Dairy products are mass produced and ingredients in many different foods. A simple definition of Dairy, is any foods made from the milk products of animals, or produced in the mammary glands. Dairy products, for those that can consume them act as a source of protein, fat and sugar and they are processed in a similar fashion to these groups. Dairy contains useful nutrients such as calcium, which has been shown to improve bone strength and especially in developing children. Among the various product of dairy the curd, yogurt, butter and cheese as food dairy product that was introduced centuries, are most familiar with our morden life ago.

EVOLUTION

Dairy has been in use since prehistoric period. In India, from the historical evidence it suggests that dairy may have been in use at least since the Harappan Civilization (3300–1300 BCE). The first written mention of milk and dairy products in the subcontinent is found in the *Rigveda* which might have been written in around 1700 BCE. The earliest evidence of milk use dates back to around 6,500 BCE. A team led by Richard Evershed, a biogeochemist at the University of Bristol, discovered residues of milk fats on pottery found in Northwest Turkey. It is believed that raw milk wasn't actually consumed by people at this time due to uniform lactose intolerance in adults. The high amounts of milk fats found in the pottery suggest that people ate butter, cheese and yogurt, rather than consuming raw milk. The entry counted foods that are still prominent in the Indian diet today such as curd, butter, buttermilk, and ghee. According to ancient records passed down through the centuries, the making of highlighted food dairy product dates back more than 4,000 years.

For centuries, yogurt was made only within the home and not for mass production. That all changed when in 1905 Bulgarian microbiologist Stamen Grigorov discovered *Lactobacillus bulgaricus*, the bacteria strain that ferments milk into yogurt. Soon after Grigorov's breakthrough discovery, Danone, (or as we know it in the US, Dannon), began to produce commercialized yogurt in 1919 in Barcelona, Spain.

MODERN TREND

The dairy products are the most important foods that can sustain the nutrition and health of people at least in India. That is why the dairy industry has been continuously evolving and developing its direction in order to meet the recent trends of consumer demands and flavours. Different type's flavours products have been prepared in markets.

On this valuable dairy products knowledge, let us now enter into the health beneficiary fields of dairy food products like curd, cheese, butter and yoghurt to explore it further in light of chemistry behind it.

CHEMISTRY OF CURD

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WHAT IS CURD?

In simple words curd is the coagulated form of milk. It constitutes a major portion of dairy products. Curd is a best example of easy to digest food that contains essential nutrients, proteins, minerals for human body.

HISTORY OF CURD:

Card has been a part of human diet for thousands of years and goes by many names throughout the world. Indian ayurvedic books, dating from about 6000 BC, refer to the health benefits of consuming fermented milk products. Today hundreds of Curd and Cheese products are found in Indian cuisine.

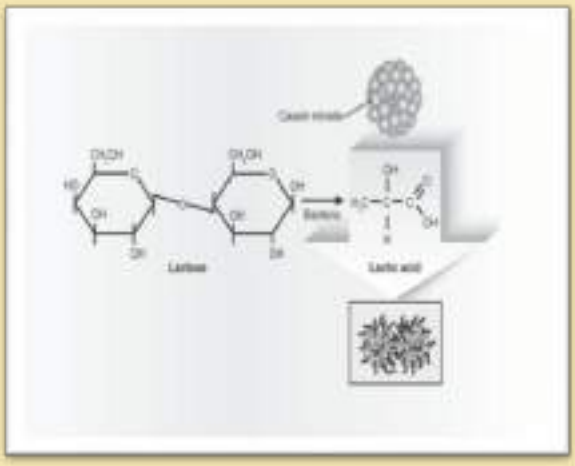
SCIENCE BEHIND THE CURD FORMATION:

Initial materials required for curd formation is milk and the starter (day old curd). Now the question is how a spoonful of starter curdles a whole bowl of milk? Milk is an excellent ensemble of various carbohydrates, proteins, fats, vitamins and minerals. The characteristic white colour of milk is due to the presence of a protein called casein. Besides, the "milk sugar" mainly contains lactose (a disaccharide).

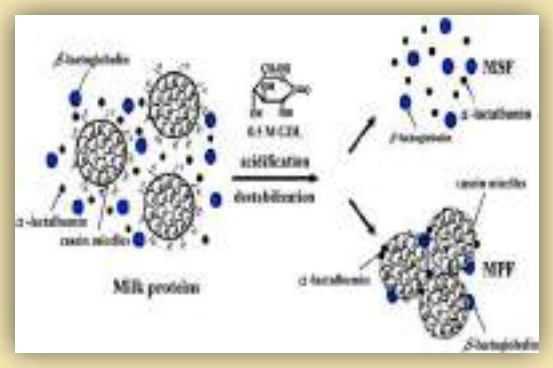
Starter is an old curd which contains bacteria called Lactobacillus sp. These bacteria converts milk to curd.

Image-Lactobacillus sp.

At room temperature lactobacillus bacteria present in milk uses lactose and multiplies itself until the conditions are favorable. Lactose present in milk is utilised by bacteria and converted to lactic acid by an enzymatic reaction.



Lactic acid accumulates in milk, increases the H^+ ion concentration which decreases the pH of milk. Lactic acid acts on globular protein (casein) present in milk and denaturate it. This denaturation destroys the tertiary and quaternary structures of proteins and the globular proteins are converted into fibrous proteins, thus giving a thick texture to the milk. Coagulated casein curdles into curd and the remaining liquid in milk as Whey (light yellow coloured).



NUTRITIONAL VALUE OF CURD

Nutrients of Curds	Values
Calories	61Kcal
Carbohydrates	4.7g
Proteins	5.1g
Fats	3.5g
Minerals	
Calcium	121 mg
Iron	0.1 mg
Phosphorus	141 mg
Magnesium	12.0 mg
Selenium	2.2 µg
Zinc	0.6 mg
Electrolytes	
Potassium	155 mg
Sodium	46.0 mg
Vitamins	
Vitamine A	99.0 IU
Vitamine C	0.5 mg
Vitamine K	0.2 µg
Vitamine B12	0.4 µg
Vitamine B2	0.2 mg
Vitamine D	0.1 mg
Folic Acid	7 µg

MODERN SCIENTIFIC (INDUSTRIAL) TECHNIQUE OF PREPARATION OF CURD

Receiving of milk

↓

Pre-heating (35-40 °C)

↓

Filtration/ clarification

↓

Standardization

↓

Pre-heating (60 °C)

↓

Homogenization (176 kg/ sq cm)

↓

Pasteurization (80-90 °C/ 15-30 min)

↓

Cooling (22-25 °C)

↓

Addition of starter cultures (1-1.5%)

↓

Packaging

↓

Incubation (22-25 °C/ 16-18 hrs)

↓

Dahi

↓

Cooling and storage (4-5 °C)

BENEFICIARY ROLE OF CURD IN HUMAN BODY

- Curd helps to improve our digestive system, by making nutrients (from other food items) easy to absorb. Recent studies have found that it helps to cure stomach infections including H. Pylori infection.
- Curd contains some good bacterias (also called Probiotics), which strengthen our immune system. Consuming curd on a regular basis can lead us to a better health. It also inhibits vaginal infection.
- Curd reduces the risk of coronary heart diseases, by preventing the formation of cholesterol in arterial region.
- Curd contains Calcium and Phosphorous, both of which are immensely important for the growth and maintenance of bones and teeth.
- Calcium present in curd controls the level of Cortisol in our body, Imbalance of which leads towards diseases like hypertension and obesity.
- Curd can be an alternative of milk for those people who can't digest milk (Lactose intolerant).
- It contains Vitamin E, Zinc, phosphorous, all of which play important role to improve skin texture.

➔ Dandruff is a very common hair problem,

which is nothing but a type of fungal infection. Lactic acid present in curd has antifungal properties. Applying curd on scalp can help to eliminate dandruff from hair.

Modern studies have found that Curd plays important role in treatment of some critical diseases like Cancer, Insomnia, Diabetes etc. It also helps to improve lipid profile and to prevent various liver diseases can be chopped, ground, shaved, or melted and is preferred for ganache, glazes, mousse, and pudding. It can also be found in nearly any chocolate dessert you can imagine. Semi-sweet chocolate chips are the preferred form in chocolate

chip cookies. Since dark chocolate does not contain milk, it is useful in vegan recipes as well.

CONCLUSION

Curd represents that rare category of food which is easy to prepare, consume and digest. It helps in beating intense heat of summer, in addition to enhancing vitality and stamina. That is why, it is an integral part of daily diet of the people across various tropical countries. In fact its origin is linked to Indian subcontinent. However in any case, consumption of this dairy product enhances our life-span.

YOGURT

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Yogurt has been consumed by human beings for hundreds of years. Yogurt is a well-liked dairy product which is made by the bacterial fermentation of milk. It provides protein and calcium, and it may enhance healthy gut bacteria. The word "yogurt" is believed to have come from the Turkish word "yogurmak", which means to thicken coagulate, or curdle. Today, the FDA defines yogurt as a milk product fermented by two bacterial strains: a lactic acid producing bacteria: *Lactobacillus bulgaricus* and *Streptococcus thermophile*.

CHEMISTRY OVER THE YOGURT:

Yogurt prepared when bacteria ferment the sugar lactose ($C_{12}H_{22}O_{11}$) into lactic acid ($C_3H_6O_3$). The lactic acid makes the milk more acidic (lower the pH), causing the proteins in milk to coagulate. The main protein in dairy milk is casein. The acidity gives yogurt its tangy flavour, while the coagulated

proteins result in a thickened, creamy texture. There is no simple chemical equation for yogurt production since multiple reactions occur. Several types of bacteria can ferment lactose. Yogurt cultures may contain *Lactobacillus delbrueckii subsp. bulgaricus*, other *Lactobacillus* strains, *Streptococcus thermophilus*, and *bifido bacteria*.

BASIC STEPS TO MAKING HOMEMADE YOGURT

There are six basic steps for making yogurt at home:

1. **Heat the milk to 180 degrees Fahrenheit.** This kills whatever unsavory microbes may be lurking in your milk and ensures you've got no remnant bacteria, pathogens, mold, or spores. When you create an environment for bacteria to multiple, you only want the good bacteria (which you introduce to the milk) to multiply. Heating the milk also creates a thicker yogurt by changing the protein structure.
2. **Cool the milk to 112-115 degrees Fahrenheit.** After you've made the milk inhospitable for the bad stuff, you want to make it hospitable for the good bacteria– your starter mix. Use the same instant read thermometer you used when heating your milk, to know when it's cooled to 112-115 degrees Fahrenheit.
3. **Add your yogurt starter– the good bacteria.** Pour out one cup of warm milk and stir in either a yogurt starter (use **Yogourmet**) or 3 tablespoons of pre-made yogurt. For a good starter, look for lactic acid forming bacteria. At a minimum you want *Lactobacillus bulgaricus* and *Streptococcus thermophilus*. Other good bacteria include

Lactobacillus acidophilus and *Bifidobacterium lactis*.

4. **Stir the yogurt starter with the rest of the milk.** This spreads the good bacteria throughout all the milk.
5. **Pour the milk into jars and incubate for 7-9 hours.** A consistent, luke-warm temperature is paradise for all your good bacteria and promotes their growth. The longer you incubate your yogurt the thicker and tangier it'll be. And after about 8 hours, you'll have delicious, healthy, thick and creamy yogurt.
6. **Place the jars in the fridge to cool and set.** Cool the yogurt in the refrigerator for a couple of hours. As the yogurt cools it will get even thicker.

WHAT ARE THE HEALTH BENEFITS OF YOGURT?

Yogurt may provide potential health benefits by enhancing nutrient absorption and digestion. It's very nutritious, and eating it regularly may boost several aspects of your health. For example, yogurt has been found to reduce the risk of heart disease and osteoporosis, as well as aid in weight management. Yogurts contain high nutrients as protein, calcium, vitamins B12, D and riboflavin, and live culture, or probiotics, which can enhance the gut microbiota.

Yogurt provides an impressive amount of protein which support metabolism by increasing your energy expenditure, or the number of calories that you burn throughout the day. These can offer protection for bones and teeth and help prevent digestive problems.

The yogurt containing probiotic bacteria successfully protects children and pregnant women against the effects of heavy metal exposure. Low-fat yogurt can be a useful source of protein on a weight-loss diet. It is seen that amazing Yogurt face mask benefits for skin. Yogurt contains beneficial lactose fermenting bacteria commonly found in milk, similar to the bacteria — or microflora — found in the breasts of mothers who have breastfed. Lactose fermenting bacteria in the breast is protective and reduction in the risk of breast cancer.

CHEESE

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"The moon is made of a green cheese."
------ Thomas Heywood

WHAT IS THE CHEESE?

Cheese is one of the fermented milk-based foods characterized by its many different flavour, texture and aroma. It was first exposed by herdsmen who would put their daily rations of milk in dried calves' stomachs. While stored in this outlandish container, the heat from the sun would naturally combine the milk and the digestive enzyme, rennet, which would form a white lump in diluted whey. So, the milk would coagulate and form curds and whey. It is probable that the process of cheese making was discovered accidentally by storing milk in a container made from the stomach (source of rennet enzyme) of animal.

INGREDIENT OF CHEESE:

Cheese is a good source of calcium and protein; however, it also similar to high in saturated fats and sodium. Its ingredients are water, calcium, sodium chloride, fat, protein, mineral crystals

PREPARATION OF CHEESE

Standardization: The fat and protein levels of collected milk from farms have to be adjusted to create a uniform product with highest possible yield, by standardization process.

Pasteurization: Standardized milk is pasteurized by heating to 161 degrees Fahrenheit for 15 seconds to inactivate all milk-borne pathogens and most of the naturally occurring enzymes.

Additives: Annatto is added to give cheese an orange or yellow colour, hydrogen peroxide and benzyl peroxide are added to some varieties to bleach colour. $CaCl_2$, Na_2PO_4 and also $Ca_3(PO_4)_2$ are added to speed up coagulation and improve the firmness and yield of the cheese.

Starter Cultures: For acidification starter culture is added and the milk is stirred to mix it, starter culture cultures consist of lactic acid bacteria, which ferment the sugar in milk they convert lactose to lactic acid. These bacteria allow the milk to coagulate faster when rennet is added, since rennet enzymes work better under acidic condition and contribute greatly to flavour and texture formation. The CO_2 gas generated during the process helps to form eyes.

$$\text{Glucose} + \text{ADP} + P_i \longrightarrow \text{Lactate} + \text{Ethanol} + CO_2 + \text{ATP}$$

Rennet Addition: Rennet consists of a number of enzymes, especially chymosin, which is produced in the stomachs of mammals for digestion of the

mother's milk. Chymosin is a protease or proteolytic enzyme, meaning that it breaks down protein and forms a curd.

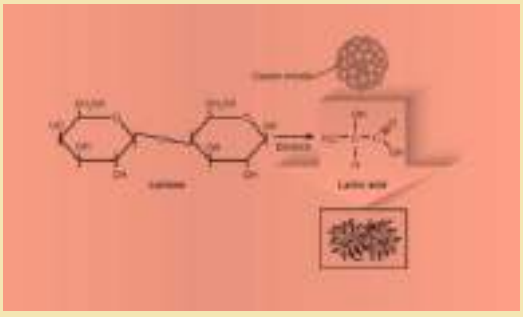
The chief protein of milk is called Casein, it is an amorphous white solid, and in cow milk 3% of casein is present. Renne attacks casein, casein comes in the form of micelles, made up of sub micelles and stabilized by κ -casein. The micelle is

thus destabilized, and various interactions then allow the caseins to aggregate into a three-dimensional coagulum. Chymosin is water-soluble, so the more moisture in the curd the more chymosin is retained in the cheese, leading to extra flavour development later on. After action of rennet we observe gel like texture

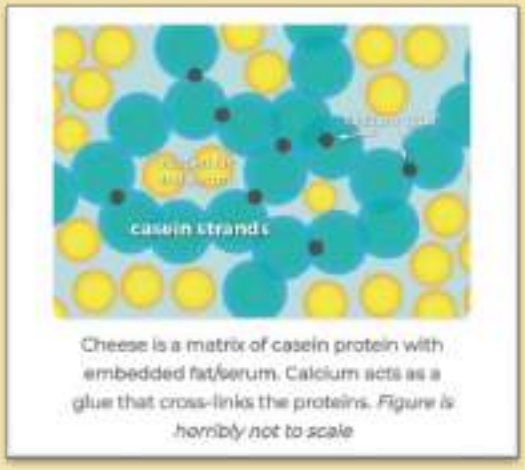
Casein + Rennet ⟶ Para-casein (gel) + Macropeptides

Salting: Sodium chloride is added to cheese after drying the curd to enhance flavour and to control microbial and enzymatic activity. Acid production by micro-organisms is prevented by addition of NaCl.

Casein comprises 80% of the protein in milk. The casein molecules are normally wrapped into compact spheres that are packed together with calcium and phosphate ions to form microscopic micelles. Acid causes the casein molecules to partially unfold and link with each other. The interconnected micelles form a mesh-like structure that causes the milk to gel into.



After all the treatments we get a solid thing from liquid milk, the main structure of cheese is casein protein. Casein micelles aggregate and form 3-D matrix. The glue that holds these proteins together is calcium, the gaps in the casein matrix are filled with fat and serum.



GOOD AND BAD EFFECT OF CHEESE OVER HUMAN BODY:

"Numerous cheeses are high in sodium and fat; however, the advantages may exceed the disadvantages"

"Cheese favoured items don't have the equivalent dietary benefit and are bound to be high in sodium".

Good effects: Cheese is a great source of calcium, fat, and protein. It also contains high amounts of vitamins A and B-12, along with zinc, phosphorus, and riboflavin. The researchers additionally found that the cancer prevention agent properties of cheese may make certain against the negative impacts of sodium, at any rate, for the time being.

The cheese and dairy products in general -could work to protect your teeth from cavities. High-fat cheeses like blue cheese, Brie, and cheddar contain small amounts of conjugated linoleic acid (CLA) which helps prevent obesity, heart disease, and reduce inflammation. Not only does the cheese containing calcium, protein, magnesium, zinc, and nutrients A, D, and K substance helps the solid bone improvement in youngsters and youthful grown-ups, and to osteoporosis counteraction. As a matured food, cheese may help support sound gut microscopic organisms.

Bad effects: Some people are sensitive to cheese. It also acts as a high in sodium and saturated fat which is dangerous for hypertension, cardiovascular ailment, and type 2 diabetes.

BUTTER

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"Everything tastes better with butter. Meat that has fat in it is tender in a certain way, flavorful in a certain way. It's hard to deny the flavor quotient there."

----------Alice Waters

Butter is a one of the healthy dairy products with numerous health benefits. From long time butter is used as a medicine in Ayurveda. It is made by whipping crisp or aged cream or milk, to isolate the butter fat from the buttermilk. We can make butter from different mammals milk, such as cows, buffalo, sheep, goats, camel, etc. Butter is one of the world's preeminent sustenance. All through the greater part of human development, spread has been viewed as an image of good living. Its color ranges from yellow to white. It melts just below body temperature (32–35 °C)

WHAT IS THE BUTTER?

Butter is a dairy product made from the fat and protein components of milk or cream. It is a semi-solid water in oil emulsion at room temperature, consisting of approximately 80% butterfat. Most frequently made from cow's milk. It is made by churning milk or cream to separate the fat globules from the buttermilk. Salt and food colorings are sometimes added to butter. Rendering butter, removing the water and milk solids, produces clarified butter or *ghee*, which is almost entirely butterfat. It is a water-in-oil emulsion resulting from an inversion of the cream, where the milk proteins are the emulsifiers. Butter remains a firm solid when refrigerated, but softens to a spreadable consistency at room temperature, and melts to a thin liquid consistency at 32 to 35°C (90 to 95°F). However, it is defined as a yellow-to-white solid emulsion of fat globules, water, and inorganic salts produced by churning the cream from cow's milk.

HISTORY OF THE BUTTER

The earliest butter would have been from sheep or goat's milk; cattle are not thought to have been domesticated for another thousand years. An ancient method of butter making, still used today in parts of Africa and the Near East, involves a goat skin half filled with milk, and inflated with air before being sealed. The skin is then hung with ropes on a tripod of sticks, and rocked until the movement leads to the formation of butter.

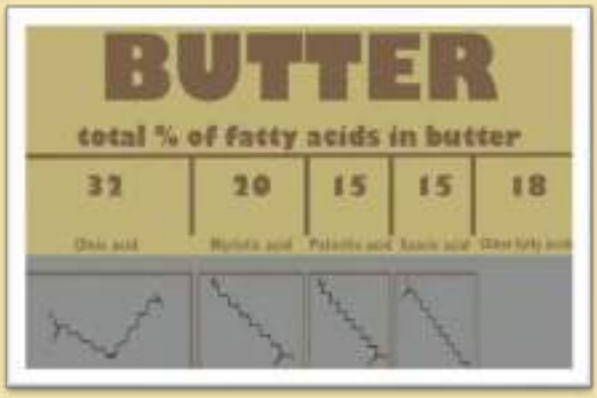
PROCEDURE OF THE BUTTER:

Standardization of milk: The fat and protein levels of collected milk from farms have to be adjusted to create a uniform product with highest possible yield, by standardization process by keeping pH > 6.6.

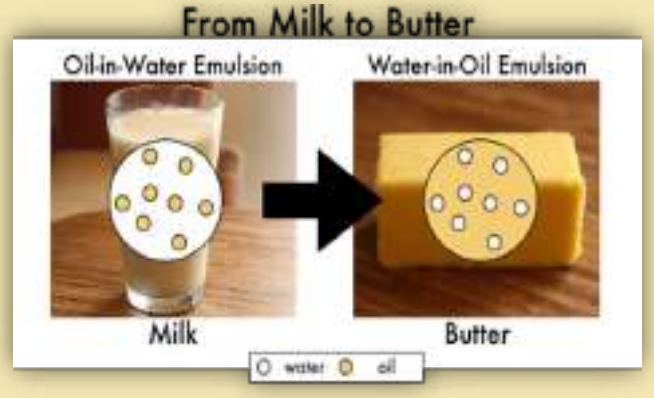
Pasteurization: Standardized milk is pasteurized by heating to 161 degree for 15 seconds to inactivate all milk-borne pathogens and most of the naturally occurring enzymes.

Separation of butter grains: Pasteurized milk then store in a container where churning of milk takes place. During the churning process the fatty globules in the cream break open to release the entrapped fat molecules. The hydrophobic fat molecules clump together and mix to form larger fat globules that coalesce into larger solid fat droplets. This processes pushes out the liquid portion and the solid portion becomes the butter.

Addition of Salt: Salt are added to enhance the test and to secure it from microorganism, salt can able to anhydrate cells by osmosis.



Now, that we have talked about the structure of butter, how to get from cream to butter? (Remember: milk and cream are oil-in-water emulsions and butter is a water-in-oil emulsion.) The oil-in-water emulsion of the cream is reversed into a water-in-oil emulsion in butter. So butter is an water in oil emulsion that is a highly condensed form of fluid milk obtained by churning.



WHAT ROLE DOES BUTTER PLAY IN FOOD?

- Imparts a rich, luscious flavour to food
- Acts as a shortening agent
- Carries the flavor of food effortlessly
- Allows our body to digest certain nutrients

BUTTER VARIETIES:

- Salted butter
- Unsalted butter
- Cultured butter
- Cultured salted butter
- Clarified butter/ghee
- Butter concentrate
- Butter oil
- Dairy blends
- Reduced fat dairy spreads
- Low fat dairy spreads

EFFECT OF THE BUTTER ON HUMAN BODY

Good effects: The consumption of butter on a regular basis in moderate amounts is beneficial to health as it provides several necessary minerals and vitamins essential for healthy living. It contains, for instance, vitamins A and D which are required for the proper development of the brain and nervous system, the skeleton, and many physiological processes. Also, butter helps in the proper functioning of many other parts of the body.

- **Vision:** Beta-carotene is mostly found in butter. This is a nutrient which is required for healthy vision, and gives protection to eye. Beta-carotene also lowers the risk of angina pectoris. The risk of macular degeneration is also reduced.
- **Bone:** Calcium and other minerals such as copper, zinc, selenium, and manganese are found in butter. They are crucial elements in building and maintaining bone strength, and also aid in bone repair and growth. Premature aging of bone, arthritis, and osteoporosis may occur due to inadequate intake of these minerals.
- **Thyroid gland:** The thyroid gland is a major endocrine gland and is a crucial link in the metabolism of vitamin A. Individuals with thyroid disorders have low vitamin A levels. Butter provides sufficient vitamin A, and the consumption of butter in adequate quantity will help alleviate thyroid problems.
- **Heart:** Naturally processed butter is a heart healthy food when taken regularly in moderation. Butter fats constitute high density lipoprotein (HDL) cholesterol which is considered as good cholesterol. The omega-3 fatty acids in butter also lower the level of omega-6 fatty acids and thereby reduce the risk of heart diseases.

Bad effects: Although butter has many health benefits, it is chiefly composed of fats which can cause many undesirable problems if consumed in excess. These include obesity, hypertension, heart disease and cancer. It is also possible that the use of white flour in most situations where butter is consumed is the primary culprit in causing obesity and linked complications. As in most cases, a moderate intake of butter will obviate most of the health risks ascribed to it, including a high level of bad cholesterol. This is especially so in individuals who already have heart disease or high blood pressure. They may need to carefully restrict their intake of butter, or even avoid it completely for a period. The continuous intake of butter in high quantities may also result in type 2 diabetes. The high fat level in the blood will affect insulin production in the β cells which results in the occurrence of diabetes. Overall, however, there is no question that a limited quantity of butter taken on a regular basis is highly beneficial for health.

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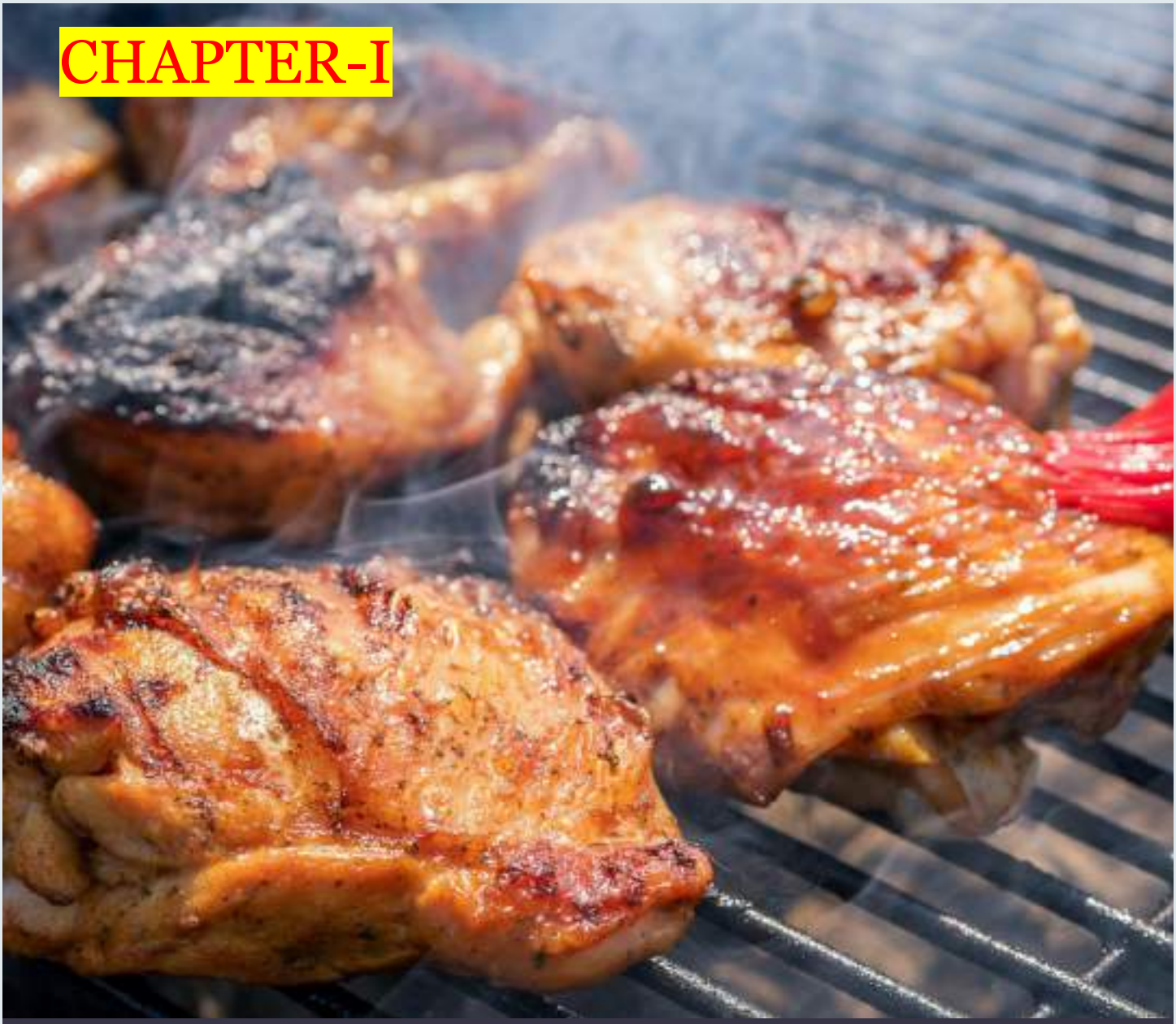
CHAPTER-I



BARBECUE CORNER

A TANTALIZING JOURNEY

PRELUDE

Barbecue, an outdoor meal, usually a form of social entertainment, at which meats, fish, or fowl along with vegetables, are roasted over a wood or charcoal fire. The term also denotes the grill or stone-lined pit for cooking such a meal, or the food itself, particularly the strips of meat. The word “barbecue” came into English via the Spanish, who adopted the term from the Arawak Indians of the Caribbean, to whom the *barbacoa* was a grating of green wood upon which strips of meat were placed to cook or to dry over a slow fire.

PROCESSING METHOD:

While there is a vast degree of variation and overlap in terminology and method surrounding this form of cooking, the generally accepted difference between barbecuing and grilling is in the cooking time and type of heat used. Grilling is generally done quickly over moderate-to-high direct heat with little smoke, while barbecuing is done slowly over low indirect heat and the food is flavored by the smoking process. Restaurant barbecue may be cooked in large brick or metal ovens specifically designed for that purpose. Barbecuing has numerous regional variations in many parts of the world.

EVOLUTION:

No one is really sure where the term *barbecue* originated. The conventional wisdom is that the Spanish, upon landing in the Caribbean, used the word *barbacoa* to refer to the natives’ method of slow-cooking meat over a wooden platform. By the 19th century, the culinary technique was well established in the American South, and because pigs were prevalent in the region, pork became the primary meat at barbecues. Among the barbecue cooking, history of Tandoor takes us back by 5000 years to Indus valley and Harappan civilizations of ancient India. But *Tandoori* cooking is believed to have originated in Persia and is found in some form throughout Central Asia.

Samuel Johnson's 1756 dictionary gave the following definitions:

"To Barbecue- a term for dressing a whole hog" (attestation to Pope) "Barbecue– a hog dressed whole". While the standard modern English spelling of the word is barbecue, local variations like barbeque and truncations such as bar-b-q or bbq may also be found. The spelling barbeque is given in Merriam-Webster and the Oxford English Dictionary as a variant.

MODERN TREND:

Barbecue is growing moderately in restaurants, with overall barbecue menu items growing 11% from the fourth quarter of 2016 to the fourth quarter of 2019, according to Chicago-based Mintel International’s Menu Insights (MMI). Surprisingly, it is not so much breathing smoke from the grill, but eating grilled foods and absorbing carcinogens through the skin that pose dangers. With this background knowledge, let us now enter into the sweetest world of barbecue to explore it further in light of chemistry.

CHEMISTRY OF BARBECUE

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WHAT IS THE BARBECUING?

Barbecue (or *Barbeque*, *BBQ*) is a special type of grill. It is also a way to prepare meat which is then cooked with a barbecue. It is especially popular in Australia and in certain parts of the United States. There are some difference between barbecuing and grilling in respect of their cooking time and type of heat used. The Grilling is generally done quickly over moderate-to-high direct heat with little smoke, while barbecuing is done slowly over low indirect heat and the food is flavoured by the smoking process.

TECHNIQUES AND CHEMISTRY IN BARBECUING:

Barbecuing techniques involved various types of cooking techniques. The original technique is cooking using smoke at lower temperatures (usually around 240-280°F or 115–145°C) and significantly longer cooking times (several hours), known as smoking. Another technique is baking and braising which use convection to cook meats with moderate

temperatures for an average cooking time.

Holy smokes: it is not just cool summer afternoon or chance to sit outside that gets us excited for the first barbecue of the year. It is also the thought of that delicious smoky taste you just cannot seem to achieve unless you are spinning skewers or searing steaks over outdoor grill. Like wood, charcoal used in your barbecue contains several organic polymers like cellulose and lignin. When charcoal burns, it forms a variety of phenolic compounds as a result of thermal degradation of its organic polymers.

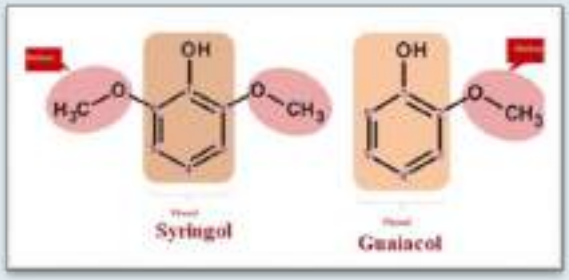
While cellulose is the most famous constituent of wood and charcoal, it is lignin that steals the show here. This is because it is the pyrolysis of lignin that contributes to the irresistible smoky flavour and taste of barbecue meat.

Pyrolysis of lignin: Lignin is a complex arrangement of phenolic molecules. Not only is it the main constituent of the cell walls in every dry-land plant, it also comes in second place behind cellulose as the most abundant natural polymer in the world. When lignin burns, it yields a range of aromatic products. The most important of these products are the 2-methoxy-substituted phenols: **guaiacol**, which causes a smoky flavour, and **syringol**, which causes a smoky smell.

Guaiacol and Syringol: There are two key chemical components involved in the smoky taste and aroma of barbeque. These two chemical components are Syringol and Guaiacol. With the chemical formula $C_7H_8O_2$ guaiacol appears as yellowish aromatic oil. Also known as 3-methoxyphenol, it can be biosynthesised by a number of organisms and is usually derived from a genus of flowering plants, known as guaiacum, or from wood creosote. Guaiacol can be found in wood smoke as a product of the pyrolysis of lignin. It is a phenolic compound that comprises up to 85% of the world's production of vanillin, a fragrant compound and essential component in vanilla. You may also

recognise is as a contributor to some of your favourite flavours, including whisky and roasted coffee.

Syringol is also known as 2, 6-dimethylphenol, syringol ($C_8H_{10}O_3$) is a dimethyl ether of pyrogallol and a naturally occurring aromatic compound. Like guaiacol, it can be found in wood smoke as a characteristic product of the pyrolysis of lignin. Syringol is responsible for the aroma of most smoked foods, and it is even used in artificial smoke flavourings to give you the experience of a barbecue isn't there.

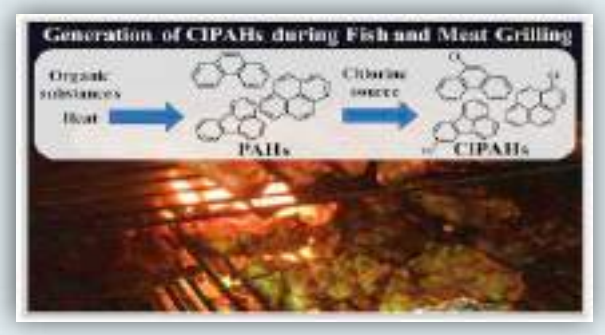


Both guaiacol and syringol are characteristic properties of the pyrolysis of lignin. When lignin burns and oxygen breaks it down, these aromatic compounds are released in the form of smoke. They can then stick to the moist surface of meat being cooked, infusing it with that delicious smoky flavour. This is why barbecue meat tastes so good.

The Millard Reaction in a barbecue: First developed in 1921 by Louis-Camille Maillard, this is a chemical reaction between amino acids and reducing sugars that contributes to tasty flavours of cooked food. It is also one of the only chemical reactions that are better tested in kitchen than in lab.

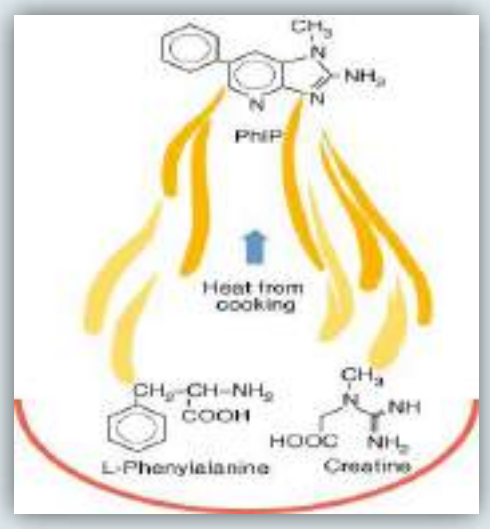
HARMFUL EFFECT OF BARBECUE FOOD IN OUR HUMAN BEINGS:

The studies have shown that regular consumption of barbecue food is linked with health risk. So far most of the studies have linked Heterocyclic Amines (HCAs) and Polycyclic Aromatic Hydrocarbons (PAHs) to risk of cancer. It has been seen that the highest levels of PAHs and HCAs which unintentionally generated during barbecuing, eating processed and red meat also increases the risk of bowel cancer. Switch to barbecued fish, lean beef or chicken.



But raw foods don't have HCAs nor PAHs. Indeed, more than 90% of our exposure to HCAs and PAHs comes from cooked food. HCAs are made when creatines and amino acids (both found in meats) react together with heat. At many places, people don't eat barbecue food because of the health risk involved.

However experts suggests that eating barbecue food once in a while will not cause any threat. It is more harmful for Children and pregnant women by barbecue smoke inhalation and exposure.



TANDOOR CORNER

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WHAT TANDOOR MEANS?

Tandoor is currently one of the most important menus in the Indian restaurants around the world. Tandoor cooking was brought to the country with the Persians who invaded India via Punjab. Even so, it is Indian cuisine that has coined the term 'tandoori food', even though the dishes are essentially an amalgamation of the cuisines of North India's invaders. The word Tandoor means a cylindrical oven used for baking and cooking. They can be large, permanent structures ensconced in a kitchen or outdoor area, or they can be smaller, portable ovens that can be carried from place to place.

TANDOOR COOKING TECHNIQUE:

The ovens are made of clay with some sort of insulating material like concrete or mud on the outside. They are cylindrical and often curve inward toward the top like a beehive or jug to concentrate the heat. A top opening left clear to allow access and ventilation. Traditionally the fuel used in Tandoor is charcoal or firewood. A fire is built in the bottom, which heats both the walls of the oven and the air inside to upwards of 900° Fahrenheit. Before cooking, the fire is allowed to die down to coals so that the temperature remains consistent while food is cooked. The radiant heat and convection cooking technique from the Tandoor, allowing the fat and juices from the cooked dish drip into the fuel, thereby are making it extremely delicious and adorably flavoured.

Today, modern tandoors run on gas or electricity and they range anywhere from top of the line, stainless steel and ceramic insulated ovens. Meats are usually cooked on long skewers that are either inserted directly into the oven or cooked over the mouth of the oven.

CHEMISTRY BEHIND TANDOORI CHICKEN AND ITS BENEFITS:

Tandoori Chicken is the most demanded item. There are many attributes to this popularity. First is, as everyone knows, the enchanting taste of this dish. Second is the growing knowledge of its health benefits. Preparation of tandoori chicken involves marinating the meat in yogurt and then seasoning it with the spice mixture. The colour, smell and taste of an item heavily depend on these ingredients. This procedure is believed to completely eliminate the action of harmful chemicals present in the meat.

The most important aspect of Tandoor is the cutting down of fats in the meat. The excess fats drip off while cooking. This helps to avoid the unhealthy substances entering our body and thereby making sure we eat fewer calories. When cooked in Tandoor, a major portion of the micronutrients and minerals are conserved, while most of them are lost in other cooking methods. Meat cooked over fire retains more riboflavin and thiamin. Both of these nutrients are very essential in a healthy diet because they play a very important role in body's metabolism. However, chicken is rich in selenium that helps in burning calories faster. Selenium improves the metabolic rate of the body. Tandoori Chicken also reduces the risk of Alzheimer's disease.

Grilled foods may be low in fat in calories, but the carcinogens present in them can increase the risk of cancer at the same time. Cooking in high temperatures, charring and exposure to smoke produces carcinogens such as heterocyclic amines and polycyclic aromatic hydrocarbons. The blackened areas of charred foods are sources of carcinogenic chemicals that have been shown to cause cancer. These chemicals directly damage the DNA and initiate mutations that can lead to cancer.

Cooking in charcoal can be dangerous if you are not using the right technique. Make sure that you are careful while cooking foods as the substances you use to ignite the charcoal, such as gasoline and other flammables, can result in burns. Using charcoal gas in a closed area can cause carbon monoxide poisoning, which can lead to death.

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“Cooking demands attention, patience, and above all, a respect for the gifts of the earth. It is a form of worship, a way of giving thanks.”

– Judith B. Jones

CHAPTER-J

THE JAMMY WORLD

A TEMPTING LOOK THROUGH

WORLD OF JAM

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WHAT IS JAM

Jams are made from crushed or ground fruit and usually have a thick consistency due to high pectin content. Jam processing is one of the most important methods of fruit preservation. Jam differs from Each other in the raw materials used, processing methods and additives. Commercially, Jams are prepared by concentrating the mix using thermal treatment at normal or reduced Pressure, which results in a thick or gelled consistency.

It also ensures destruction of fruit Enzymes, pectin from the fruit and concentrates the product to a point where its acidity and reduced water activity are self-preserving.

PREPARATION

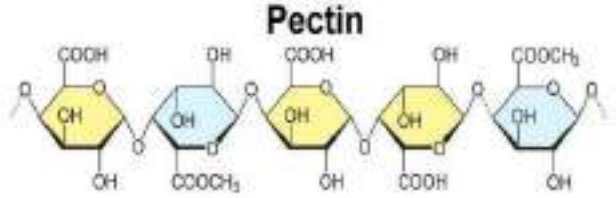
Operating conditions were determined from preliminary studies. The rehydrated fruit samples were blended using a laboratory blender, the ratio of water to that of crushed fruit was 18:34 g/g. Sugar (65%) was added to the crushed fruit (34.2%) followed by the addition of 0.4% citric acid and 0.4% pectin.

The resultant mixture was heated between 80 ℃ an100 ℃ until it set between 22 – 23 min. The jam samples were hot filled into sterilized jars, sealed, and rapidly cooled under running water to minimize thermal stress.

The products were stored under refrigeration condition for further analysis. Jam samples are also produced from fresh and dried non-dehydrated samples.

PRESERVATIVES

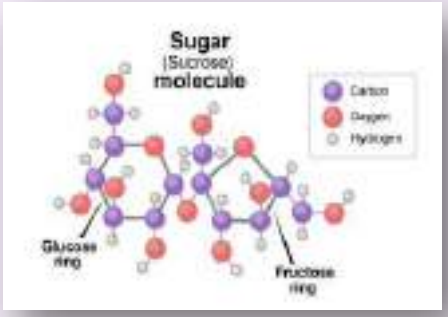
Pectin: Pectins are long, linked chains of sugar molecules, which are found naturally in plant cell walls. Pectins are found in fruits, particularly in the peels and cores. When jam sets, pectin plays a vital role, the long pectin chains can bind to each other via intermolecular interactions, forming a gel network.



This network generally forms at the 'setting point' of jam, which is approximately 104˚C. Once it has formed, the jam can be allowed to cool, and the gel network 'traps' the water content of the jam, leading to setting. The pectin content of different fruits varies

fruits such as apples and blackcurrants have higher levels of pectin than those such as strawberries and raspberries. In cases where a jam is being made from a low pectin fruit, either a higher pectin fruit must also be included, or commercial pectin must be added. Commercial pectin is obtained from the peel of citrus fruits, which have a naturally high pectin content.

Sugar: An important part of jam is, of course, the sugar content, which is vital for the flavour and plays a role in helping jam set. Many jam recipes recommend the use of a 1:1 ratio of fruit to sugar in jam-making. As well as sweetening the jam, the sugar also helps the pectin set – it enhances the pectin's gel-forming capability by drawing water to itself, decreasing the ability of the pectin to remain in separate chains. Additionally, sugar imparts a preservative effect.



Acids: Acids are also important in helping the pectin to set. The COOH groups in the pectin are usually ionised, and the negative charges on the molecules this ionisation causes can cause repulsion and prevent the pectin chains from being able to form the gel network.

To avoid this, we need the pH of the mixture to be roughly in the range of 2.8-3.3. At this more acidic pH's, the COOH groups are not ionised, lowering the magnitude of the repulsive forces. Fruits naturally contain acids – the most well-known is citric acid, but malic acid and tartaric acid are also found in several fruits. Whilst some acid will be contributed by the fruit from which the jam is made, often this won't be enough to reach the desired pH, and for this reason more must be added. The three factors of pectin, sugar and acid must be in perfect balance for jam to set. If it does not, you can often point to one of those three factors being somehow amiss and understanding the chemistry behind why jam sets in the first place can often help you identify how to fix it!

So this much about jam. Now let us move on to another member of this jammy world, the jelly in the next section.

WORLD OF JELLY

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WHAT IS JELLY

Jellies are clear substances since they are made of fruit juice or a water extract of fruit.

The description of an ideal jelly written in 1911 by ***Goldth Waite*** may be helpful in evaluating the quality of jelly. "Ideally fruit jelly is beautifully colored, transparent, palatable product obtained by treating fruit juice so that the resulting mass will quiver, not flow.

When removed from its mold, a product with texture so tender that it cuts easily with a spoon, yet so firm that the angles thus produced retain their shapes and a clear product is neither syrupy, gummy, sticky, nor tough; neither it is brittle and yet it will break and does this with a distinct, beautiful cleavage which leaves sparkling characteristics faces"

THE NAME

The word **jelly** comes from the French word gelée, meaning to congeal or gel.

INVENTION

Gelatin desserts are the desserts made with a sweetened and flavoured processed collagen product. This kind of dessert was **first** recorded as jelly by ***Hannah Glasse*** in her 18th century book, ***The Art of Cookery***.

PREPARATION

Fruit jellies are semisolid, preserved mixtures of fruit juice and sugar. Jelly making is a good way to preserve fruit flavours for enjoyment throughout the year. The most plausible steps are as following

1. *Selection of fruit* (deep color, mature, not over-ripe; often used whole fruits that have seeds in

them or skins, like grapes, cranberries, and raspberries)

2. *Washing*
3. *Cutting into slices*
4. *Boiling with water for extraction of juice* (1.5 times the weight of fruits for about 20-30minutes)
5. *Addition of Citric acid during boiling* (2g per kg of fruit)
6. *Straining of extract*
7. *Pectin Test* (Alcohol test, Jell meter test)
8. *Addition of sugar*
9. *Boiling*
10. *Judging of End point (*Sheet/Drop/Temperature test)

11. *Removal of scum or foam* (one teaspoonful edible oil added for 45kg sugar)
12. *Colour and remaining citric acid added*
13. *Filling hot into clean sterilized bottles*
14. *Capping*
15. *Storage at ambient temperature*

WHAT IS GELATIN

Gelatin is a protein obtained by boiling skin, tendons, ligaments and/or bones with water.
It is usually obtained from cows or pigs. It is used as a **thickener** for fruit gelatins and puddings.

CHEMISTRY WITHIN

The reaction that occurs is called ***hydrolysis***. This happens when the gelatin is mixed with another water-based liquid. This is a chemical reaction because once the compound's molecules are broken down, they cannot be put back together (In other words this is **irreversible**).

COMMON PRESERVATIVE

SODIUM BENZOATE

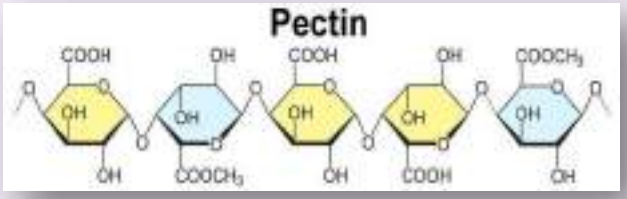
It is the most common preservative used in acid or acidified foods such as jellies, pickles, syrups, juices etc.

Benzoic acid is absorbed into the cell that decreases the intracellular pH. Hence the anaerobic fermentation of glucose through phosphofructokinase decreases. This inhibits survival of microorganisms that cause food spoilage.

PECTIN

It is a group of substances which forms gels when dissolved in water under suitable conditions. It is derived from the propectin found in the middle lamellae of plant cells.

Propectin is insoluble but is converted to soluble pectin as fruit ripens or is heated in acidic medium.



Pectin is negatively charged colloid in an acid fruit substrate. As sugar is added to the colloid, the pectin-water equilibrium breaks down and a fibrous network capable of supporting liquids is established.

The fibre network forms the **gel necessary for the setting of jellies**. Gel formation depends on the structure of Pectin as well as on the other factors, such as pectin and sugar concentrations, the presence of crosslinking agents, temperature, and pH.

SWEETNESS AND LOVE FOR JELLY

When we eat jelly taste buds got the signals and via Hypoglossal nerve, facial nerve, Mandibular nerve it reaches to Cerebral cortex of our brain.

Then we can realize the taste of the food, here jelly. When we can understand it tastes sweet and juicy and got the essence of the food, we all love to eat jelly as our regular dessert.

HEALTHY CHOICE

Gelatine is a protein product derived from Collagen. It has important health benefits due to its unique combination of amino acids.

Gelatine has been shown to play a role in joint health and brain function and may improve the appearance of skin and hair. So, a small part from the world of chemistry enters in our daily dessert list in this sweet way.

So this much about jelly. Now let us move on to another member of this jammy world, the preserve and conserve in the next section.

PRESERVE AND CONSERVE

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WHAT ARE PRESERVE AND CONSERVE

Unfamiliar with the names? That is alright but probably you have eaten them without realizing. Maybe you like the Mixed Fruit flavor of Jam.

Then let me tell you that is Conserve. Every Jam that consists of more than one fruit is called a Conserve. So basically, all Conserves are Jams, but all Jams are not Conserves.

Now let us talk about Preserves. The word explains it all. In Preserves, whole pieces of fruits are cooked and stored either in its own juices, syrup or even in water. In Christmas, we all like to eat fruit cakes, right?

Those fruit pieces come from these Fruit Preserves. But while we are learning about these two things, we should also have a look at their origin and history.

HISTORY

Preserving food is a process that even people from Paleolithic period were capable of. It used to make

their survival easier during the times of scarcity. Honey, which has no moisture in it, can easily preserve foods dipped in it.

Quince was the first fruit used in the Ancient Greece, that was mixed with Honey, dried somewhat, and packed tightly into jars. Romans improved the method by cooking the Quince and Honey together, producing the so-called Preserve. **This was the steppingstone to everything in the World of Jams**. So enough about boring history and now let us move on to the preparation part.

PREPARTION

Preparation of Preserve:

The steps are Fruit (not over-ripe) → Washing→ Cutting into thin slices→ Boiling with water→ Addition of Citric Acid during boiling→ Straining of extract→ Pectin Test (for addition of sugar) →then Addition of sugar→ Boiling→ Judging of end point (temperature test) → Filling hot into clean sterilized bottles→ Waxing→ Capping→ Storage at ambient temperature.

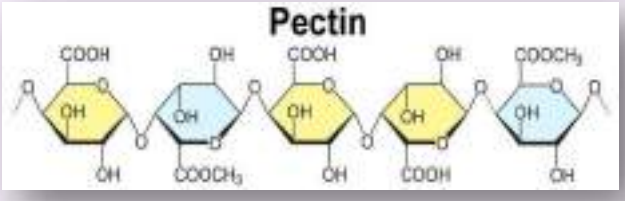
Preparation of Conserve:

Preparation of conserve is almost like that of the Jams; only difference is, in case of conserve more than one kind of fruit is used.

However, Chemistry somehow comes into the action in both the preparation processes. Let us know about that.

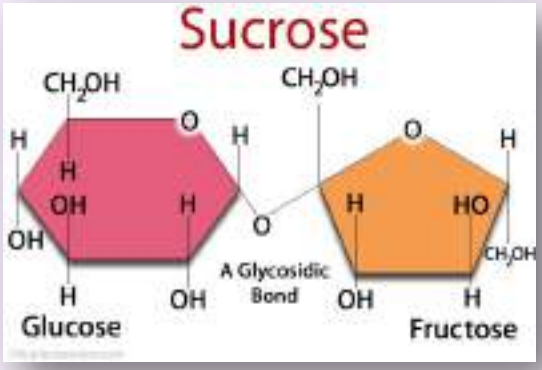
CHEMISTRY BEHIND

Have you ever wondered that why jams or jellies are gel like? Pectin, which is present in every fruit cover either in high or less amount, forms a gel network that



traps liquid as the product cools and help it set. Fruits with less pectin content have to be supplied with pectin externally.

Do you know how does Sugar also help in preparation of these products? Sugar boosts the gel-forming capability of these products by drawing water away from pectin. So, with higher level of Sugar, there is no



longer water available in the mixture to support microbial growth and thus it imparts a natural preservative effect. So at least 65-69% of Sugar content is required in the final product. Again, you see some time that the jelly did not set properly, this is often due to the lack of acidity. Though fruits provide some acid naturally, but often extra acids are needed to be added. Citric Acid & Tartaric Acid are commonly

used. A pH of 2.8-3.3 is needed to allow the gel to set properly.

So this much we can talk about Preserve and Conserve.

The World of Chemistry you know, is never a small one. Endless number of things are entangled somehow with Chemistry, and the kitchen world is only a small part of it, which makes the topic Preserve and Conserve even smaller. However, now we know that it still adds some value to our kitchen life, highlighting the most happening chemistry in cooking.

Now let us move on to other members of this jammy world, the compote and marmalade in the next section.

COMPOTE AND MARMALADE

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WHAT IS COMPOTE

It is a type of preserve, made with fresh or dried fruit, cooked low and slow in a sugar syrup so that the fruit pieces stay somewhat intact.

WHAT IS MARMALADE

It is simply the name for preserves made with citrus since it includes the citrus rinds as well as inner fruit and pulp.

PREPARATION

Marmalade is a fruit preserve made from the juice and peel of citrus fruits boiled with sugar and water. It is mainly made from bitter orange, but it is also made from sweet orange, grapefruits, lemons etc.

Compote is made from the fruits like apple, jackfruit, orange etc., sugar syrup and spices like cinnamon, clove, almonds etc.

HISTORY

Compote conformed to the medieval belief that fruit cooked in sugar syrup balanced the effects of humidity on the body. The name is derived from the Latin word *compositus*, meaning mixture. In late medieval England it was served at the beginning of the last course of a feast (or sometimes the second out of three courses), often accompanied by a creamy potage.

The word "marmalade" is borrowed from the Portuguese *marmelade*, from *marmelo* 'quince'. The Romans learned from the Greeks that quinces slowly cooked with honey would "set" when cool.

The Apicius, Rome's most extravagant gourmet chef gave a recipe for preserving whole quinces, stems and leaves attached, in a bath of honey diluted with defrutum—Roman marmalade. Preserves of quince and lemon appear—along with rose, apple, plum and pear.

CHEMISTRY BEHIND

Marmalade is a jelly type in nature. This is due to the presence of pectin. Citrus fruit contains 0.5%-3.5% pectin which is largely present in peel portion of the fruit. Pectin is a complex polysaccharide (carbohydrate) consisting mainly of methoxy esterified α, d-1, 4-galacturonic acid units. The average molecular weight of pectin is about 50,000-180,000 Da.

In case of Marmalade, sugar boosts the gel forming capability of these products by drawing water away and the heat i.e., use in the reaction helps to condense the pectin monomer to polymer.

In case of compote, the preparation process is similar very much, but compote does not contain the peel part of fruit where the pectin lies, that is why it is liquid in nature. Generally, compote is sweet in nature (use of sugar syrup) though it has a pH near 3.0-4.0 due to the presence of many types of acids like citric acid, maleic acid etc.

In conclusion, we can say that the world of chemistry is vast, and the cooking chemistry is just a representation of its beauty. In kitchen endless type of natural acids and chemical compounds come together to form a new taste with new fragrance. However, in today's date the safety and hygiene are big issues. Hence, we must add some values to our kitchen life, the most tempting and vibrant part of chemistry in our daily life.

So this much about compote and marmalade. Now let us move on to another member of this jammy world, the chutney in the next section.

CHUTNEY

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CHUTNEY

It is a family condiments or sauces in the cuisines of the Indian subcontinent. Chutneys may be realized in such forms as a tomato relish, a ground peanut garnish, yogurt or curd, cucumber, spicy coconut, spicy onion, garlic, ginger, mint dipping sauce.

DIFFERENT FORMS

Due to the vastness of India, the word "chutney" has different names in different places along with different taste and texture.

As for example, in Tamil Nadu, chutney is called "Thogayal" which is a pasty in texture, in Andhra Pradesh it is called "Roti Pacchadi" etc. Chutney have only two type of textures: -- thick pasty or jelly type nature and liquid type nature.

HISTORY

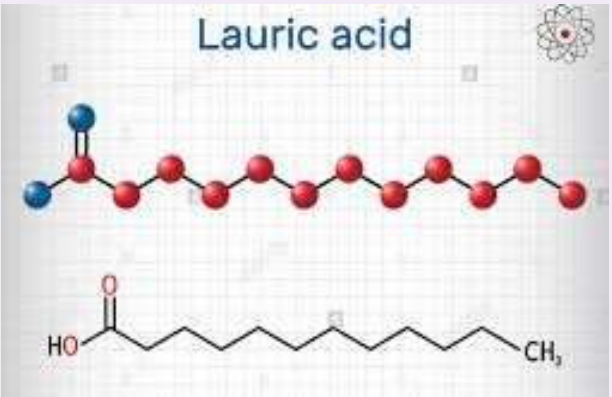
Chutney was first made at 500BC in India, in the form of pickle. Later British and Romans were adopted this way to preserve the food. During the British period in India, as greater imports of foreign and varied foods increased into Northern Europe, chutney feel out of favor in Britain.

PREPARATION

There are many types of chutneys available throughout the world. But the main steps are fruits (cut into pieces) > sugar > hot water > mixing. Indian pickles use mustard oil as a pickling agent, but Anglo-Indian style chutney uses malt or cider vinegar.

CHEMISTRY BEHIND

The most interesting thing is the texture and taste of a chutney. Do you know why some chutney is pasty in nature? chutneys like coconut chutney and many more have condensed type texture. This is due to the presence of acids with high molecular weight, sugar syrup and heat.



In the processing way of chutney, high heat causes condense in sugars and acids (like maleic acid, lauric acid, tartaric acid etc.) and form a product which has a high molecular weight and create pasty type nature. Along this some fruit chutney uses the peel of the fruit where the pectin i.e., the main gelatin compound lies which causes high pasty type nature. As for example, apple contains 1 to 1.5%, citrus peels contain 30% pectin. The liquid form of chutney contains high sugar and that is why it is not very condensed in nature.

HEALTH AND NUTRITION

Chutneys are very healthy and as well as very efficient way to preserve natural fruits. Chutney is not only satisfy our taste buds but along with it also act as a natural probiotics.

Mint chutney is one of the most healthiest chutney as it is help in our digestive system. However, the high oil and spices make the chutney primarily unhealthy.

At the end we can only say that the cooking chemistry a very small representation of the present chemistry world and it just show its beauty through taste, colour, fragrance. From making a food to digestion, the chemistry lies everywhere. And it suggest us that we have to add some value in our kitchen, the most sparkling and alluring part of chemistry in our daily life.

So this much about chutney. Now let us move on to another member of this jammy world, the Jell-O in the next section.

MAGIC OF JELL-O

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ABOUT JELL-O

Jell-O is a variety of gelatin desserts (fruit-flavored gels), puddings, and no-bake cream pies. The original Jell-O gelatin dessert (genericized as jell-o) is the signature of the brand. Jell-O is a registered trademark of Kraft Heinz and is based in Chicago, Illinois.

HOW OBTAINED

Jell-O is sold prepared (ready-to-eat), or in powder form, and is available in various colors and flavors. The powder contains powdered gelatin and flavorings, including sugar or artificial sweeteners. It is dissolved in hot water, then chilled and allowed to set. Fruit, vegetables, and whipped cream can be added to make elaborate snacks that can be molded into shapes. Jell-O is chilled in a refrigerator till it is set up.

HISTORY BEHIND

In 1964, the slogan "There's always room for Jell-O" was introduced, promoting the product as a "light dessert" that could easily be consumed even after a heavy meal.

However, throughout the 1960s through the 1980s, Jell-O's sales steadily decreased.

Many Jell-O dishes, such as desserts and Jell-O salads, became special occasion foods rather than everyday items. Marketers blamed this decline on decreasing family sizes, a "fast-paced" lifestyle and women's increasing employment.

By 1986, a market study concluded that mothers with young children rarely purchased Jell-O. To turn things around, Jell-O hired Dana Gioia to stop the decline. The marketing team revisited the Jell-O recipes published in past cookbooks and rediscovered Jigglers, although the original recipe did not use that name.

JIGGLER

They are typical Jell-O snacks molded into fun shapes and eaten as finger food.

Jell-O launched a massive marketing campaign, notably featuring Bill Cosby as spokesman. The campaign was a huge success, causing a significant market gain. Cosby became the company's pudding spokesperson in 1974 and continued as the voice of Jell-O for almost thirty years. Over his tenure as the mouthpiece for the company, he helped introduce new products such as frozen Jell-O Pops (in gelatin and pudding varieties), the new Sugar-Free Jell-O, which replaced D-Zerta in 1984 and was sweetened with NutraSweet; Jell-O Jigglers concentrated gummi snacks; and Sparkling Jell-O, a carbonated version of the dessert touted as the "Champagne of Jell-O." In 2010, Cosby returned as Jell-O spokesperson in an on-line web series called OBKB.

JELL-O SHOT

An alternative recipe calls for the addition of an alcoholic beverage to the mix, contributing approximately one third to one half of the liquid added after the gelatin has dissolved in a boil. A serving of the resulting mixture is called a "Jell-O shot", or the genericized "Jello shot", at parties.

The quantity and timing of the addition of the liquor are vital aspects; it is not possible to make Jell-O shots with liquor alone, as the colloidal proteins in dry gelatin consist of chains which require a hot liquid to denature them before they can then reform as a semisolid colloidal suspension. Pure alcohol cannot be heated sufficiently to break down these proteins, as it evaporates.

MANUFACTURIN AND TOURISM

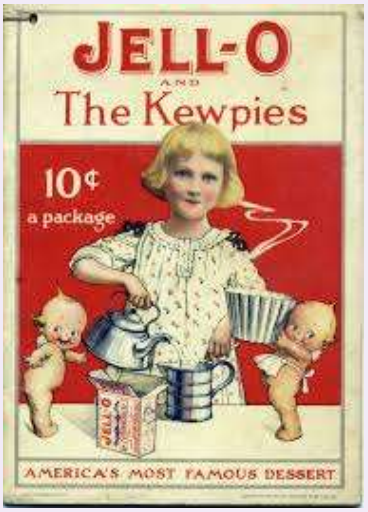
As of 2012, LeRoy, New York, is known as the home of Jell-O and has the only Jell-O Museum in the world, located on the main road through the small town. Jell-O was manufactured here until General Foods closed the plant in 1964 and relocated manufacturing to Dover, Delaware. The Jell-O Gallery museum is operated by the Le Roy Historical Society at the Le Roy House and Union Free School, listed on the National Register of Historic Places in 1997.

At the museum, visitors can learn about the history of the dessert from its inception.

The museum offers looks at starting materials for Jell-O, such as sturgeon bladder and calves' hooves, and various molds. The Jell-O plant in Mason City, Iowa, produces America's supply of ready-to-eat Jell-O gelatin dessert and pudding cups.

ADVERTISING

Jack Benny's top-rated radio show did not break for commercials. Instead, announcer Don Wilson incorporated speeches about Jell-O into the program at appropriate places, to Jack's feigned comic annoyance. Lucille Ball's My Favorite Husband, the radio predecessor to TV's I Love Lucy, was another popular program sponsored by Jell-O for much of its 124-episode run. Ball's character Liz Cooper often opened the program with the lively greeting "jell-o everybody!" So many people campaigned for this product.



FLAVOURS

The following are the flavors of Jell-O products that are currently being produced Apricot, Berry Blue, Black Cherry, Cherry, Cherry Lemonade, Cranberry, Fruit Punch, Grape, Lemon, Limea, Mango, Margaritab, Melon Fusion, Mixchief Grape, Color-Changing Mixchief Juice, Mixchief Soda Pop, Orangea, Peacha and so on.

FOOD VALUE AND NUTRITION

Gelatin is rich in protein and has a unique amino acid profile that gives it many potential health benefits.

There is evidence that gelatin may reduce joint and bone pain, increase brain function, and help reduce the signs of skin aging. So this much about Jell-O.

With this Jell-O story, let us end our journey in the Jammy World and see what is in store for us in the next section.

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CHAPTER-K

THE CHOCOLATE FACTORY

AN AMAZING JOURNEY

CHEMQUEST, VOL-1, ISSUE-2, 2020, PAGE-K1-K17

PRELUDE

Chocolate is the most popular sweet treat in the world. Eating chocolate not only makes us feel good, but it may also be good for our heart and brain. It is prepared from the fruit of the *Theobroma cacao*, a tropical tree whose name means "food of the gods" in Greek.

EVOLUTION

Chocolate's history goes back to at least 2,000 years and the word chocolate can be traced back to the Aztec word "xocoatl," the name for a bitter drink made from cacao beans. This was the way chocolate was consumed until the Spanish conquistadors came to Central America. When the Spanish arrived, sweetened chocolate came into existence.

Chocolate was traditionally a fashionable drink for rich Europeans throughout the 18th century. The Industrial Revolution allowed it finally to be mass-produced and brought the treat to the masses.

In 1815, Dutch physicist Coenraad Van Houten experimented with removing varied amounts of cocoa butter from chocolate liquor and this led to the creation of cocoa powder and soon solid chocolate.

In 1847, an England chocolate company, Fry's, created the first mass-produced chocolate bar when Joseph Fry added additional cocoa butter to Van Houten's chocolate, that turned it into a mouldable paste.

Milk chocolate was invented soon after with the help of Henri Nestlé, who created his own food company. Major European chocolate brands Lindt and Cadbury also got their start in the 1800s.

Mass chocolate consumption hit the United States in late 1800s when Hershey began selling chocolate-coated caramels and developed his own formula for milk chocolate introducing for the first time chocolate bars and other shapes, like Hershey's Kisses, in 1900.

In 1923, the Mars Co. developed their Milky Way bar by putting nougat inside and former Hershey employee H.B. Reese introduced Peanut Butter Cups, that later became a part of the Hershey brand.

MODERN TREND

With time chocolate concoctions from both small and large producers became increasingly innovative. Very recently, in September 2017, Swiss chocolate company Barry Callebaut has introduced ruby chocolate. Isolation of specific compounds of cocoa beans along with a modified processing technique, results in a rosy pink chocolate that has a sweet but sour berry taste and no traditional chocolate flavor.

With this background knowledge, let us now enter into the sweetest world of chocolates to explore it further in light of chemistry.

ABOUT CHOCOLATE

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WHAT IS CHOCOLATE

Chocolate is basically a semi-solid suspension of fine solid particles from sugar and cocoa (~70% total) in a continuous fat phase. This is rich in carbohydrates, an excellent source of quick energy, and also contains minute amounts of the stimulating alkaloids theobromine and caffeine.

The word "chocolate" comes from the Aztec word, "cacahuatl" or "xocolatl", which means "bitter water".

Chocolate is generally extracted from Cocoa Beans and has more than 500 flavour components, which is double the amount found in strawberry and vanilla. The annual consumption of cocoa beans averages around 600,000 tons per year.

ESSENTIAL INGREDIENTS

Chocolate contains three main stimulating and pleasure-producing compounds. Those are caffeine, cannabinoids and phenylethylamine.

Caffeine stimulates the central nervous system and triggers in the brain the release of the pleasure-producing chemicals dopamine and adenosine.

Cannabinoids are fatty acids that cause feelings of relaxation and intoxication when they strike certain receptors in the brain.

Phenylethylamine, or the love drug, releases the same chemicals introduced into the human body when someone is in love. The main ingredients of chocolate are:

- Chocolate Liquor
- Cocoa Butter
- Sugar/Agave Nectar
- Sea Salt
- Lecithin
- Vanilla or vanillin and other flavours

INDUSTRIAL PREPARATION

Cocoa beans are stored in silos or warehouses in their original sacks. Imported raw cocoa is subject to strict quality control.

Laboratory technicians ensure that the beans are healthy, perfectly fermented, and dried, and have suffered no damage during transport. Silos, measuring from 40 to 120 feet in height can store up to 1000 tons or more.

The raw cocoa is sucked up by powerful vacuums and fed into the silos. The storage area must be isolated from the rest of the building to protect the

sensitive beans from strong odours that might be absorbed.

PREPARATION STEPS

Cleaning: On arrival in factories, the cocoa beans contain not only dust and sand but often also large foreign bodies such as stones, wood, or jute fibres. These impurities must be removed fully before processing, partly to protect the processing machines and mainly to maintain quality.

Cleaning of Beans

In the cocoa pre-cleaning unit, the cocoa beans go through several sieving stages: a coarse sieve, a fine sieve, a strong flow of air (aspiration), a metal separator (magnet) and a vibratory sieve remove leaves, fibres, sand, stones, and metal from the cocoa beans. Now the cocoa beans have been cleaned of impurities.

Roasting and Winnowing: To bring out the characteristic chocolate aroma, the beans are roasted in large rotary cylinders. Depending upon the variety of the beans and the desired result, the roasting lasts from 30 minutes to 2 hours at temperatures of 250°F and higher. As the beans

Roasting of Beans

turn over and over, their moisture content drops, and their colour changes to a rich brown, and the characteristic aroma of chocolate becomes evident.

A winnowing machine removes the bean shells and leaves just the cacao nib.

Winnowing of Beans

The nibs are then cracked, ground, and liquefied into a cocoa liquor. Heavy-duty presses can further process and separate the liquor into either fat-rich cocoa butter or cocoa solids (that are ground to make cocoa powder).

Grinding of Beans

Blending: After the mixing process, the blend is further refined to bring the particle size of the added milk and sugar down to the desired fineness.

Blending of Chocolate

The Cocoa powder or 'mass' is blended back with the butter and liquor in varying quantities to make different types of chocolate or couverture.

Moulding of Chocolate

After blending, moulding is the final procedure for chocolate processing. This step allows cocoa liquor to cool and harden into different shapes depending on the mould.

Conching & Refining: The penultimate process is called conching. A conche is a container filled with metal beads, which act as grinders.

Conching of Chocolate

The refined and blended chocolate mass is kept in a liquid state by frictional heat. Chocolate before conching has an uneven and gritty texture. The length of the conching process determines the final smoothness and quality of the chocolate. High-quality chocolate is conched for about 72 hours, and lesser grades about four to six hours. After the process is complete, the chocolate mass is stored in tanks heated to about 45 to 50 °C until final processing.

Tempering: Cocoa butter comprises of several glycerides of fatty acids – which solidify at different temperatures.

Tempering of Chocolate

When the liquid chocolate is cooled, fatty acid crystals form nuclei around which the other fatty acids will crystallize – creating a single, stable form.

Cocoa Butter

Once that action has taken place, however, the temperature needs to be raised to prevent them from solidifying. The binding which takes place during tempering also makes the product resistant to developing chocolate bloom – the white film that can form on the surface.

Tempering is a highly controlled process which sees the temperature of the chocolate very gradually raised, gradually lowered, and gradually raised again to form exactly the right kind of crystals.

Chocolate Liquor

For tempering, chocolate manufacturers use a cooling tunnel that takes the chocolate from ambient air temperature down to 45-55°F and then gradually back up to ambient temperature again.

Packaging, Storage: Chocolates are packed to protect your chocolate from light, the elements, and insects.

Problems:

Fat bloom happens if the chocolate gets too warm. The cocoa butter melts and then re-solidifies, leaving those grey streaks.

Fat Bloom of Chocolate

Sugar bloom happens if the chocolate was stored in a damp area. Moisture collects on the surface of the chocolate and draws out the sugar. When the moisture evaporates, it leaves behind a grit of sugar crystals across the surface.

Sugar Bloom of Chocolate

Chocolate is generally stored away from other foods, as it can absorb different aromas. Ideally, chocolates are packed or wrapped, and placed in proper storage with the correct humidity and temperature. Additionally, chocolate is frequently stored in a dark place or protected from light by wrapping paper. The glossy shine, snap, aroma, texture, and taste of the chocolate can show the quality and if it was stored well.

Irrespective of our ages, we all love to eat chocolates, right? Let us now try to learn about different types of chocolates in the next section.

TYPES OF CHOCOLATE

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DIFFERENT TYPES

There are three main types of chocolate – dark chocolate, milk chocolate, and white chocolate. From the taste point of view, it is also three types – bitter, bittersweet, and semisweet.

Bitter Chocolate: Also called Baker's chocolate or unsweetened chocolate: these are *made from pure chocolate liquor* (100% cacao with no sugar added)

Bittersweet Chocolate: these are *sweetened dark chocolate with sugar and cocoa butter and ≥ 35% chocolate liquor* (70-100% cacao)

Semi-sweet Chocolate: these are *dark, sweetened chocolate made with ≥ 15% chocolate liquor*.
This different form of chocolate depends on the quantities of different ingredients present in it which is classified below.

DARK BLACK CHOCOLATE

This is the form of chocolate which contains carbohydrates, fats, proteins, and vitamins, *15-35% chocolate liquor with cocoa butter, vanilla, sugar, or other sweetener, and usually lecithin as an emulsifier*.

The cocoa content and several organic compounds (such as flavanols, catechins, polyphenols) present in dark chocolate contains antioxidants called flavonoids. Dark chocolate is the best source of antioxidants that damage the excessive amount of free radicals in the cells and tissues of the body and neutralize it.

The cocoa flavanols decreases the risk of heart attack, prevents blood clotting, and keep the platelets less sticky.

It protects our skin from UV rays coming from sun and increases the blood flow in our body that makes our skin healthier, glowing and wrinkle free. This is also known as plain chocolate, sour chocolate, and black chocolate. This chocolate is rich in several minerals such as zinc, magnesium, phosphorus, calcium, potassium, and iron.

MILK CHOCOLATE

Milk chocolates are made from dark chocolate of low cacao content, higher sugar content additionally contains milk products. Milk chocolate *contains ≥ 10% chocolate liquor and 12% whole milk* (usually in dried form). Bars of fine milk chocolate generally contain 30-45% cacao. The cheapest variety can have as little as 5% cacao.

WHITE CHOCOLATE

White chocolate has texture like milk and dark chocolate. It contains cocoa butter (≥ 20%), sugar lecithin (a fatty emulsifier) and milk solids but does not contain cocoa solids and *spices such as vanilla*. *It* has slightly yellow color that comes from cocoa butter.

It contains good amount of calcium which helps to protect the cardiovascular diseases. It also contains high amount of saturated fat which makes it unhealthy for our body. The regular dose of white chocolate increases the risk of heart disease and diabetes. It increases the cholesterol level and leads to weight gain. Technically, it is not considered as chocolate because it does not contain cocoa solids (chocolate solid) and even it does not have a taste like chocolate.

DIFFERENT CHEMICALS AND COMPONENTS

Chocolate production is a complex process during which numerous chemical reactions occur. Roasting of cocoa beans is one of the most important processes due to the occurrence of Maillard's reactions, during which aroma compounds are formed (Non-enzymatic reaction between amino acid and reducing sugar). This is the most important chemical reactions that occur with proteins, carbohydrates, lipids, and polyphenols. Other components that may be naturally present or form during the production process, such as methylxanthines, aldehydes, esters, ketones, pyrazines, acids, and alcohols.

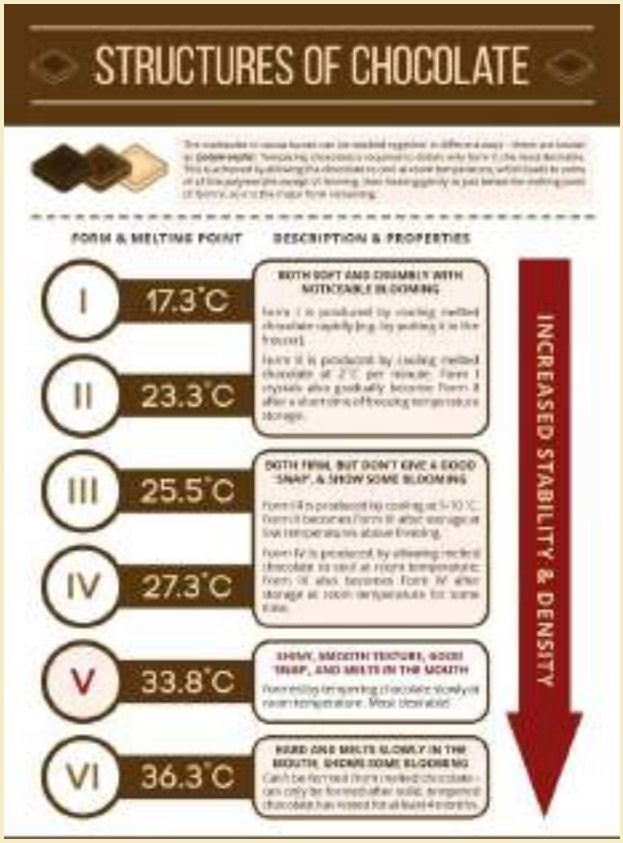
The chocolate production process as mentioned earlier consists of fermentation, drying, roasting, grinding of cocoa beans, mixing of all ingredients (cocoa mass, sugar, cocoa butter, emulsifiers, aroma, and milk components if needed), conching, and tempering. Major chemical reactions occur during fermentation, drying, roasting of cocoa beans, and conching of chocolate mass. These reactions are the most important for flavor and aroma development

Lipids

Cocoa beans contain 50–58% fats, 97–98% of which are triacylglycerols (TAG). These TAGs consist of 24.1–27.1% palmitic acid, 32.9–37.6% stearic acid, and 32.7–37.6% oleic acid, and low amounts of linoleic acid (2.3–3.7%). Fatty acid composition depends on origin, variety, growing season, and method of cultivation of cocoa beans. There are differences in cocoa butter considering origin and bean type. Softer cocoa butter has a higher content of 1-palmitoyl-2-3-dioleoyl-glycerol and 1-stearoyl-2-3-dioleoyl-glycerol, while harder cocoa butter has increased content of saturated fatty acids. Fats which are rich in symmetrical monounsaturated triglycerides, such as cocoa butter, show a high degree of polymorphism.

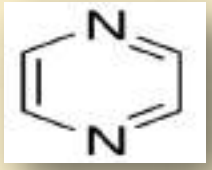
Regardless of the TAG composition, cocoa butter can exist in six Polymorphs, that have melting points of 17.3, 23.3, 25.5, 27.3,33.8, and 36.3, respectively, and can transform from one form to another, depending on temperature and time. The most desirable form in chocolate is (V) that melts at 29–31.5°C. This form is obtained by a properly conducted tempering process.

The polymorphs with different structural forms are given:

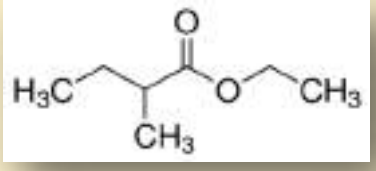


Pyrazines

They are Primary odor components. ~80% contributes to overall flavor. Mostly originate from α-aminoketones by Strecker degradation and Maillard reactions during roasting

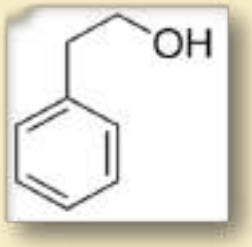


Esters



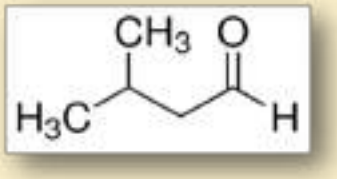
They are second most important odor components, arise from amino acids and due to fermentation. Long chain esters produce undesirable fatty and waxy flavors (e.g., Ethyl-2-methylbutanoate)

Alcohols



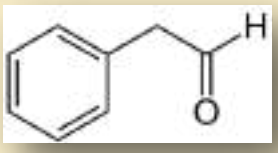
They arise during fermentation from microbial activity. May also result from heat degradation of amino acids. 2-phenylethanol is the most odor-active compound in dried and fermented cocoas.

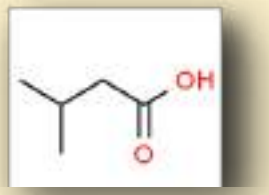
Aldehydes and Ketones



3-Methylbutanal

This is formed during fermentation**.** Aldehydes also arise from Strecker degradation of amino acids during roasting. Phenylacetaldehyde is needed for pyrazine formation from 2-3-Methylbutyric acid





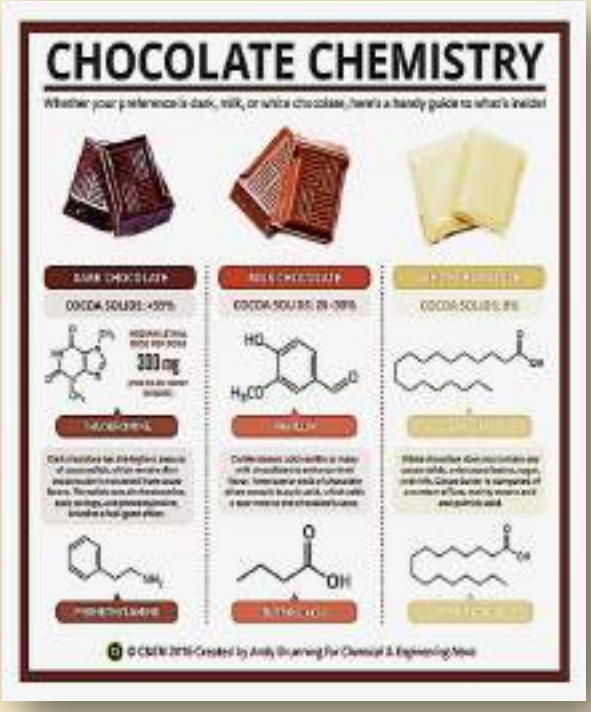
Acids

Acetic acid is the most odor-active compound. Short chain acids are mostly removed during processing leading to undesirable odors.

Others

Apart from the above-mentioned chemicals, chocolate contains more than 300-500 known chemicals in which some react with human brain and alter their moods. Chocolate includes chemicals like phenylethylamine, anandamide, theobromine, caffeine, serotonin, phenolics, xanthenes, histamine, thyphylline etc. It is also the rich source of saturated fatty acids that help to balance cholesterol in human body. The chocolate made from cocoa beans, having so many beneficial compounds leads to good health. It is also rich in antioxidant polyphenols. All the chemicals present in chocolates have a deep effect on human brain and physiological effect on human body.

DIFFERENCE AT A GLANCE



Now let us move on to the next section to learn about basic differences in the chemical compositions of the chocolates, that differentiate one chocolate form from another.

REASON FOR DIFFERENCE

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CHOCOLATE

All chocolates contain some level of cocoa, an ingredient that comes from the beans of the cocoa tree. Those beans are fermented, roasted, and ground to make chocolate.

DARK CHOCOLATE

Speciality: Dark chocolate is chocolate with no added milk solids. The basic ingredients are cacao beans, sugar, an emulsifier like soy lecithin to preserve texture, and flavourings such as vanilla. The more cocoa and less sugar dark chocolate has, the more bitter it will taste, and a small amount is considered as a healthful snack. The perfect flavour also makes it a preferred type of chocolate for baking and melting for a variety of desserts.

Varieties: Different types of dark chocolates are distinguished by the percentage of cocoa solids in the bar. They are classified as bittersweet, semi-sweet, and sweet dark chocolate. The cocoa content of commercial dark chocolate bars can range from 30 percent for sweet dark chocolate to 80 percent (or higher) for extremely dark, bitter bars. The names semi-sweet and bittersweet are sometimes interchanged in recipes. They range from 50 percent to 60 percent cocoa; the higher amount indicates more bitterness.

Uses: You can eat dark chocolate straight out of the package without preparation or use it in recipes. It can be chopped, ground, shaved, or melted and is preferred for ganache, glazes, mousse, and pudding. It can also be found in nearly any chocolate dessert you can imagine. Semi-sweet chocolate chips are the preferred form in chocolate chip cookies. Since dark chocolate does not contain milk, it is useful in vegan recipes as well.

Taste: In general, dark chocolate is bitter and less sweet than milk chocolate with a chalky texture. The more cocoa, the more pronounced these characteristics are, though even sweet dark chocolate is not as sweet or smooth as milk chocolate.

Nutrition and Benefits: The more cocoa in dark chocolate, the more nutritional value it has. High-quality dark chocolate with 70 percent to 85 percent cocoa is rich in fibre, copper, iron, magnesium, and manganese. However, a 100-gram bar does have about 600 calories, 43 grams of fat, and 24 grams of sugar, so it should still be eaten in moderation. Dark chocolate also contains powerful antioxidants that

can increase blood flow, reduce blood pressure, and heart disease risk, and it has anti-inflammatory properties

MILK CHOCOLATE

Like the name suggests, milk chocolate must contain milks (four percent milk fats and 12 percent milk solids) along with cocoa butter, chocolate liquor, vanilla and a stabilizing ingredient known as lecithin. This milk component can be in any of the form; milk powder, condensed milk, regular liquid milk, or any combination of those.

Varieties: Different types of milk chocolates are distinguished by the percentage of milk solids in the bar. It is the superior chocolate variety, no question. The chief flavour in it is sweetness, making it excellent both on its own and when paired with other foods. Sweet, smooth milk chocolate will always beat out dark.

Uses: You can eat milk chocolate straight out of the package without preparation or use it in recipes. It can also be chopped, ground, shaved, or melted and may be used for ganache, glazes, mousse, and pudding. It can also be found in nearly any chocolate dessert like cake, pastry, ice cream and all you can imagine.

Taste: Milk chocolate gets its mild, velvety taste from a delicate balance of ingredients. While milk chocolate and dark chocolate both use cocoa liquor, cocoa butter and **sugar**, milk chocolate also uses milk powder to give it a creamier taste, **texture**, and lighter colour.

Nutrition and Benefits: This is rich in calcium the main mineral present in our bones. This also contains smaller amounts of zinc, selenium, iodine, magnesium, and vitamins A, B1, B6, B12 and rich in protein and phosphorus, as well as often fortified with vitamin D all of which are additional nutrients important for building and maintaining strong bones and teeth. Thanks to the fact that it is made with milk, it contains significantly more calcium than the darker stuff. Our bodies rely on calcium to maintain strong bones and to sustain the healthy function of our hearts, muscles, and nerves.

WHITE CHOCOLATE

The term “white chocolate” is a misnomer, and most interesting fact is that it is technically not a real chocolate. While it contains many of the same ingredients as milk chocolate; milks, sugar, lecithin, and cocoa butter; it contains no chocolate solids (cocoa powder) or the primary non-fat constituent of conventional chocolate liquor chocolate in its raw, unsweetened form. During manufacturing, the dark-coloured solids of the cocoa bean are separated from its fatty content, as with milk chocolate and dark chocolate, but, unlike with other

forms of chocolate, no cocoa mass is added here. Cocoa butter is the only cocoa ingredient that is used in white chocolate. This form of chocolate contains only trace amounts of the popular stimulants theobromine and caffeine that are usually found in the cocoa mass but not in the butter. Flavourings such as vanilla may be added to

white chocolate confectionery and can be coloured in any preferred colour.

Varieties: Different types of white chocolates are there from different countries with different ingredients. distinguished by the percentage of cocoa solids in the bar. They are classified as bittersweet, semi-sweet, and sweet dark chocolate.

Some of them are Felchlin Mont Blanc Couverture from Switzerland that is mildly sweet with a fresh milkiness, well-suited to truffles and confections, France's Valrhona Ivoire having a deep, elegant richness that comes through best in puddings, ganache, and frostings, Askinosie Davao White Chocolate, a single-origin bar made with goat's milk powder, offering layers of earthy, nutty, and floral flavours, the straight forward dairy smoothness of Lindt Classic Recipes White Chocolate making it ideal for folding into cookies, brownies, or ice cream and so on.

Uses: You can eat dark chocolate straight out of the package without preparation or use it in recipes. It can be chopped, ground, shaved, or melted and is preferred for ganache, glazes, mousse, and pudding. It can also be found in nearly any chocolate dessert you can imagine. Semi-sweet chocolate chips are the preferred form in chocolate chip cookies. Since dark chocolate does not contain milk, it is useful in vegan recipes as well.

Taste: While tasting white chocolates from both large producers and craft chocolatiers, we encounter a surprising spectrum of flavours, from grassy to fruity to salt edged. Cocoa butter percentages generally varied from 29 to 55 percent, but we generally prefer the moderate creaminess of those composed of just over one-third cocoa butter.

Nutrition and Benefits: White chocolate is made up of milk solids, cocoa butter, and sugar. It is the presence of pure cocoa butter that makes your white chocolate bar a healthy one. Pure cocoa butter is rich in antioxidants, which are favourable for your body. Also, the milk contents in the chocolate make it rich in calcium, which is beneficial for the bones in your body.

The benefits of white chocolate show up when it is consumed in moderation. It is wisely said that excess as well as dearth of anything is not good. When you eat white chocolate within specified limits, it has the following health benefits:

Boosting Immunity – As the white chocolate contains cocoa butter, a rich source of antioxidants, it helps to eliminate toxic substance from your body. It also improves the flexibility in the movement of white blood cells and thus helps to reduce artery clogging. The good bacteria present in white chocolate helps to fight against the bad bacteria in case of sepsis.

Lowering Cholesterol – Consuming white chocolate in limited quantities can help regulate the fat in your body, which in turn can reduce levels of the bad cholesterol. This can lead to having a healthy heart and lower the risk of coronary heart disease.

Improving Liver Health – Studies have shown that white chocolate has the properties to improve liver health by increasing the blood flow in your body. It also helps in enhancing the recovery of ruptured tissues.

Elevating Blood Sugar Levels – The presence of sugar in white chocolate makes it beneficial for people suffering from hypoglycaemia, deficiency of glucose in the bloodstream.

Toning-down Hypertension and Breathing Problems – White chocolates contain linoleic acid, which helps to curb hypertension and methylxanthine, which is useful in relaxing the respiratory muscles.

Besides the benefits mentioned above, white chocolate is also helpful during headaches, sleeplessness, breast cancer, arthritis, dementia etc.

The only caution that you must observe is the quantity of white chocolate that you consume in one go and that it should not be eaten frequently. It is recommended that you have 1-ounce piece of white chocolate at a time and enjoy its delicious taste.

DIFFERENTIAL NUTRITION CONTENT

White chocolate often contains more calories than dark and milk chocolates. One tablespoon of Hershey's dark chocolate chips contains 70 calories, while the same portion of Hershey's milk chocolate chips provides 70 calories and Hershey's white chocolate chips contain 80 calories per tablespoon.

Nutrition Information	
	Per 100g
Energy	2120kj/505kcal
Fat	26.8g
(of which saturates)	13.7g
Carbohydrates	62.6g
(of which sugars)	25.7g
Fibre	3.7g
Protein	5.5g
Salt	1.2g

HEALTHIEST CHOICE

All three of these different types of chocolate provide about 1 gram of protein, 8 to 9 grams of sugar and about 4.5 grams of fat – much of which is saturated fat. Milk chocolate and white chocolate provide small amounts of calcium, while dark chocolate generally offers more health benefits than milk chocolate or white chocolate.

A review published in 2011 in Antioxidants and Redox Signaling found that because cocoa in chocolate (especially dark chocolate) is rich in antioxidants, it provides cardiovascular benefits by reducing inflammation, protecting the skin from oxidative damage, and helping to improve cognitive function and mood. It may also reduce the risk for diabetes and increase satiety. Another study published in 2013 in the European Review for Medical and Pharmacological Sciences found that eating dark chocolate containing 70 percent cocoa is associated with increases in good high-density lipoprotein cholesterol and reductions in waist circumferences in women.

But irrespective of the nutrition values, we all crave for chocolates, right? Let us try to explore the reason behind this extreme craving for chocolates in details in the next section.

CHOCOLATE CRAVINGS

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WHY DO WE CRAVE FOR CHOCOLATE?

Cravings can be defined as an intense desire for a thing somewhat equivalent to 'Addiction'. And we all crave for chocolates, right?

There are so many chemical compounds in chocolates, which brings cravings for them. Among all of them ***Xanthines*** are mostly responsible for such cravings.

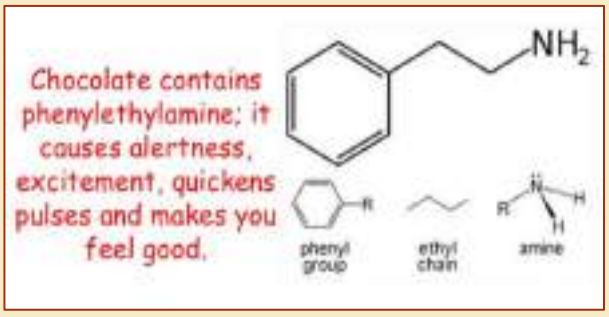
Chocolate craving probably stems from flavor, texture, aroma, appearance, taste, and psychology more than due to some specific chemical compounds. Let us discuss about them one by one.

PHENYLETHYLAMINE ($C_8H_{11}N$):

This is a chemical which stimulates the pleasure centers, and which release when we fall in love. And guess what? chocolate consists of highest amount of PEA. So, do not get crazy if you feel lovey-dovey after eating chocolate. Phenylethylaminse is considered as *"Love drug"* by the popular media which makes chocolate a "Sex substitute" of all time.

- It is related to amphetamines which also releases dopamine.
- It is derived from phenylalanine in body or by microbes.
- Typically, in a 100gm chocolate bar, only 50-100 mg PEA is present.
- It is quickly metabolized by monoamine oxidase B.

So, do not get too excited!! most of the PEA derived from chocolate is metabolized before reaching to our central nervous system, making it unlikely to have any significant aphrodisiac effects on the brain.



THEOBROMINE ($C_7H_8N_4O_2$):

Theobromine is one of the most interesting compounds in chocolate and it also has mild stimulant properties. It has no bromine in this compound. Theobromine, the name is derived from Theobroma, where *"Theo"* means *"God"* and *"Broma"* means "Food", Food of God, and suffix *"ine"* for its alkaloid property.

- Theobromine consumption results mood booster in the form of greater relaxation and a more positive affect.
- But this significant behavioral changes not seen below 560 mg theobromine in most people
- 100 g milk chocolate contains nearly 150 mg theobromine while 100 g very dark chocolate contains *less than 440 mg*.

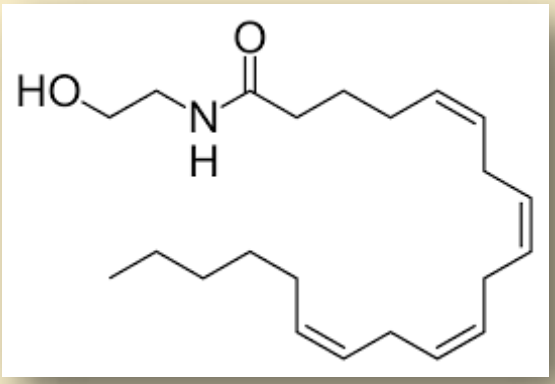
CAFFEINE ($C_8H_{10}N_4O_2$):

- The word came from French word Café which means coffee.
- Caffeine is a *Central Nervous System (CNS)* stimulant of the *methylxanthine* alkaloid.

- Caffeine acts as an adenosine-receptor antagonist, which dilates blood vessels to ensure good oxygenation during sleep.
- As it binds with adenosine which is also causes pituitary gland to
- It increases dopamine production in brain's pleasure circuits which increases feelings of well-being.
- Up to *400 mg of caffeine a day appears to be safe for most healthy adults*. 100mg milk chocolate contains nearly 20 mg caffeine and 100 mg dark chocolate contains nearly 43 mg caffeine.

ANADAMIDE ($C_{22}H_{37}NO_2$):

- Anandamide, this word is come from *Sanskrit* word *"Ananda"*, which means *joy, delight,* and *"Amide"*.
- It is a fatty acid and a neurotransmitter derived from arachidonic acid. It is also known as *"N-arachidonoylethanolamine"* (AEA).
- It is an endogenous cannabinoid, which plays role in regulation of appetite and food intake, involve in reward processes that mediate incentive or hedonic value for food.

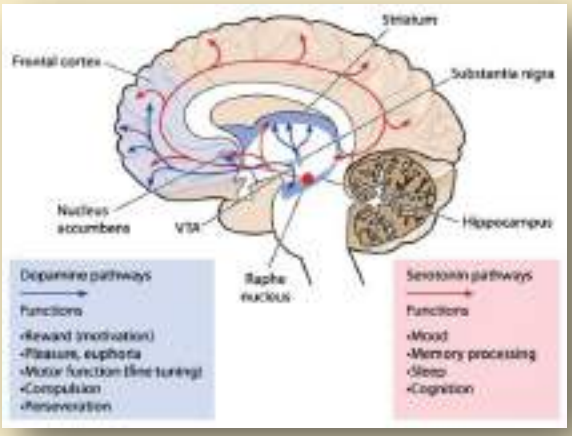


ANADAMIDE

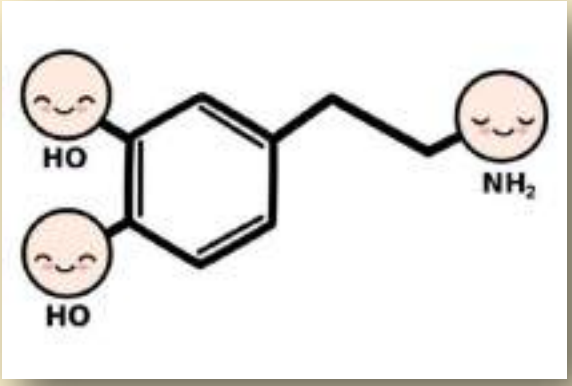
- Anandamide specially amplifies hedonic impact of sweetness (prototypical sensory pleasure). That is why, chocolate is so sweet in taste.
- It also contributes to feeling of well-being. But it rapidly broken down by fatty acid amide hydrolase.
- *100 gm* cocoa bean contains 50 µg anandamide. So, *greater than 30 kg chocolate consumption comparable to 1 dose of cannabis*.

DOPAMINE ($C_8H_{11}NO_2$):

- Dopamine is a type of neurotransmitter that helps to control the *brain's reward* and *pleasure centers*.
- Chocolate contains a key compound called *tyramine*, which is derived from the amino acid tyrosine. Tyrosine is the amino acid precursor to dopamine.



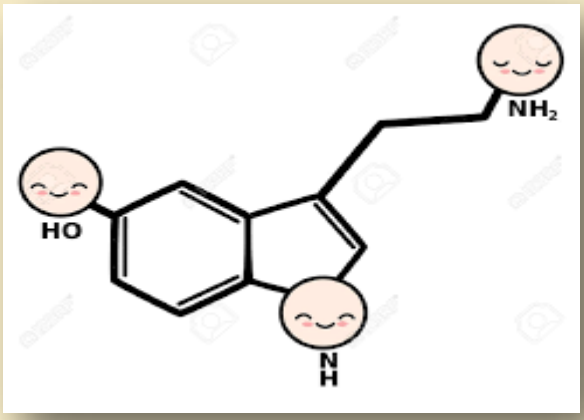
- Dopamine contributes to our mood regulation. This influences the way we behave in the sense that we keep going back to the thing that makes us feel good.
- Compounds that act on receptors in the brain that release the so-called pleasure-generating neurotransmitter like dopamine work in two ways: ***(i)*** They bind to the receptor, causing it to release the neurotransmitters. ***(ii)*** Or they bind to the site to prevent the re-absorption of those neurotransmitters.



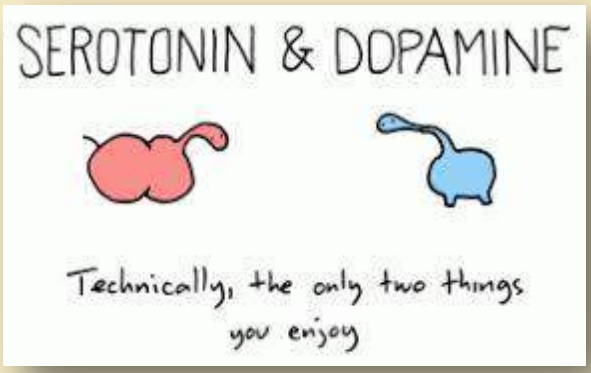
DOPAMINE

SEROTONIN ($C_{10}H_{12}N_2O$):

- Serotonin is a chemical that nerve cells produce to *communicate in the brain*. Chocolate is linked to the neurotransmitter serotonin through a key compound that can be isolated from chocolate bar itself



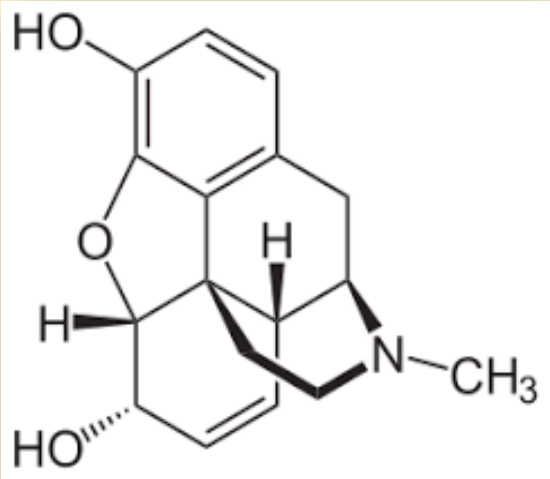
Tryptophan is another amino acid found in small quantities in chocolate and is also the precursor for serotonin. Because chocolate contains tryptophan, the resulting increase in serotonin can help explain why one might feel happier, calmer, or less anxious after eating a piece of chocolate cake. Serotonin is known as a "natural mood stabilizer" because it helps reduce depression and regulate anxiety.



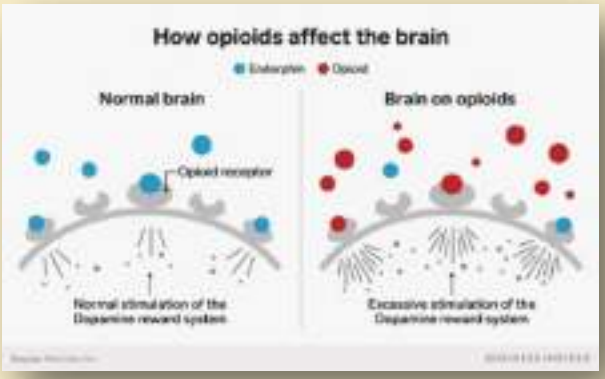
OPIOIDS ($C_{55}H_{70}N_4O_7$):

- The natural brain chemical *"Enkephalin"* is heightened when chocolate is consumed. This enkephalin triggers opioid receptors like those triggered by heroin and morphine use.

- This chemical leads the brain to desire more after chocolate is initially consumed, which can lead to addiction.



- Intake of sweet food increased by *opiate agonists* and decreased by *opiate antagonists*.
- Opioids can stimulate immediate release of *beta-endorphin* in hypothalamus, **which produces *analgesic effect***



CONCLUSION:

Chocolate has all the ingredients needed to make it a wonder drug. After all, it contains compounds like those found in ecstasy, morphine, and marijuana. By all rights, eating a bar of chocolate send you into orbit.

So, the question arises, why isn't this stuff regulated by FDA? Why are not chocolate bars sold from locket cabinets behind the pharmacy counter?

The truth is, while there are indeed pleasure-inducing and stimulating chemical compounds found in chocolate, the amounts of most of these compounds are relatively small. And there are other reasons too. As a result of the regular energy drinks, coffee, cigarettes and, yes, chocolate humans consume these days, our brains have become quite accustomed to the effects of those drugs that release pleasure-inducing chemicals. So however effective it is, can not be used as drugs in case of emergencies.

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CHAPTER-L

FOAMING DESSERTS

A MAGICAL WONDERLAND

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PRELUDE

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INTRODUCTION

In cuisine, foam is a gelling or stabilizing agent in which air is suspended. Foams have been present in many forms over the history of cooking, such as whipped cream, meringue, and mousse. In these cases, the incorporation of air or another gas creates a lighter texture and a different mouth feel. Foams add flavour without significant substance, and thus allow cooks to integrate new flavours without changing the physical composition of a dish.

Cream

More recently, foams have become a part of molecular gastronomy technique. In these cases, natural flavours (such as fruit juices, infusions of aromatic herbs, etc.) are mixed with a neutrally flavoured gelling or stabilizing agent such as, agar or lecithin, and either whipped with a hand-held immersion blender or extruded through a whipped cream canister equipped with nitrous oxide cartridges. Some famous food-foams are foamed espresso, foamed mushroom, foamed beet and foamed coconut. An espuma or thermo whip is commonly used to make these foams through the making of a stock, creating a gel, and extruding through the nitrous oxide canister.

Meringue

ICULINARY FOAM CREATION

To form a stable foam and emulsion, a surfactant, such as lecithin, monoglycerides or proteins, must be present to reduce the interfacial tension between the air-oil phase and the aqueous phase.

Culinary Foam

If the surfactants are at equal concentrations at the interface, proteins are generally less effective than small surfactants, such as lecithin or monoglycerides, at decreasing the interfacial tension. Of course, this is not true of heated soybean or whey protein, which readily forms copious foam.

Foams consist of two phases, an aqueous phase, and a gaseous phase. Foams have been used in many forms in the history of cooking, for example, whipped cream, ice cream, cakes, meringue, mousse, and marshmallow. It has a unique light texture because of the tiny air bubbles and/or a different mouth feel.

Ice cream

Marshmallow

In most of these products, proteins are the main surface-active agents that help in the formation and stabilization of the dispersed gas phase. To create a protein-stabilized foam, it usually involves bubbling, whipping, or shaking a protein solution and its foaming properties refers to its capacity to form a thin tenacious film at the gas-liquid interface for large amounts of gas bubbles to become incorporated and stabilized.
When protein concentrations are increased to their maximum value, the foaming powers and foam formation are generally increased. Often to compare foaming properties of various proteins, the foaming

Foaming Cake

power at a specific protein concentration is determined. A protein will always have certain stresses that it must overcome, such as gravitational and mechanical; it is the protein's ability to stabilize foam against these stresses that determines the foam's stability. The foam's stability is usually expressed as the time required for 50% of the liquid to drain from foam (a 50% reduction in foam volume
Foams are one of the techniques most associated with modernist cooking. They are easy to make, very versatile, and fun to use and eat. Foams have been around traditional cooking for a very long time and include whipped cream, head on beers, and even bread dough.

Malaiyo

At the most basic level, foams are a structure that traps air in bubbles. Foams are similar in this way to an emulsion, which is when a liquid traps fat in a structure, or fat traps liquids in a structure. The structure can be made from a variety of things such as, proteins, water, or fat. The texture of the foam is determined by the size of the bubbles and how much liquid is in the foam.

HISTORY

The first use of culinary foams dates to the 1700's when both sweet and savoury souffles were created. The name souffle literally translates to "puffed up", which is a description of the dish and the soft matter which is neither flowing nor completely solid. The use of foams evolved to meringues and eventually the cream that is put in many gourmet beverages today. Culinary foams are often created with usual flavours taken from stock, fruit juices, vegetable purees and even soups. These are combined with stabilizing agents to prevent breakdown later. Stabilizers range from natural plant and animal derivatives. Examples of commonly used stabilizers are agar-agar and lecithin. Depending on what is being made, fats and egg whites may also be used.

Air is then introduced into these through a mechanical force in the form of whipping. Foams made with the use of a handheld immersion blender results in a delicate froth like that found in cappuccino. On the other hand, those made with the use of a special cream whipper called a siphon results in spumes or air, which is dense foam comparable to mousse. In the same way that traditional foams can be made either sweet or savoury, so can modern cuisine foams. They can also be served in a range of temperatures from cold to hot.

Like many other molecular gastronomy techniques foam serves a number of purposes that all point to giving its audience a better dining experience. Flavour is one of the most important functions that foam carries in the kitchen. It allows cooks to incorporate various tastes into dishes being cooked without changing physical makeup. Foam can simply be added on top of a completed dish and it will deliver the desired flavour.

PRESENTATION WITH FOAMS

Without any doubt, culinary foams also play a large role in the way a dish looks when it is served. Long before the advent of modern cooking, foams had already served to make dishes look much more appetizing.

With the use of new approaches and equipment in creating these airy substances, the options for creating enticing dishes are widened.

CREATIVITY WITH FOAMS

One of the things that can make dining more enjoyable is the experience of new things. Foams make it possible for diners to feel different textures in their mouth. This is especially true when it is combined with other foods that present other textures. It also allows for the use of unorthodox cooking methods such as the formation of sauces and even warm foams.

PRESERVATION WITH FOAMS

On a more industrial level, the production of foams with the use of a siphon makes it possible to store these substances longer. Modern cuisine foams have an extended shelf life and are not susceptible to absorbing smell and taste from other foods due to storage option.

This means, better tasting and fresher dishes will be served to diners. For a foam to last more than a few seconds, it needs to be stabilized.

There are many ways to stabilize a foam, often by thickening or gelling the liquid. For best foaming action be sure to pick liquids that are thin and watery and do not contain many particles. If you want to make foam from a thicker sauce, you can try watering, it down until it becomes thinner.

THICKENED LIQUID FOAMS

One of the simplest ways to create a foam is to combine a liquid with a thickening ingredient, such as, xanthan gum. Then you introduce air into it, usually through whipping, blending, or using a whipping siphon. This usually results in a course, wet foam that is on the lighter side. Xanthan gum is usually added in a 0.2% to 0.8% ratio, depending on the density of foam desired.

Foams have been used in many forms of cooking, as for example, whipped cream, ice cream, cakes, meringue, mousse, and marshmallow. These are explained in detail in the next sections of this chapter.

CREAM

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INTRODUCTION

Nowadays CREAM is an extremely popular food item all over the world. Basically, cream is a dairy product composed of higher-butter fat layer skimmed from the top of the milk before homogenization. Its' colour is slightly yellow type & it is too concentrated than milk.

WHAT IS CREAM

The fatty part in non-homogenized milk that floats on the above part of milk is generally known as cream. With its smooth velvety feel, it enhances taste of coffee, pie, soup & many more food items. Cream usually prepared in factory, but it can be prepared at home also. A good balanced cream (based on fat percentage) has too many needed vitamins & nutrition's for human body and hence cream is treated as a good food item.

CREAM MANUFACTURING PROCESS

For preparation of cream in factory five main steps are following:

Skimming & Centrifugation: Here in this step, at first, the fat globules part of milk is separated. The process of skimming of milk is done in a centrifugal cream separator.

Fat Standardization: In the second step, fat standardization is done to obtain the needed fat content.

Homogenization: Next, homogenization is done to prevent the creaming phenomenon during storage. This step also helps to increase the cream viscosity.

Heat Treatment: In this step, heating is done to inactivate microbial lipases and this treatment helps to destroy pathogenic germs without damaging the cream's organoleptic qualities.

Seeding & Maturation: The pasteurized cream is now matured with acidifying, aromatic or even thickening mesophilic lactic bacteria. This step gives more taste to the cream and provides protection against lactic acid and bacteriocin production.

DIFFERENT TYPES OF CREAM

There are several types of cream available in the market depending on the percentage of milk fat. Some well-known creams with there with % of milk fat is in the following chart.

Name of cream	% of milk fat contains
Clotted cream	At least 55%
Whipping cream	30% to 36%
Heavy cream	More than 36%
Light cream	18% to 30%
Sour cream	At least 18% milk fat

Beside these, there are some other cream also available in the market, namely, double cream, heavy cream, butter etc.

USE OF CREAM

Nowadays, cream is used largely in food industry. For its smoothness, soft texture and flavor cream is used in many food items. Cream is used in chocolate manufacturing, bakery, pastry, biscuit manufacturing etc. Cream is also used in cooking like in making soup and in many other dishes.

CONCLUSION

Using of cream in many food items is extremely useful, not only for taste & texture of food but also it is good for human body. A good balanced cream contains fat soluble vitamins like vitamin A, D, E, & K, which is very essential. Beside this, cream contains some minerals also. On the other hand, some saturated fat present in cream is not good for human body. Consumption of such cream may increase cholesterol which is not good for human body. So this much about cream. Let us move on to the most important part, Ice-Cream.

HISTORY OF ICE CREAM

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INTRODUCTION

Ice cream is a sweetened frozen food typically eaten as a snack or dessert. It may be made from dairy milk or cream and is flavoured with a sweetener, either sugar or an alternative, and any spice, such as cocoa or vanilla. The mixture of component cooled below the freezing point of water to prevent detectable icecrystals from forming. Ice cream is formed at extremely low temperatures (below 2 °C or 35 °F).

It becomes more malleable as its temperature increases. Ice cream is a mixture of milk, cream, sugar, and sometimes other ingredients that has been frozen into a soft, creamy delight using special techniques.

HISTORY

Origin of Frozen Dessert: A kind of ice-cream discovered in China about 2nd century BC. Those time ice creams were prepared by milk and rice mixture was frozen by packing it into snow. Roman emperors sent their slaves to mountain tops to bring back fresh snow which was then flavoured and served as an early form of ice-cream. In 1500 -1600 CE Marco polo published recipe of ice cream during his trip to china and introduced them to Italy. On May 12, 1777 first advertise was published by New York city.

Ice cream sundaes invented when it was illegal to sell ice cream sodas during the late 19th century.

AMERICA: Ice cream comes in the New World from a letter written in 1744 by Governor William Bladen. President Thomas Jefferson was said to a favourite 18-step recipe for an ice cream delicacy that resembled a modern-day Baked Alaska. In 1813, Dolley Madison discovered strawberry ice cream. In 1874, the American soda fountain shop invents the ice cream soda. Ice cream became an edible morale symbol during 2nd World War.

In 1945, first "floating ice cream parlour" was built for sailors in the western Pacific.

EUROPE

The first recipe of ice cream in French for flavoured ices appears in 1674, recipes for flavoured ices was produced les Confitures, les Liqueurs, et les Fruits, starting with the 1692 edition. Ice cream recipes fast appear in eighteenth century in England.

SOUTH ASIA

In the 16th century, the relays of horsemen to bring ice from the Hindu Kush to Delhi, where it used as fruit sorbets. Kulfiis a famous frozen dairy dessert from the Indian subcontinent and is described as "traditional South Asian ice cream."

COMPOSITION

Ice cream must contain 10 to 16 percent milk fat. Ice creams that contain less than 10% milkfat are referred to as "ice milk" or more popularly, "low fat" ice cream. In addition to milk or cream, ice cream often contains stabilizers, like gluten, to help keep the mixture a consistent texture.

MAIN INGREDIENTS

Milkfat: >10% - 16%
Milk solids-not-fat (snf): 9% - 12%
Sucrose: 10% - 14%
Corn syrup solids: 4% - 5%
Stabilizers: 0% - 0.4%
Emulsifiers: 0% - 0.25%
Water: 55% - 64%

CONCLUSION

There are so many kinds of ice cream. The cheap ice cream contained the highest overall fat content and highest overall air content. On the other hand, ice cream containing a high amount of air can be bad. The medium ice cream came in the middle in both the fat and air test. In addition, the medium ice cream contains emulsifiers; monoglycerides and diglycerides. The lower priced ice cream contains glucose and fructose syrup.

So this much about history of Ice-creams. Let us now move on to the variety of such Ice-Creams that are so popular all over the world depending on the additives.

VARIETY OF ICE CREAM

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INTRODUCTION

Ice cream derived from the word 'iced cream' or 'cream ice'. It is a sweetened frozen food eaten as a dessert. Ice cream is a mixture of milk, cream, sugar, and sometime other ingredients that have been frozen into soft, creamy using special techniques. A few ice cream variations including frozen custard, frozen yogurt and even ingredients like coconut milk.

COMPOSITION

Ice cream must contain 16% milk fat. Higher milk fat ice cream has a smoother texture because they contain a lower amount of water and few ice crystals. Sugar substitutes are usually added to provide the sweet flavor that most people expect.

CLASSIC VARIETIES

Depending on the recipe, ingredients, colour, flavour, consistency etc, there are so many popular varieties of ice creams available. Some most popular among them will be discussed here.

VANILLA ICE CREAM

For a vanilla flavor, few drops of vanilla essence is required to fold along with condensed milk.

CHOCOLATE ICE CREAM

For a chocolate flavor and colour, cocoa powder or drinking chocolate is required to fold along with condensed milk.

BUTTER SCOTCH ICE CREAM

For butter scotch variety, half cup of crushed praline or butter scotch chips is required in the ice cream.

DRY FRUIT ICE CREAM

For this about half cup of chopped dry fruits must be added to fold with condensed milk.

OTHER FLAVOUR VARIETIES

There are countless numbers of ice cream flavours. Considering the popularity of the ice creams amongst the people, the makers are constantly coming up with new flavours.

Along with the traditional vanilla ice cream, chocolate ice cream, mango ice cream, etc. there are now many different other flavours available.

Some of them are: Raspberry, Coffee, Caramel, Sea Salt, Bubble Gum, Cookies and Cream, Mint with Chocolate Chip, Strawberry, Lemon Sorbet, Peppermint etc.

Kulfi Ice Creams are also a good option in ice cream flavours which is made using all the Indian ingredients.

VARIETIES BY SHAPE

There are significant numbers of ice cream shapes available. They are Ice cream **cones, sticks, cakes, buckets, floats, and sundae** and so on.

Sundae is the most popular and famous ice cream dessert available. It is the combination of ice creams along with different toppings and syrups that enhances the taste of this amazing dessert. In general, the ice cream sundae is made by adding some scoops of ice cream in a tall glass.

Later the different flavour of ingredients, toppings, and syrups are added on the ice cream scoops. The entire combination results in the outcome that has the potential to make every heart tempt for it.You can try with experimenting with different flavours of syrups, ingredients, ice creams and toppings to get a new sundae every time.

VARIETIES OF CONES

There are different types of cones available for the cone ice creams. They are **cake cone, pretzel cone, sugar cone and waffle cone**.

PRODUCTION

Before the development modern refrigeration, ice cream was made by hand by large bowl placed inside as 'pot freezer method'. The temperature of ingredients is reduced by mixture of crushed ice and salt. The salt water is cooled by the ice.

In Europe and early America, ice cream was made by small business mostly confectioners. Maryland was the first to manufacture ice cream on a large scale.

COMPOSITION & CHEMISTRY

Ice cream must be a least 10% milk fat and 180 grams of aqueous solid per liter, where cocoa chocolate syrup, fruit, nuts, or confectionaries are added.

The ice cream mix is defined as pasteurized mix of cream, milk and it may contain eggs cocoa or chocolate syrup, a sequestering agent which preserves the food color, edible casein that does not exceed 1% of the mix, propylene glycol in an amount that will not exceed 0.35% of ice cream mix.

CONCLUSION

So, we conclude this part about different ice creams. The cheap ice creams contain the highest overall fat content and highest overall air content of the four ice creams.

Furthermore, in the melt test, it came second which suggest that it contain preservatives rather than natural ingredients which slow down the rate of which the ice cream melts.

Also, the lower priced ice creams contain glucose and fructose syrup and galactose as a substitute for lactose, a natural bi product of milk. So only good quality ice creams should be consumed. So, this much about popular varieties of Ice-cream. Let us now move on to another variety of foaming dessert, Meringue in the next section.

MERINGUE

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INTRODUCTION

Meringue is a type of desert often associated with European (Swiss, France etc.) cuisines. It is traditionally made from whipped egg whites and sugar, and sometimes an acidic ingredient such as lemon, vinegar, or cream tartar. Binding agent such as salt or gelatin is also added. There are three types of meringue Italian meringue, French meringue, and Swiss meringue.

DESCRIPTION

Protein distribution in egg white

1. 54% ovalbumin
2. 13% conalbumin
3. 11% ovamucoid
4. 4% ova globulin
5. 3.5% lysozyme
6. 2% ovamucin

Ova globulin drive foaming and ovamucin is the main stabilizing agent.

MAKING OF FOAM

The key to the formation of good meringue is the formation of stabilized foam by denaturing the globular protein egg via mechanical shear. Making

of foam by trapping air bubbles in water can be achieved by some surprisingly simple chemistry. It relies on presence of molecules with part that are attracted to water (hydrophilic) and parts that are repelled by water (hydrophobic). This will from foam because the hydrophilic parts will bring water, but the hydrophobic parts will bind either with each other or to any air bubble.

STABILIZATION OF FOAM

In meringue the foam is stabilized by exploding the properties of globular protein (ovamucin) in egg white. Protein are made up of side chain which may be either hydrophilic or hydrophobic. Ordinarily sits in such a shape or “conformation”, that the hydrophilic residue point outwards, interacting favorably with water in egg white, whereas hydrophobic residue points inwards, interacting only

with each other. However, by heating and warming the egg white the protein becomes “denatured”, changing their conformation, so that hydrophobic residues are exposed, and the formation of intermolecular protein-protein interaction is promoted. These protein-protein interactions, usually disulfide bridges create network responsible for the structure of foam and this change in structure leads to stiff consistency required for meringues. Thus, the tiny pockets often introduce by whisking, are trapped by hydrophobic residues which do not interact favorably with water, so the meringues expand and forms stable foam.

USE OF CREAM OF TARTAR

The addition of cream of tartar also known as potassium hydrogen tartrate ($KC_4H_5O_6$) is added to the egg white as it is helpful in denaturation process. Cream of tartar is an acid that is used to stabilize and coagulate proteins, which further enhance the strength of protein network to trap air for foam formation.

Cream of tartar being an acid has also low pH which brings the protein near their isoelectric point to allow them to departure easily.

Cream of tartar also acts as a catalyst which inverts the sugar during baking process, as a result the sugar molecules split up into glucose and fructose. This prevents the sugar from recrystallizing and giving the meringue a gritty, undesirable texture.

ROLE OF SUGAR IN MERINGUE

The last thing to consider on this subject is the role of sugar in meringue. Other than improving flavor, sugar have many hydrophilic hydroxyls (-OH) groups and so interact preferentially with water in the foam.

This will lighten the protein network, allowing the foam to be stronger and more elastic. When sugar is added to the egg-white, the mixture on beating yields a pliable foam and increases the stability of that foam retarding the coagulation process.

Strengthening of foam and formation of meringue:

After a strong protein network has formed complete foam, the meringue is ready to bake. Adding heat to the mixture is the final step to strengthen the foam structure. The meringue must be baked at a low temperature for a long period of time. This allows the protein to finish coagulating, strengthening the meringue evenly throughout. The protein should be baked evenly otherwise the bottom of the meringue will not be able to support the structural weight, causing the meringue to collapse.

The heat results in expanding of air bubbles, creating an airier structure. Evaporation of water causes the meringue to become lighter with a stronger foam structure. It is important to not evaporate all the water out of the meringue as it makes the meringue more stable by holding the foam together.

SHELF LIFE

Meringue being hydroscopic in nature has a short shelf life of about two weeks. Meringue contains high concentration of sugar so more moisture is absorbed from air which makes the meringue soft and chewy.

As more water is absorb, the meringue will become too heavy for the foam structure to support itself, and it will start to collapse. It is advisable to not make meringue in rainy day as it may disrupt the foam structure formation. To extend the shelf life of meringue to about three months, the meringue can be stored in colder temperature like freezer or in an airtight container.

NUTRITIONAL CONTENT

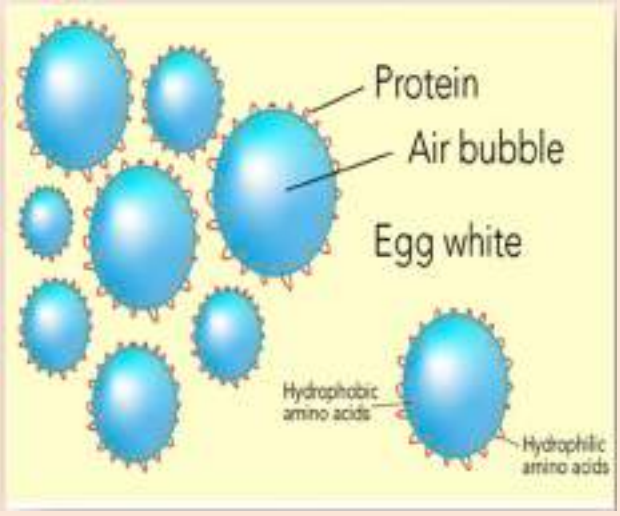
Meringue consists of protein from egg white and simple carbohydrate from the refined sugar. So due to the presence of sugar, it is not considered as a low-calorie food.

USES OF MERINGUE

Meringue is extensively used in making or decorating desserts and can be also eaten as biscuits when it is baked at an extremely low heat for a long time. Meringue can be used for embellishment.

INTERACTION BETWEEN EGG PROTEIN AND AIR BUBBLE

Hydrophilic and Hydrophobic end of protein:



So this much about meringue. Let us now move on to anothervariety of foaming dessert, Marshmallow in the next section.

MARSHMALLOW

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INTRODUCTION

Marshmallow is a type of confectionery that is typically made from sugar, water and gelatine whipped to a solid but soft consistency. It is used as a filling in baking, or commonly melded into shapes and coated with corn starch. It is the modern version of a medicinal confection made from Althaea officinalis, the marshmallow plant.

HISTORY

The word "marshmallow" comes from the mallow plant species (Althaea officinalis), an herb native to parts of Europe, North Africa, and Asia which grows in marshes and other damp areas.

The plant's stem and leaves are fleshy, and its white flower has five petals. It is not known exactly when marshmallows were invented, but their history goes back as early as 2000 BC.

Ancient Egyptians were said to be the first to make them and eating them was a privilege strictly reserved for gods and for royalty, who used the root of the plant to soothe coughs and sore throats, and to heal wounds. The first marshmallows were prepared by boiling pieces of root pulp with honey until thick.

Once thickened, the mixture was strained, cooled, and then used as intended.

By the early 1900s, thanks to the starch mogul system, marshmallows were introduced to the United States and available for mass consumption. They were sold in tins as penny candy and were soon used in a variety of food recipes like banana fluff, lime mallow sponge, and tutti Frutti. In 1956, Alex Dou-mak patented the extrusion process which involved running marshmallow ingredients through tubes.

The tubes created a long rope of marshmallow mixture and were then set out to cool. The ingredients are then cut into equal pieces and packaged.

Modern marshmallow manufacturing is highly automated and has been since the early 1950s when the extrusion process was first developed.

Numerus improvements and advancements allow to produce thousands of pounds of marshmallow a day. Today, the marshmallow typically consists of four ingredients: sugar, water, air, and a whipping agent (usually a protein). The type of sugar and whipping agent varies depending on desired characteristics. Each ingredient plays a specific role in the final product.

INGREDIENTS

Marshmallows consist of four ingredients: sugar, water, air, and a whipping agent/aerator (usually a protein). The type of sugar and whipping agent varies depending on desired characteristics. Each brand of marshmallow has its own specific formula for how to produce the perfect marshmallow. No matter how they are made, each ingredient plays a specific role in the final product.

The marshmallow is foam, consisting of an aqueous continuous phase and a gaseous dispersed phase (in other words, a liquid with gas bubbles spread throughout). In addition to being foam, this also makes marshmallows an aerated confection because it is made up of 50% air. The goal of an aerated confection like a marshmallow is to incorporate gas into a sugar mixture and stabilize the aerated product before the gas can escape. When the gas is introduced into the system, tiny air bubbles are created. This is what contributes to the unique textural properties and mouthfeel of this product.

ADDITIONAL INGREDIENTS

FLAVOURS: Unless a variation of the standard marshmallow is being made, vanilla is always used as the flavouring. The vanilla can either be added in extract form, or by infusing the vanilla beans in the sugar syrup during cooking. This is the best technique to get an even distribution of flavour throughout the marshmallow.

ACIDS: Acids, such as cream of tartar or lemon juice, may also be used to increase foam stability. Addition of acid decreases the pH. This reduces the charge on the protein molecules and brings them closer to their isoelectric point. This results in a stronger, more stable inter-facial film. When added to egg whites, acid prevents excessive aggregation at the interface. However, acid delays foam formation. It may therefore be added toward the end of the whipping process after stable foam has been created.

CONCLUSION

The traditional marshmallow recipe uses powdered marshmallow root, but most commercially manufactured marshmallows instead use gelatine in manufacture. Vegans and vegetarians avoid gelatine, but there are versions which use a substitute non-animal gelling agent such as agar. In addition, marshmallows are generally not considered to be kosher or halal unless either their gelatine is derived from kosher or halal animals or they are vegan, Marshmallow creme and other less firm marshmallow products generally contain little or no gelatine, which mainly serves to allow the familiar marshmallow confection to retain its shape. They generally use egg whites instead.

Non-gelatine, egg-containing versions of this product may be consumed by vegetarians. Several brands of vegetarian and vegan marshmallows and marshmallow fluff exist.

So this much about Marshmallow. Let us now move on to the next section and explore about Malaiyo.

MALAIYO

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INTRODUCTION

'Malaiyo' or 'Mallaiyo' is one of the hidden gems that is prepared only in Benaras (Varanasi) during winter season (from mid-November to first week of March). It is known as 'Makkhanmalai' in Lucknow and 'Nimish' in Kanpur and Lakhimpur etc. Every region has their own minor variations in flavours, but it is essentially a winter specialty and if you see it being served or sold in warmer seasons you be assured it is made of trans fats. The Delhi version is called 'Daulat ki chaat' which is white in colour and quite pale in comparison to the taste of Banarasi malaiyyo.

Most of the food enthusiast sees Banaras as the city of Paan, Lassi, Chat and Sweets.

But in narrow lanes of old Benaras, you get one of the most exclusive and exquisite, sweet, which is being served by few vendors since ages.

Malaiyo or Mallaiyois basically flavoured milk foam/froth or cloud served in a small earthen bowl, garnished with Pistachios and Almonds. But let us tell you, it will blow your mind with its out-of-this-world texture.

The light-yellow beauty of this winter sweet is in the texture of the froth or foam that just collapse or melt in your mouth giving your taste buds a nice treat. The texture of foam is not like of a whipped cream, it is very delicate, cloudy, and frothy.

For the best and the authentic Malaiyo, one must visit Chaukhamba in Varanasi. It is a place you can reach by travelling inside the Gali, you'll start seeing vendors selling Malaiyo, you can try any one of them, but for the best you've to go more inside and find Shri Gopal Mandir (Temple). Go to a shop and ask for a cup of Malaiyo.

You will never forget the delicate, melt in mouth foamy texture of Malaiyo topped with nuts. Just dig into it and forget everything. Once your cup is empty, the vendor will serve you the milk settled at the base to savour, and it is rich with Saffron, Sugar and Cardamom.

Malaiyyo is 'saffron flavoured milk'. The foam can stand only in low temperature during winters and that is why it is being sold till 11 am in the morning. It is made by churning whole milk early in the morning during winter months by the shopkeepers in the old part of the city who are galas (keepers of cows) and produce and sell milk products including yogurt, khoya, butter and ghee depending on seasons.

When saffron flavoured milk is churned slowly (manually) it results in the fats separating into a froth that is collected in a large kadhai (a utensil they use for many purposes through the year).

Later this frothy cream is sprinkled with finely sliced nuts and saffron to garnish. If you ask for the malaiyowala doodh and they bring a bucket full of Malaiyowala doodh within a couple of minutes, this proves the Malaiyo is made using whole milk and not using trans-fat-based icing/whipped cream. But to be honest, if the Malaiyo had a little 'dalda' or transfat added. As you could feel the fat sticking to your upper palate. A Trans-fat containing malaiyo will look a bit fluffier and stiffer the whole day while the real 100% milk fat malaiyo would be like soft peaks falling and collapsing easily.

CONCLUSION

Malaiyo is made of Sugar mainly. Sugar was especially appealing because it was quickly metabolised and absorbed yet it provided "empty"
calories lacking in minerals and vitamins.

Instinctively, humans show preference for sweet flavours because they are considered as a source of energy, avoiding those that are bitter and sour as they are related to toxicity and danger. From a simple point of view, physiologically the body is no more than a chemical processing unit that runs on water, oxygen, and sugar. The food we eat is eventually reduced into glucose, a simple sugar. This chemical reaction takes less effort if we supply sugar itself to the body, whether in the form of lactose, fructose, or sucrose, for instance.

So this much about 'Malaiyo'. And with this, let us end the chapter of Foaming Desserts. Let us now move on to the next section and explore about a totally different perspective of the huge culinary world.

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CHAPTER-M

SPICY TWIST

A TANGY EXPERIENCE

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PICKLE

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INTRODUCTION

Pickling is one of the oldest and most successful methods of food preservation known to humans. It is difficult to suggest a date for production of the first pickle, but it is known that both vinegar and spices were being used during biblical time. Pickles of various kinds are known throughout India and many parts of the World. They are good appetizer and add to the palatability of the meal. Pickles from India or 'Achaar' are unique because these are mixed with spices that only India produces. Pickles are aromatic and spicy food accessory which simulate the sense of test and act as an appetizer.

HISTORY

Pickling began nearly 4000 years ago using cucumbers native to India. It is called 'Achaar' in North India. This was used topreserve food for out of season use and for long time.

CHEMISTRY IN PICKLE

BRINE SOLUTION: Brine is a high-concentration solution of Salt (NaCl) in water (H_2O). When you dip the vegetables in salty Brine, the water inside the vegetables flows out into the Brine, making the Pickles crunchier. This salty Brine solution has a lower water concentration than the water inside fresh vegetables, so water will flow out of the vegetables. This process is known as Osmosis.

VINEGAR: Vinegar is used in all sorts of food preservation methods. It has a few key properties that make it ideal at slowing or stopping food from spoiling for long periods. It is primarily the pH or acidity of the vinegar that inhibits bacteria growth, and this process is most calledPickling.

It is important to keep the pH below 4.6 because microbial growth is greatly inhibited below a pH of 4.6, which ensures that the pickled product is self-stable and not prone to microbial spoilage.

MERITES AND DEMERITS

Pickle has many health benefits like- improving digestive health, providing Vitamin-C, helps to maintain the blood sugar level and improves liver health. But it has some bad effect too. One of it is its high Sodium content which increases risk of Stomach Cancer. It contains antioxidants and vital minerals. Helps in pregnancy, builds immunity, prevents ulcers, and helps in muscle cramps.

So, this is much about pickles. Let us now move on to the next portion i.e., dip and spread.

DIP & SPREAD

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DIP & SPREAD

They are basically same, only dips having higher consistency than spreads. Dip or dipping sauce is a common condiment for many types of food. Dips are used to add flavor or texture to a food. Dips in various forms are eaten all over the world and people have been using these sauces for dipping for thousands of years.

Dips are most often prepared with a mixture of ingredients that complement other foods including raw vegetables, chips, crackers, or toast, which are dipped into the mixture; hence the name, *dip*.

A base for a dip can be prepared with sour cream, softened cheese, mayonnaise, or mashed vegetables with herbs, spices, and other ingredients added to the base to provide flavor, color, and texture.

POPULAR TYPES & PREPARATION

Cheese Dip
A type of appetizer that consists of melted cheese often combined with other ingredients. There are a wide variety of flavoured cheese dips such as Avocado, Bacon, Blue Cheese, Cheddar, Cream Cheese, Chili, Nacho, or Seafood cheese dips.

Nachos Cheese
Melted cheese garnished with sliced chile peppers that is traditionally served with tortilla chips.

There are many variations of this dish with other ingredients added into the cheese, such as salsa or ground meat. One commonly available variation is Salsa Con Queso, which is cheese with salsa ready to be heated and served with chips.

Queso (Queso Dip)
A Spanish word meaning "cheese." In the United States, the word is commonly used as a name for a Mexican cheese dip as well as varieties of Mexican cheese.

Guacamole
A Mexican dish consisting of mashed avocados and a small amount of lemon or lime juice. It is used as a side dish, dip, or topping. Occasionally, other ingredients are added such as finely chopped tomato, onion, garlic, or cilantro.

Corn Relish
Made primarily from a base of sweet corn and seasonings, this condiment is a common addition to many grilled foods.

Corn relish is produced as a mild or spicy product that consists of corn, peppers, onions, sugar, vinegar, and various spices combined to create a savoury dressing or topping for foods.

Sweet Pepper Spread or Dip
A food spread that is made from roasted sweet peppers, which can use any variety of sweet pepper as the base for the spread. The red pepper is most often used since it provides a mildly sweet and delicate flavour to the spread.

Fonduta
An Italian term for a thick sauce or appetizer dips typically to be used for fondue-like dipping. A fonduta will most often be made with melted cheese (Fontina or Camembert) combined with other ingredients, such as milk or cream, eggs, possibly wine, herbs, and seasonings.

Tzatziki Sauce or Dip
A creamy Greek garlic sauce often served as a topping, a condiment, or a food dip that is commonly prepared with numerous Mediterranean foods.

Tzatziki is a white sauce made with yogurt, cream, cucumbers, fresh herbs and seasonings, such as mint, dill, olive oil, and garlic.

Taramasalata
A Greek appetizer that is a dip for crackers or other similar foods. The dip consists of carp roe combined with milk, breadcrumbs, and olive oil.

Hummus

A popular Middle Eastern dish consisting of chickpeas that have been mashed, olive oil, garlic, and lemon juice.

Mouhammara
An appetizer dip or spread that is common for use with Lebanese foods. Made from a mixture of walnuts, red sweet peppers, breadcrumbs, olive oil, and pomegranate juice.

Baba Ghanoush
A Middle Eastern food consisting of roasted eggplant, olive oil, garlic, lemon juice, and tahini all blended to be served as a savoury spread.

Tahini
A rich creamy paste made from sesame seeds and sesame oil. It is remarkably like peanut butter (except thinner in consistency) and can be made by grinding sesame seeds with light sesame or vegetable oil, a little warm water, and salt.

Muhammara
A traditional Mediterranean condiment that was originally created in southeast Turkey. It is made as a pepper puree combining red bell peppers, hot peppers such as habanero, toasted walnuts, garlic, olive oil, cumin seeds, vinegar, pomegranate molasses, and water.

Salsa
The Spanish term for "sauce," salsa can be a mixture of fruits or a mixture of vegetables, or both that are whole and chopped, which are used to complement the flavour of a variety of foods. The mixture can be fresh or cooked with a spicy flavour that can range from mild to extremely hot tasting, depending on the spices added.

Fruit salsas may include balsamic vinegar, and any of several fruits such as cantaloupe, grapes, kiwi, mango, papaya, pineapple, orange, banana, and cilantro. A typical mixture for vegetable salsas that are red in colour may include tomatoes, green, red or yellow sweet peppers, onions, chile peppers, garlic, and other seasonings, such as cilantro. The green (Verde) vegetable salsas commonly use tomatillos, cilantro, and sweet onions as a mixture for the relish.

Picante Sauce or Dip
A tomato-based Mexican sauce made up of tomatoes, chile peppers, and onions. It is a sauce that is terribly like salsa, except thinner and smoother in consistency, not as chunky. Picante is available as a red or green (Verde) sauce, either of which can be mild to extremely hot depending on the spices added.

COMMON INGREDIENTS

Cream Cheese, Sour Cream, Mayonnaise, Beans, Vegetables, meat, fish

HISTORY

French Onion as a flavor emerged in the 17th century. Sour cream was invented in the U.S. between 1815 – 1825. Somewhere around there, the first dip as we know it must have come into being. No one has laid claim to that distinction, but if we were around then, we surely would have! Many cuisine-related sources claim that **hummus** is one of the oldest known prepared foods in the Middle East. Some say it was made in the 18th-century Damascus while others claimed that it was first prepared in the 12th century by Saladin. Hummus is a dip made from chickpeas and is mixed with garlic, vinegar, and sometimes lemon juice. The Egyptians ate chickpeas, so maybe even Moses ate “dip”!

Chips and dip gained significant popularity in the United States during the 1950s, in part due to a Lipton advertising campaign for their French onion dip recipe, sometimes referred to as "California dip". Specialized trays and serving dishes designed to hold both chips and dip were created during this time. Chips and dip are frequently served during the Super Bowl American football game in the United States. National Chip and Dip Day occurs annually in the U.S. on March 23.

CHEMISTRY BEHIND

Several authors have investigated the antimicrobial action of common herbs and spices, many of which are key components of common dip or salsa preparations. Common ingredients including garlic, cilantro, onion, and jalapeño are reported to possess antimicrobial properties. These plants produce the secondary metabolites allicin, linalool, thiopropanal-s-oxide, and capsaicin, respectively. The use of spices and herbs in traditional ethnic foods essentially borrows the plant’s defensive

mechanism and allows humans to benefit from these metabolites. In fact, Sherman and Billing

have suggested that herb and spice use in

traditional recipes follow certain trends, namely that as mean annual temperature increases so does the number of spices used in traditional recipes, as

well as the strength of antimicrobial activity in the spices used.

Conversely, cooler climates tend to use fewer spices per recipe, and those additives have decreased antimicrobial activity. In salsa, it is hypothesized that a combination of aromatic secondary compounds from the vegetables and herbs and the naturally low pH help salsa to remain unspoiled for long periods, even without refrigeration.

Tomato, onion, garlic, cilantro, and jalapeño were tested for antimicrobial properties against a representative fungus, *Saccharomyces cerevisiae*, and the common food spoilage bacteria *Staphylococcus aureus*, *Bacillus cereus*, and *Escherichia coli*. Garlic demonstrated the greatest inhibitory effects against all organisms tested.

Onion demonstrated a slight inhibition of all four organisms, while cilantro showed some

inhibition of all three bacteria but no effect against the fungus. Jalapeño may have slightly inhibited *E. coli* and *S. aureus*, as evidenced

HEALTH AND NUTRITION

Dips are very healthy and as well as very efficient way to preserve natural fruits, vegetables, herbs and spices without much oil or fatty things. This is not only satisfy our taste buds but along with it also act as a natural probiotics, as as natural antimicrobial agents.

At the end we can only say that dip is a very small representation of the kitchen chemistry world and it just shows its beauty through taste, colour, fragrance. And it suggests of course that we have to add some value to our kitchen, the most sparkling and alluring part of chemistry in our daily life.

So, this is much about dips and spreads. Let us now move on to the next portion i.e., sauce and ketchup.

SAUCE & KETCHUP

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SAUCE

In cooking, a sauce is a liquid, cream, or semi-solid food, served on or used in preparing other foods. Most sauces are not normally consumed by themselves; they add flavour, moisture, and visual appeal to a dish. They may be used for sweet or savoury dishes.

They may be prepared and served cold, like mayonnaise, prepared cold but served lukewarm like pesto, cooked, and served warm like bechamel or cooked and served cold like apple sauce. They may be freshly prepared by the cook, especially in restaurants, but today many sauces are sold premade and packaged like Worcestershire sauce, HP Sauce, soy sauce or ketchup. Sauces for salad are called salad dressing. Sauces made by deglazing a pan are called pan sauces. A chef who specializes in making sauces is called a saucier.

SAUCE TYPES

Generally, they are of **three** types**.**

Braising Sauce or marinade
Cooking Sauce
Dipping Sauce
Salad Dressing

There are also **five fundamental "French Mother Sauces"**, they are believed to be precursors of all available sauces till today.

Sauce Espagnole, a fortified brown veal stock sauce, thickened with a brown roux

Sauce Velouté, a light stock-based sauce, thickened with a roux or a liaison, a mixture of egg yolks and cream.

Sauce Béchamel, a milk-based sauce, thickened with a roux of flour and butter.

Sauce Tomate, a tomato-based sauce.

Sauce Hollandaise, an emulsion of butter and lemon (or vinegar), using egg yolk as the emulsifier.

SOME POPULAR SAUCES

British origin Apple, White, Cheddar sauces
Japanese origin Worcestershire Sauce
Spanish/Mexican origin Salsa Verde, Taco Sauces
Chinese origin Soya, Chilli, Vinegar, Oyster Sauces
Middle Eastern origin Hummus Sauce
Thai/Vietnamese origin Fish Sauce
Louisiana origin Tabasco Sauce
Portuguese origin Peri Peri Sauce

KETCHUP

Ketchup is a table condiment or sauce. The unmodified term ("ketchup") now typically refers to tomato ketchup, although original recipes used egg whites, mushrooms, oysters, grapes, mussels, or walnuts, among other ingredients. Tomato ketchup is a sweet and tangy condiment made from tomatoes, sugar, and vinegar, with seasonings and spices. Vinegar makes the ketchup acidic. Vinegar is composed of about 5% acetic acid.

The chemical formula for acetic acid is CH_3COOH. The spices and flavours vary, but commonly include onions, allspice, coriander, cloves, cumin, garlic, and mustard, and sometimes include celery, cinnamon, or ginger. This is most often used as a condiment to dishes that are usually served hot and may be fried or greasy: French fries and other potatoes, hamburgers, hot dogs, chicken tenders, tater tots, hot sandwiches, meat pies, cooked eggs, and grilled or fried meat. Ketchup is sometimes used as the basis for, or as one ingredient in, other sauces and dressings, and the flavour may be replicated as an additive flavouring for snacks, such as potato chips.

TARGET: TOMATO SAUCE AND KETCHUP

There are so many sauces available world-wide but when we come to the ketchup section, we see it is

only tomato ketchup that is the most popular one. Hence, now onwards we would concentrate on the tomato sauce and tomato ketchup only.And when it comes to ‘tomato sauce’ and ‘tomato ketchup’, we often consider them the same, but the fact is they are not. If we go by the food historians, ketchup is only one kind of a sauce. Ketchup word originated from Chinese 'koechiap' meaning ‘brine of fish’, or generally mentioned as ‘spicy sauce’.

The word 'sauce' is derived from Latin word salsas that means ‘salted’. According to historians, the sauce was invented for many reasons. It served the purpose of a cooking medium and was looked like a meat tenderizer and had the capability of enhancing the flavours too. And interestingly, there was no fixed recipe for this multi-functional dish, so its type and taste differ from culture to culture. Sauce is a French word taken from the Latin salsa, meaning salted. Possibly the oldest recorded European sauce is garum, the fish sauce used by the Ancient Romans; while doubanjiang, the Chinese soybean paste is mentioned in Rites of Zhou in the 3rd century BC.

With the commercialization and experimentation, the sauce is now a very household thing and many people make various types of sauces at home. The sauces can be of various viscosities which depend on the usage of the sauce. For instance, the sauce used for cooking will have less viscosity while the one used for dressing will have high viscosity.

Ketchupis made with tomatoes, sugar, vinegar/acetic acid, and spices. Whereas tomato sauce is made from tomatoes, oil, meat or vegetable stock and spices. It never uses vinegar. Also, ketchup is cold in nature and is never served hot, while all varieties of sauces are served hot. To make it simpler, ketchup is made up with a variety of spices while the sauce is generally made without spices. Another major point of difference between the tomato sauce and ketchup is, sauce generally does not contain sugar while ketchup has a specific amount of sugar and other sweet spices.

INVENTION/HISTORY

TOMATO SAUCE: The first person to write about what may have been a tomato sauce was Bernardino

de Sahagún, a Franciscan friar from the Kingdom of Spain who later moved to New Spain, mentioned a prepared sauce that was offered for sale in the markets of Tenochtitlan (Mexico City today). Historically, however, the first Italian cookbook to include tomato sauce, Lo ScalcoallaModerna ('The Modern Steward'), was written by Italian chef Antonio Latini and was published in two volumes in 1692 and 1694. The use of tomato sauce with pasta appeared for the first time in 1790 in the Italian cookbook L'Apiciomoderno, by Roman chef Francesco Leonardi.

TOMATO KETCHUP: Many variations of ketchup were created, but the tomato-based version did not appear until about a century after other types. An early recipe for "TomataCatsup" from 1817 still has the anchovies that betray its fish-sauce ancestry. James Mease published another recipe in 1812. As the century progressed, tomato ketchup began its ascent in popularity. It was popular long before fresh tomatoes were. People were less hesitant to eat tomatoes as part of a highly processed product that had been cooked and infused with vinegar and spices.

This was sold locally by farmers. Jonas Yerkes is credited as the first American to sell tomato ketchup in a bottle. Shortly thereafter, Heinz launched theirs. It was advertised: "Blessed relief for Mother and the other women in the household!", a slogan which alluded to the lengthy process required to produce tomato ketchup in the home. With industrial ketchup production and a need for better preservation there was a great increase of sugar in ketchup, leading to our modern sweet and sour formula. Prior to Heinz commercial tomato ketchups of that time were watery and thin, in part due to the use of unripe tomatoes, which were low in pectin. They had less vinegar than modern ketchups; by pickling ripe tomatoes, the need for sodium benzoate as a preservative was eliminated without spoilage or degradation in flavour.

LATER INNOVATION: In October 2000, Heinz introduced coloured ketchup products called EZ Squirt, which eventually included green (2000),

purple (2001), mystery (pink, orange, or teal, 2002), and blue (2003). These products were made by adding food colouring to the traditional ketchup. However, as of January, in 2006 these products were discontinued. In March of 2018, a kick-starter campaign was launched for sliced ketchup "revolutionizing the way we sauce". This is no doubt the modernist version of ketchup.

PREPARATION

Developing quality tomatoes

Tomato ketchup and sauce manufacturers must seek out the best quality tomatoes for their product. Tomato varieties are developed which are superior in colour, flavour, texture, and yield. Consistency is an important factor, as slight variations in tomato characteristics could alter the flavour and colour of the finished product.

Preparing Tomatoes: Tomatoes are harvested mechanically between June and July. The fruit is commonly conveyed by water from the trucks into a flume, or an inclined channel. The water method washes the tomatoes and protects them from

bruising while they pass from the truck to the factory. The U.S. Department of Agriculture or state inspectors approve and grade tomatoes to meet initial requirements. The tomatoes are sorted, washed, and chopped. Next, precooking, or scaling, in stainless steel vats preserves the tomatoes and destroys bacteria.

Pulping: The chopped and precooked tomatoes are pumped into pulping machines, or cyclones, which separate seeds, skins, and stems from the pulp. The pulp and juice are filtered through screens and processed further into ketchup, though some may be stored in a paste for use later in the year.

Adding ingredients and Cooking: The pulp is pumped into cooking tanks or kettles and heated to boiling. Foaming may occur if fresh tomato pulp is used but can be corrected with anti-foaming compounds or compressed air. Precise amounts of sweeteners, vinegar, salt, spices, and flavourings are added to the tomato pulp. Most spices are added early in the cooking process. To avoid excessive evaporation, volatile spice oils and vinegar must be mixed in later.

Onions and garlic can be mixed in with the spices, placed in a separate bag, or chopped and added to the pulp. Salt and sugar may be added at any stage of cooking though it is better to add sugar later to prevent burning. The mixture cooks for 30-45 minutes and is circulated by rotating blades installed in the cookers. The temperature must be carefully regulated to ensure absorption of the ingredients without overcooking, which creates a flat body.

Finishing: Once the cooking is complete, the sauce/ketchup mixture passes through a finishing machine. Finishers remove excess fibre and particles through screens, creating a smoother consistency. The ketchup passes to a holding tank before further processing. The ketchup may be milled at higher temperatures and pressures to achieve a smoother consistency.

Removing air: The sauce/ketchup must be de-aerated to prevent discoloration and growth of bacteria. Excess air might also create unattractive air pockets and impede the closure process.

Filling: To prevent contamination, the ketchup/sauce passes from the receiving tanks to the filling machines at a temperature not lower than 190°F (88°C). The containers are filled with the ketchup and immediately sealed to retain the freshness of the product. Ketchup containers come in various sizes and shapes, including 14-oz. bottles, No. 10 cans, pouch packs, room-service sizes, and single-serve packets.

Cooling: The containers must be cooled to prevent flavour loss through stack burning, which occurs when ketchup/sauce stays at high temperatures after cooking is complete. Containers of ketchup may be cooled in cold air or cold water.

Labelling and Packing: Finally, the ketchup/sauce containers are labelled and coded with product information, including ingredients, date and location of manufacture, and shelf-life. The bottled ketchup may be inspected again before shipping. The entire process of ketchup manufacturing generally takes two to three hours.

PRESERVATIVES

Two different preservatives (sodium benzoate and salt) were used to treat the tomato paste which was subjected to ambient temperature of 25°C±1°C and 4°C respectively for a period of 4 months. But now-a-days use of this compound has been restricted.

NUTRITION FACTS

Zero Nutritional Value: Tomato ketchup or sauce hardly contains any protein, any fibre, any vitamins, and minerals. Not to forget that the sauce is high in sugar and sodium. So, apart from that enhancing the taste of the dish this sauce has no health benefits at all.

Nutrition Facts

About 23 Servings Per Container

Serving size 1 Tbsp (16g)

Amount per serving

Calories 5

% Daily Value*

Total Fat 0g	**0%**
Sodium 180mg	**8%**
Total Carbohydrate 1g	**0%**
Protein 0g	

Not a significant source of saturated fat, trans fat, cholesterol, dietary fiber, total sugars, added sugars, vitamin D, calcium, iron and potassium.

*The % Daily Value tells you how much a nutrient in a serving of food contributes to a daily diet. 2000 calories a day is used for general nutrition advice.

Because sauce/ketchup is consumed in such small amounts, it is not a good source of micronutrients. The main ingredient, tomatoes, is high in vitamin C and vitamin A and can also be a good source of vitamin K, potassium, and manganese (depending on the amount consumed). But you are not likely to consume enough ketchup to get substantial levels of any of these nutrients.

HEALTH BENEFITS

Foods like ketchup or sauce that are consumed in exceedingly small quantities are not likely to have a considerable impact on your health. Including tomatoes in your diet can provide benefits because they contain lycopene and other compounds with antioxidant potential. But you are not likely to eat enough ketchup to gain these benefits. However, there are some sources that promote the health benefits of ketchup. It can be helpful to examine the claims and the science behind them. In many cases, the studies cited do not actually support the health benefits of ketchup. They reduce risk of prostate cancer, increases fertility in men, promotes eye health and they are low in calories and completely fat free.

POSSIBLE SIDE EFFECTS

- Blood sugar spike
- Tooth decay
- Diabetes
- Heart disease
- Hyperglycaemia
- Negative impact on potassium levels

INGREDIENTS TO BE AWARE OF

MSG (Mono Sodium Glutamate)

High Fructose Corn Syrup (High Sugar Content)

Tomato Concentrate (Without Seed/Skin)

Sodium (High Salt content)

GMO Corns (Not much Approved)

Distilled Vinegar

PROS AND CONS: IN A NUTSHELL

Sauce and ketchup are made from several ingredients, the primary ones being tomato concentrate, salt, and high fructose corn syrup (HFCS). Although studies have been conducted that show ketchup can have many long-term benefits, the negative impact of consuming enough ketchup to enjoy those benefits may not be worth it. First, let us look at the good news.

Pros: Ketchup/sauce contains an antioxidant called lycopene. Lycopene has been noted to reduce the risk of heart disease in women by 50%. For men, it can increase sperm count, increase swimming speed, and cut down the number of abnormal sperm cells; all of which leads to increased fertility.

They have also been shown to reduce the risk of prostate cancer. In addition to these benefits, ketchup/sauce contains a high amount of vitamin A, which is vital in maintaining good eye health. Other benefits are that they can help reduce cholesterol,

especially LDL, is low in calories, do not contain fat, and can be used to mask the flavour of various foods which may be better for the body than for the palette.

Cons: Although the benefits given above are wonderful, do not start using mounds of sauce or ketchup quite yet. First, as listed, high fructose corn syrup (HCFS) is one of the primary ingredients in ketchup specially. There is a host of negative issues associated with HCFS, one of which is tricking the body into not feeling full and thus inducing overeating. Other various studies have linked HFCS to metabolic syndrome and an increased risk of type 2 diabetes.

Tomato concentrate does not contain all the nutrients in tomatoes as the process involved strips much of them away. About 1/4 of a bottle of ketchup is pure sugar, which can increase the risk of diabetes, heart disease, and high blood sugar. Two other ingredients to take note of are vinegar (a very acidic substance linked to tooth enamel decay and negative impact on potassium levels in the body) and GMO corns that although approved by the FDA are not approved in many other countries around the world.

So this is much about sauce and ketchup and also the end of the chapter Spicy Twist. Let us now move on to the next chapter to explore a completely new area of culinary world.

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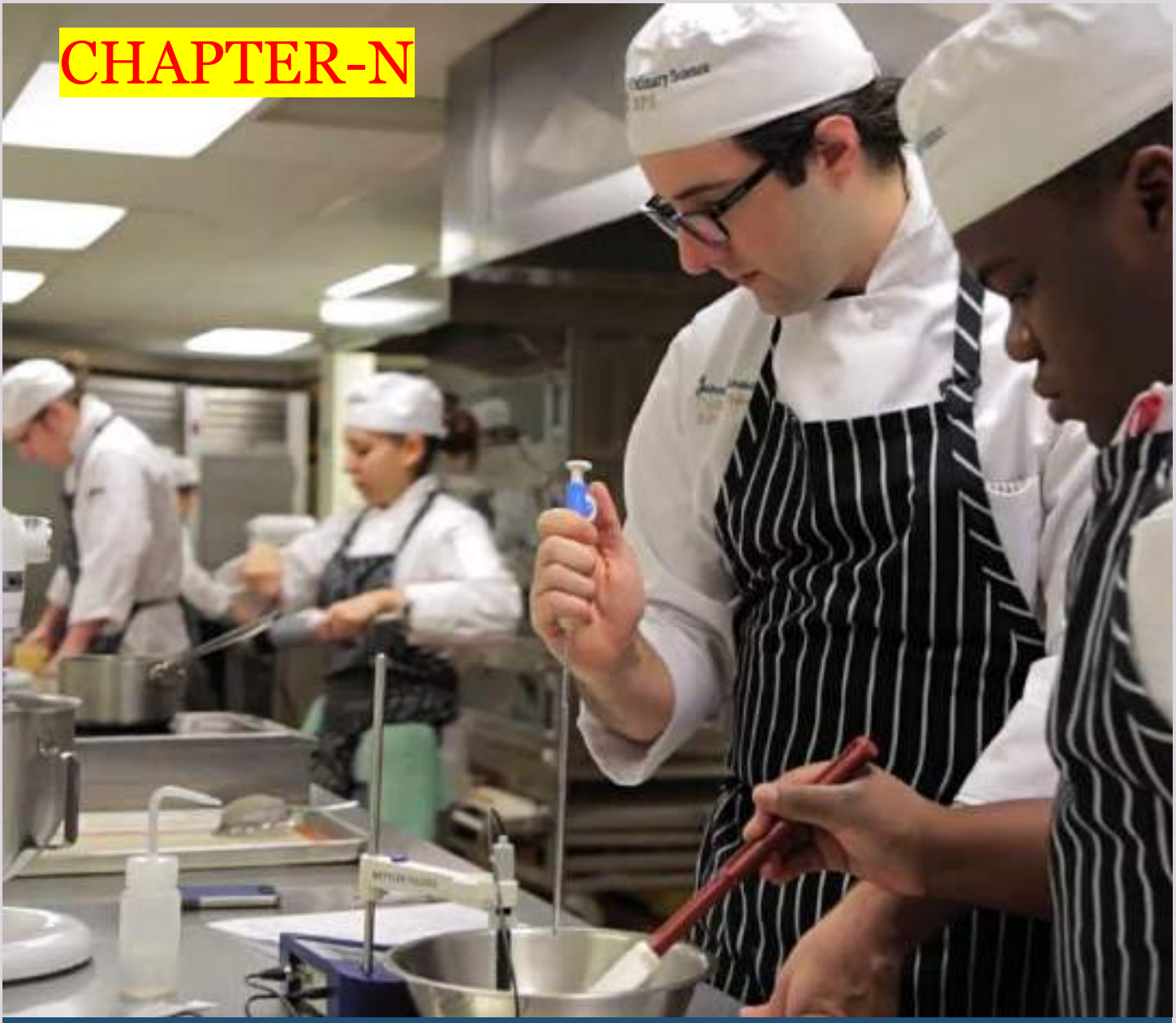
CHAPTER-N



CULINARY CHEMISTRY

WHEN CHEF IS A CHEMIST

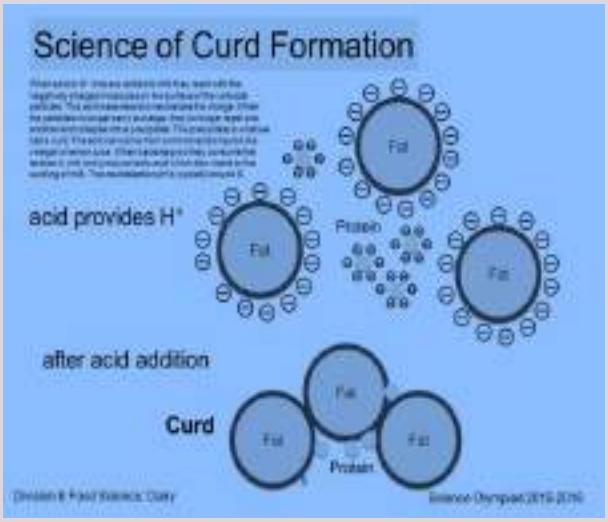
CHEMQUEST, VOL-1, ISSUE-2, **2020**, PAGE-N1-N4

PRELUDE

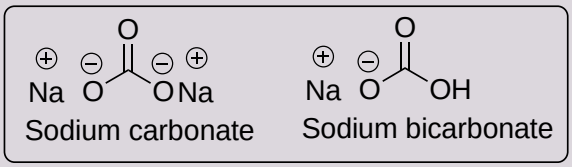
Whenever we are at kitchen, we carry many reactions to get our delicious foods. Reactions which are responsible for production and as well as destruction of food are collectively called culinary reactions.

Just as we carry out acid base reactions in laboratory, where pH of medium plays a significant role, the preparation of curds from milk or baking cakes are also pH dependent.

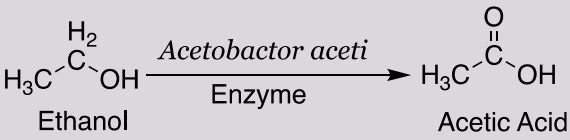
Enzymes cause destruction of foods under an optimum temperature and pH. That's why pickling is done at a pH where most of the bacterial activity gets prevented and food can be stored.



In this context lets discuss the use of sodium bicarbonate, the famous alkali used for the cooking. It reacts with acids to produce carbon dioxide which helps in baking. Again it is also useful for hyperacidity in stomach. It neutralizes the excess acid present in stomach and gives us relief. At 70°C, sodium bicarbonate dissociates to sodium carbonate, water vapour and CO_2 gas and thus can be used to make foamed candy by adding it to a very hot syrup.



Redox reactions are also important in food chemistry. Vinegar can be prepared from wine left on air in presence of certain bacteria. *Acetobactor aceti*, a famous bacteria can produce enzyme that converts ethanol to acetic acid which is simply a common oxidation reaction often seen in textbooks. The optimum temperature for this process is 27°c and this process requires atmospheric oxygen.



In the following articles we shall meet with the reactions, reagents, and mechanism of some well-known culinary reactions responsible for various changes in food.

Let's enjoy it.

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WHY SOME FOODS TURN BROWN?

Kausik Das

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INTRODUCTION:

If someone asks you "What is chemistry? you can address him by "where is chemistry?" From morning toothpaste to dinner, everything we need is related to chemistry. More to say, chemistry is essential in our every day's life.

Cooking itself is really just chemistry. Now **Culinary Chemistry** is the chemistry related to cooking only involving more dangerous and incredible materials. It is fun to do experiment with cooking but to know the chemistry behind it is spectacular, fantastic. Why does food taste better when it is grilled? what molecule compounds make a good wine? The answers lies in Culinary Chemistry.

Chemical reactions are useful in cooking to help to improve the taste, flavor, odor of food.

Browning of food is a part of Culinary chemistry.

Every day we eat kinds of biscuits, breads, chocolates , grilled meats and so many other brown foods. For industrial purpose food browning is one of the most usable and important job to do. There are three major types of food browning.

(1) Caramelization

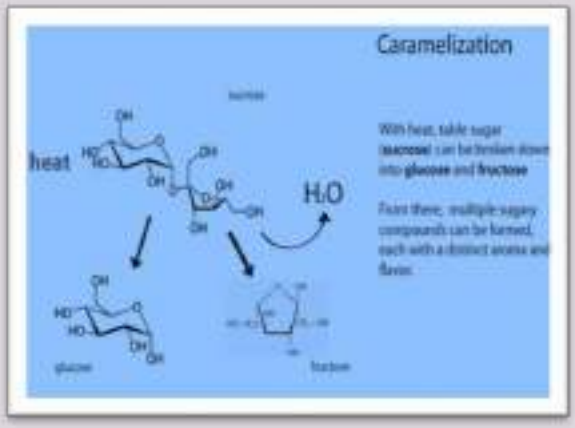
(2) Maillard browning

(3) Enzymatic browning

CARAMELIZATION:

Caramelization is the browning of sugar. It is a non-enzymatic reaction that occurs when carbohydrates or sugar in food are heating/roasting.

This caramelization process cause colour changes in food (golden-brown to dark brown). The importance of the reaction is that caramelizaton not



only help in colour changes but also in flavor. In the case of ordinary sugar caramelization begins at around 32°F. The brown colour is produced by three group of polymers:

Caramelans ($C_{24}H_{36}O_{18}$)

Caramelens ($C_{36}H_{50}O_{25}$)

Caramelins ($C_{125}H_{188}O_{80}$)

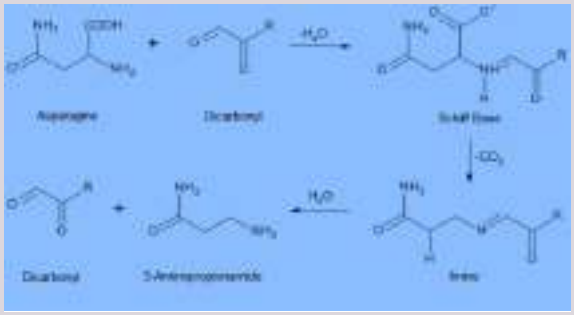
MAILLARD REACTION:

Now in case of food browning most used and widely regarded reaction is **MAILLARD REACTION** and it is the most important flavour producing reaction also.

In 1912 a French physician and biochemist, Louis-camile Maillard first described this reaction. The browning of food and the peculiar taste of food (roast meat, potato chips, coffee, bakery products,

chocolates etc.) mostly depends upon the Maillard reaction.

The Maillard reaction occurs between amino acid and "reducing" sugars, at temperature above 140°C (around 140°C to 165°C for some recipes). The carbonyl group of the sugar reacts with the amino group of the amino acid and produce *N*-substituted glycosylamine and water. Now the unstable glycosylamine undergoes Amadori rearrangement forming ketosamines.

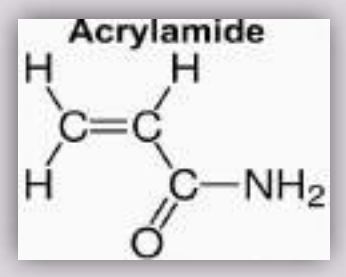


In the case of open chain Amadori products undergo further dehydration and di-carbonyls.

The Maillard reaction generate brown pigment in cooked meat in a very specific way. The rearrangement products of amino acids and certain sugars arrange themselves in rings and such collection of rings reflects light in such a way as to give the meat a brown colour.

Maillard reaction occurs in cooking of almost all kind of foods, although the simple sugars and amino acids present produce distinctly different aromas. Maillard reaction results in gradual changes to fragrance, flavor, color, texture and nutritional value of stored foods. Maillard reaction mainly refer as a browning reaction but we can also add, it's a "flavor reaction".

Beside all of this, Maillard reaction has a little dark side. Acrylamide is an undesirable product of Maillard reaction. Acrylamide has been mentioned as a possible human Carcinogen. But there is no direct evidence it causes cancer in humans.



ENZYMATIC BROWNING:

The **Enzymatic browning** is a chemical reaction which naturally occurs in different kind of fruits, vegetables. An enzyme name **polyphenol Oxidase** is the cause behind this browning. When that enzyme reach into contact with oxygen in the air and the **PPO** (polyphenol oxidase) enzyme changes substances known as Phenolic compounds into different compounds called **quinines.**

In the sliced fruits or vegetables this reaction spreads like an infection and resulting in negative effects on colour, taste, flavor, nutritional values.

HOW TO CONTROL:

Maillard reaction is affected by temperature. It is the key control for the rate of reaction. On high temperature cooking the rate of chemical reaction as well as evaporation of water increased which speeds up the Maillard reaction. This reaction is firmly affected by pH. With the increase of pH the browning rate increases.

As the enzymatic browning has a bad negative effect and it riots fruits, vegetables, so it is necessary to control enzymatic browning. There are two ways to control enzymatic browning

1. By lowering the temperature

2. By lowering the pH

When we preserve foods in lower temperature (in case of refrigerator) we can slack the enzymatic browning. Also in low pH medium we can slow down this browning. Cooking the food is the most simplest way to completely prevent the enzymatic browning. Oxygen is the reason behind this browning, so exclusion of oxygen is a way to stop enzymatic browning on food.

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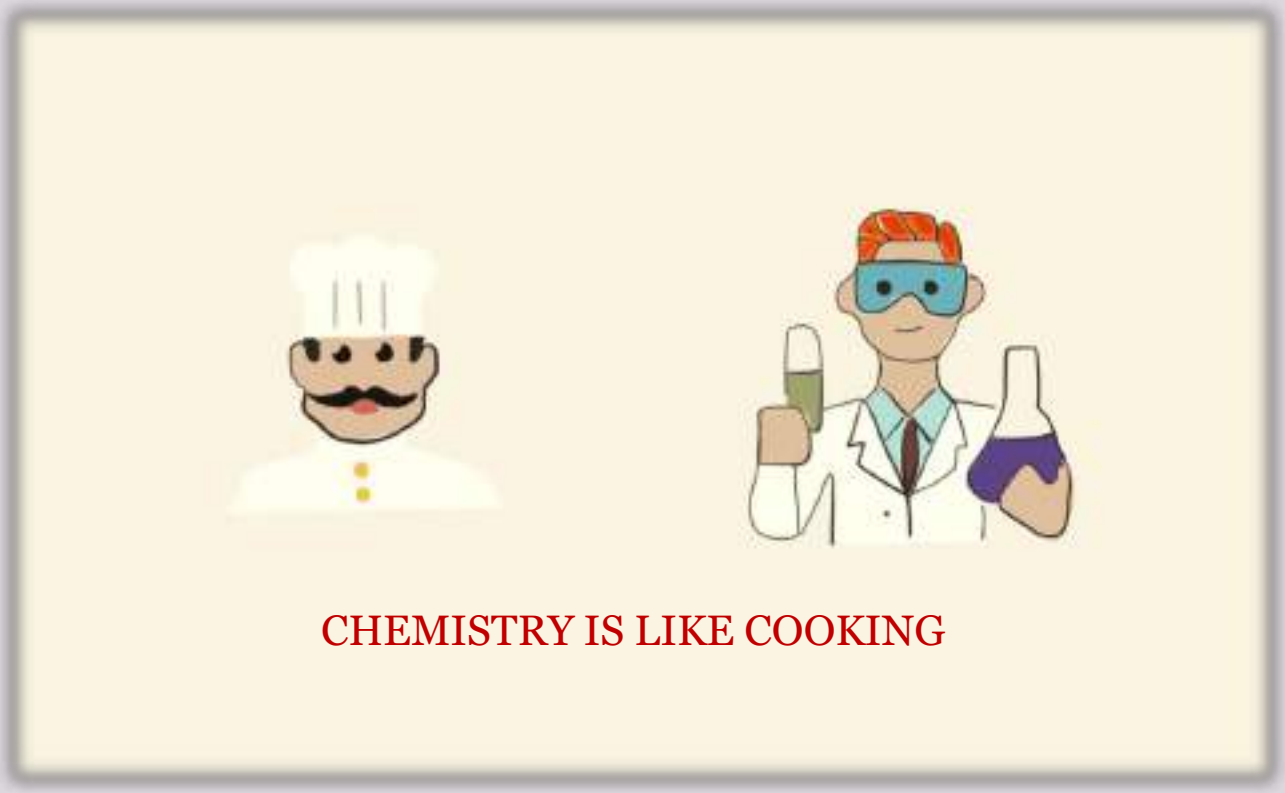

CHAPTER-O

CHEMICALS AS FOE

A CRITICAL SURVEY

CHEMQUEST, VOL-1, ISSUE-2, **2020**, PAGE-O1-O6

PRELUDE

Food is any substance that we consume to provide nutritional support for any organism. For omnivorous (like human) food is crucial.

Now a days, we judge a food according to their looks as well as taste. So colour of a food plays an important role by visually stimulating one's appetite. In the same way flavour is the perceptual impression of food.

Have anyone ever wondered from these colour and flavour come from???

Let's take a closer look on the artificial color, flavour and some things which should be avoided in food.

What are the artificial or natural color used for food decoration? Are all of these ingredients good for health? In this chapter we will discuss all these issues, so that we can be more cautious.

FOOD ADDITIVES-COLOR & FLAVOUR

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Introduction:

Whether food items are fresh or not, are always categorized by look. In markets, restaurants, people's demands keep changing. They want healthy as well as colourful, affordable and flavored food.

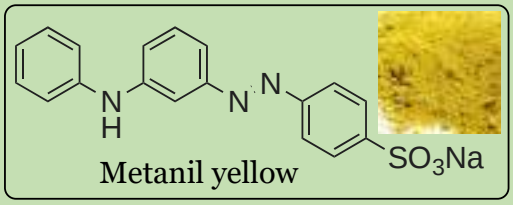
To satisfy their demands, several artificial colours and flavours are added to food.
Are these ingredients good for health?
Is there any bad impact on health?
Are these safe for children?
We never think about it. Many ingredients we consume must be carefully regulated.

Why colour ingredients are added to food:-

1. To improve the taste of the food
2. To maintain the appearance of food
3. To change the regular taste of a food
4. To create unique dishes to attract the customer

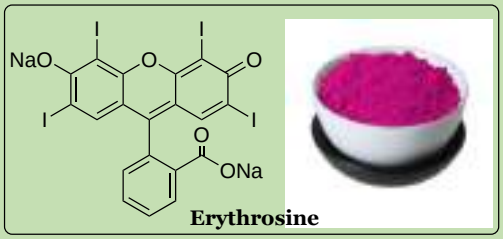
Colour additives:-

Colour additives are one type of substance (may be dye) that human body can accept it and causes no harm in body. So only approved colour additives are used in cooking.
There are two type of colour additives.
First one is synthetically produced and used widely because they are less expensive, uniform colour and it is easy to create variety.
Example: Metanil yellow, Erythrosine, Allura red



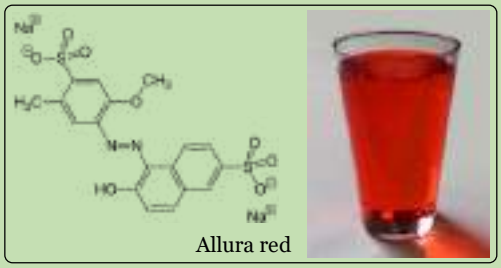
Metanil yellow

Metanil yellow:- It is yellow in colour and used as food adulterant in turmeric powder, moongdal and widely used in biriyani.



Erythrosine

Erythrosine:- It is also known as Red -3 and used as commercial dye. It is generally used in Pepsi, candies, and cake decorating.


Allura red

Allura red:-
It is a popular dye used regularly in cotton candy, soft drinks and cherry flavour products.

Other one is derived from natural sources like vegetables.
They are more expensive.
Example: Beta carotene (yellow to orange), Grape skin extract (red, green), Caramel (yellow to tan).

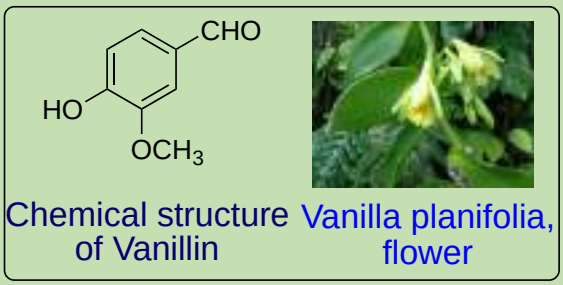
Flavour additives:-

Flavour generally enhances taste of a food. Flavours are naturally as well as synthetically can be produced.

Naturally flavours are produced from foods. The chemical compounds that give flavour are extracted from food and then concentrated.
Example: Cinamaldehyde, Vanilline

For **artificial flavour**, the compounds that flavoured the food are synthetically produced.
Examples:- Chocolate flavour, strawberry flavour.

Some natural and artificial flavour:-
Vanilla flavour (Natural way):- Vanilla flavour compounds are extracted from vanilla beans. These compounds contained hydroxybenzaldehyde, hydroxybenzoic acid and anisaldehyde. These compounds give extra flavour to vanilla. These chemical compounds already present in Vanilla.

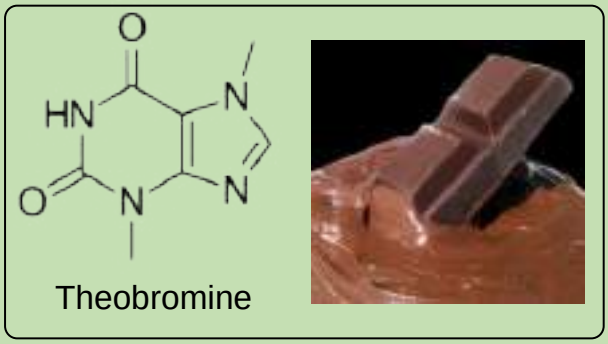


Chemical structure of Vanillin

Vanilla planifolia, flower

Artificial way of preparation:- One can easily prepare that flavour by above mentioned compounds. Those compounds can be synthetically produced in laboratories to get vanilla flavour.

Chocolate flavour:- Similarly chocolate flavor can be produced both naturally and artificially. The compound present in chocolate are ***Theobromine*** and amylacetate, citral, benzaldehyde etc.

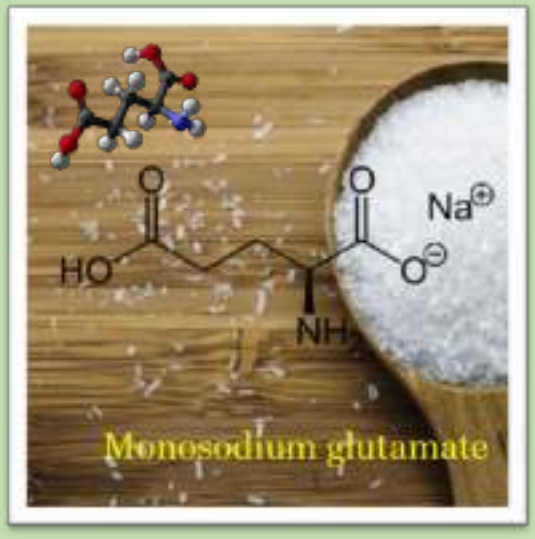


These flavour can also synthetically produced to get artificial chocolate flavour.

Effect of natural and artificial colours and flavours to health:

The primary difference between natural and artificial colour and flavour is the source of chemical compounds. Though they have same molecular structure, their taste is different. The difference is due to natural flavours, colours, which include hundreds of compounds. These compounds are absent in artificial colours of flavours. Excessive artificial, colourful and flavoured food may cause lungs disease.

MSG: Good or bad-



The full form of MSG is monosodium glutamate. It is derived from glutamic acid which is most abundant amino acid in nature.

Chemically MSG is a crystalline powder that resembles table salt or sugar. It is used as food additive to enhance flavour.

Glutamic Acid:

Glutamic acid functions as neurotransmitter in human brain. So excessive amount of glutamate can hamper activity of brain and can cause obesity, asthma. So, MSG should be taken in proper amount. Some studies indicate that MSG helps in digestive tract.

Gluten:

Gluten is a protein rich grains naturally found in wheat, barley and rye. It is act as a binder and 'stretchy' quality.

Gluten and health benefits:

Gluten is most often associated with wheat containing food and whole grain food. This type of food decreases heart disease, diabetes etc.

Gluten is a problem:

Now-a-days body reacts differently with gluten which causes fatigue, bloating, constipation and diarrhoea and celiac disease. So gluten is good for those who react negatively to it. Most of people can and have eaten gluten most of their lives without side effects. Now-a-days gluten free foods are also available in the market.

Conclusion:

In our daily life, we consume various types of foods. These foods may contain artificial colours, flavours, MSG or Gluten. These chemical components are necessary for health. We must be aware of their quantity in foods. So that food becomes healthy and tasty.

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CHAPTER-P

MODERNIST CUISINE

A TECHNO EMOTIONAL JOURNEY

CHEMQUEST, VOL-1, ISSUE-2, **2020**, PAGE-P1-P6

PRELUDE

AT A GLANCE

It is the modernist subdiscipline of food science that seeks to investigate the physical and chemical transformations of ingredients that occur in cooking. The main objectives are seeking for the mechanisms of culinary transformations and processes (from a chemical and physical point of view) in three areas: the social phenomena, the artistic and technical component linked with culinary activities. Molecular cuisine is actually a unique style of cooking that takes advantage of many technical innovations from various scientific disciplines.

INCREDIBLE INGREDIENTS

- Carbon dioxide for creating bubbles and foams,
- Liquid nitrogen for flash freezing and shattering,
- Maltodextrin for turning high-fat liquid into powder,
- Transglutaminase as a protein binder named meat glue,
- Soybeans and Potato starch for making edible papers,
- Lecithin as emulsifier and non-stick agent,
- Hydrocolloids e.g., starch, gelatin, pectin, and natural gums as thickening, gelling, emulsifying and stabilizing agents.

AMAZING TOOLS

- Anti-griddle for cooling and freezing,
- Food dehydrator for
- Centrifuge for texture change
- Immersion blender for creating bubbles and foams

- Thermal immersion circulator for low temperature cooking
- Syringe for injecting unexpected fillings

- Inkjet printer for printing on edible papers
- Ultrasound to achieve more precise cooking time

Innovative Techniques:

- Spherification for a caviar-like effect
- Whimsical or avant-garde presentation
- Use of unusual service ware

- Peculiar food pairings or combination

Fundamental Objectives:

- Investigating culinary and gastronomical proverbs, sayings, and old wives' tale
- Exploring existing recipes
- Introducing new tools, ingredients, and methods into kitchen
- Inventing even new dishes

- Using modernist techniques to help people understand contribution of science to society

Areas of Investigation:

- How ingredients are changed by different cooking methods
- How all the senses play their own roles in appreciation of food
- The mechanisms of aroma release and the perception of taste and flavor
- How and why, we evolved our taste and flavor sense organs, and our general food likes and dislikes
- How cooking methods affect the eventual flavor and texture of food ingredients
- How new cooking methods might produce improved results of texture and flavor
- How our brains interpret the signals from all our senses to tell us the "flavor" of food
- How our enjoyment of food is affected by other influences, our environment, our mood, how it is presented, who prepares it, etc.

MOLECULAR GASTRONOMY: A TASTE REVOLUTION

Dr. Suchandra Chatterjee
Associate Professor
Department of Chemistry
Surendranath College

Have you ever thought of a fresh onion soup in the form of a lollipop, a sardine coated toast, a bacon and egg ice cream or, a simple tomato mozzarella salad served as froth in a shot glass? Certainly not! But now you can expect the unexpected on your table as "Molecular Gastronomy" catches up in India. So, you can now eat chemistry right here in Indian kitchens. Indian chefs are working hand in hand with scientists and food technologists here, to deconstruct and reconstruct food and serve up some amazingly new combinations with unexpected flavours.

The chefs of the coffee shop chain Mocha are visibly excited about their lab like kitchen that is equipped with liquid nitrogen tanks, syringes, measuring bowls, pipettes, dehydrators, and foaming cylinders, no less. They are using all these equipment to serve up an unusual repertoire that includes edible menus, fruit caviars and deconstructed cheesecakes. If we look at the meal, now they are presenting a tasty menu that teases the senses with dishes like olive oil Bon Bons, deep fried mint balls (instead of ubiquitous mint dip) accompanying tandoori chicken drumsticks and an open-faced burger! As the course arrives you are asked to break the menu and eat it – Yes, that is the edible menu for you. The piece de resistance, though, is when you chomp on a dessert and puff out little rings of smoke!

Now how indeed can you get smoke out of a cold dessert? Well, here is what the chefs have done. They have flashed or cold fried the dessert items in liquid Nitrogen. So, once you pop it in your mouth, the cold Nitrogen evaporates and blows out as smoke.

In case you are wondering whether liquid Nitrogen is safe to consume, it's only while handling it the chefs must be careful. The substance after all boils at -195.9 degree Celsius! That is, it is so cold that it can freeze your hand within a few seconds. Remember liquid Nitrogen is commonly used as refrigerant!

Clearly molecular gastronomy buffs love to play around with the chemical states of foods. Take the traditional Italian dish 'Pana Cotta' which is nothing but a custard like dessert, now comes in the form of noodles or pasta!

However, the basic taste remains same and only texture changes. Hence what you see is not what you envisage! They call it popularly the 'Transmogrification' of food.

Now how did this Molecular Gastronomy come about? Well, this playing around with texture, temperature, and taste was first done back in 1988 by the French scientist Herve together with the Hungarian physicist Nicholas Kurti.

The idea was to encourage the senses to savour each aspect of a dish. That is because the most notable characteristic of molecular gastronomy is to break down food into its individual components.

You know, study of the chemistry and physics underlying the preparation of any food item happens quite naturally in any kitchen. What makes the mayonnaise firm? Why does a soufflé swell when you bake it? Is it possible to keep the yolk of a boiled egg in the Centre always? Molecular gastronomy basically answers all these questions, some of which have been used for centuries. Using this modernist technology, they can now make instant ice cream using liquid nitrogen and can add surprise elements to their dishes such as fancy fruit caviars, food foams and gels and even traditional salads in shot glasses!

At Taj Bengal, Kolkata, the chefs are working for many years with an enzyme called meat glue that does exactly what its name suggests, i.e., it helps to stick together two different kinds of meat. They are using that meat glue to fuse together chicken and mutton pieces which they then top with carrot caviar or alternatively whip up mean coconut sauce foam to go with the dish.

Even as Molecular Gastronomy promises to take food to a new level, it calls for extreme precision. So, the chefs cook under very controlled temperature and use sensitive scales such as those used to measure gold! An extra gram can change everything they say. At the Hotel Park, Delhi, the chefs rustle up a brunch of instant mousse, mushroom cappuccino, and deconstructed iced tea with mint caviar.

They inject a smooth blend of fruit pulp and sodium alginate (a common food additive for producing gel) into a syringe and then inject this into a bath of Calcium Chloride (a salt often used for making cheese) and tiny spheres of caviar immediately come into life. And as the caviar breaks in your mouth, the burst of flavor is just exquisite! They do also serve tomato mozzarella salad as froth in shot glasses. The aftertaste is the same. You must just gulp it down instead of chewing it!

The world's best gourmet chefs are also cooking up a flurry of science in their kitchens. There is Spain's famous chef, or shall we say alchemist – Ferran Adria who is the pioneer in this field and his revolutionary cooking has made the El Bulli Restaurant at Catalan coast, the most sought-after dining spot in the world.

One must book a table two years in advance

there, to savour Adria's famous 30 course dinners!

He conjures up creation in his kitchen by challenging the entire regular conventions of food. He deconstructs a familiar dish by reworking its components or ingredients and modifying their form or texture. Adria's

He conjures up creation in his kitchen by challenging the entire regular conventions of food. He deconstructs a familiar dish by reworking its components or ingredients and modifying their form or texture. Adria's creations are a result of his constant experimentation in his culinary lab.

Where he injects food with chemicals like Calcium Chloride or plays with substances like liquid Nitrogen. Indian chefs also want to push the boundaries of Indian cuisine by injecting some Molecular Gastronomy into it. They are also much moved by Adria's experiment with traditional Spanish cuisine!

So, is 'Molecular Gastronomy' a gimmick or a fad as its critics like to say? What this Gastronomy does to food is a subject of great debate indeed. Some feel it goes against the very grain of nourishment of fulfilling an appetite and of respecting products in its natural form. Others appreciate the manner which it titillates the palate through the unexpected contrasts of flavour, temperature and texture. How about trying it out and judging for yourself?

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Concluding Remarks

In this issue of CHEMQUEST the topic chosen is a popular one "CHEMISTRY IN KITCHEN" to address general community irrespective of their academic background or discipline. We have tried our best to explore almost all aspects of cooking. At the very outset we tried to explore whether cooking is an art or a necessity. The story how cooking won over the practice of consuming raw foods was then told. Next, we discussed about the evolution of cooking from prehistoric time to modern age. Different methods of cooking were then explored in detail. Some myths vs facts in the cooking domain were discussed after that. Then we concentrated on popular herbs and spices that are present in our kitchen cabinets and there after moved to different type of beverages. Baking was our next point of interest followed by different dairy products. We did not forget the smell of barbecue and grill in this wintery chill. Jam, jelly, chocolates all those delicious things were also taken care of. Spicy pickles, sauces, and dips, all the finger foods were also not neglected! Next, we concentrated on the culinary chemistry, the most happening browning reaction and all. Are you bothered about all the harmful colouring and flavouring agents? We did not miss them too! And lastly in the modernist cuisine section how chemistry has revolutionized the modern kitchen was also discussed. And in all these regimes we have always tried to find out the chemistry behind all the popular cooking processes. Our motto was obviously to emphasize on the fact that cooking is chemistry and nothing but chemistry. We have done our part. If our readers enjoy reading it and can gather at least some new information, all our endeavors would be successful. Hope you will like it and forgive all the unwanted mistakes, typos etc. despite rigorous editing process. Thank you all for taking interest in CHEMQUEST.


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