ACHARYA N. G. RANGA AGRICULTURAL UNIVERSITY

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THEORY STUDY MATERIAL

Bakery and Confectionary Products

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Theory Lecture Outlines

1. History of Bakery and Confectionery - Present Trends - Prospects - Nutrition facts of Bakery& Confectionery goods
2. Raw materials used in Bakery - Flour - Types of flour - Flour characteristics - Water - Sources - Functions - Usage of Water; Salt - Role of Salt
3. Yeast, Yeast Production - Enzymes - their functions in dough
4. Sugar and Milk - Properties and Role of milk and Sugar in Bakery
5. Leavening agents - What are leavening agents? - Different Leavening agents - their functions in Baking Industry
6. Spices used in baking and their functions; flavoring - Nuts and fruits - their function in bread making
7. Food colours; Setting materials - types - their function in baking; Cocoa and Chocolate
8. Bakery unit operations including mixing - fermentation - Proofing - baking
9. Formula construction and computation of yeast raised products; types of breads, bread faults and remedies
10. Biscuits - Ingredients - Types of biscuits - Processing of biscuits - faults & Remedies
11. Cream crackers, soda crackers, wafer biscuits & matzos, puff biscuits
12. Hard sweet, Semi Sweet and Garibaldi fruit sandwich biscuit
13. Short dough biscuits, Wafers.
14. Cakes - types - Ingredients - Processing of cakes - Problems - Remedies
15. Pizza and pastries - their ingredients and Processing
16. Setting up of a Bakery Unit - Bakery equipment required - types - Selection – Maintenance - Bakery norms and Standards
17. Types of confectionery - Basic technical considerations of confectionery - TSS, pH, Acidity and ERH
18. Raw materials - types of sugar, granulated, caster, liquid brown sugars, molasses, micro crystalline sugars - their role in confectionery
19. Alternative bulk sweeteners - Glucose, fructose, lactose, sugar alcohol, sorbitol, xylitol,Isomalt, poly dextrose - their role in confectionery
20. Enzymes - used in syrup production - used in gelling - enzymes used in whipping
21. Agar-agar, Alginates, carragenons, Gelatin, Acacia gum - Gum Arabic, Pectin, tragacanth,Xanthan gum, Egg albumen and Gelatin as a whipping agent
22. Milk protein, soya protein, oils, fats related products and their role in confectionery
23. Food colours & flavours
24. Chocolate processing - Different steps involved in chocolate processing - Ingredients, mixing,refining.
25. General technical aspects of Industrial sugar confectionery, composition effects, changes,change of state
26. Boiled sweets - classification - Ingredients used in the preparation - Caramel, toffee and fudge - Processing
27. Processing of liquorice paste, cream paste and aerated confectionery products - Ingredients- their function - Ingredients and Processing
28. Tablets, Lozenges, Sugar panning tablets, Granulated confectionery, medicated confectionery - Ingredients and Processing
29. Chewing gums, fondants, Marzipan - Ingredients & Processing
30. Crystallized confectionery - Processing - Ingredients and their functions
31. Quality and standards/Regulations to be followed in the Bakery Industry and packaging requirements
32. Quality and standards/regulations to be followed in the confectionery Industry and packaging requirements

Lecture-1
History of Bakery and Confectionary

Baking, particularly the baking of bread, is one of the oldest of human activities – indeed one of the oldest surviving papyri appears to be a set of instructions for making bread. Another document is part of a correspondence explaining that pyramid construction is falling behind because the supply of beer and bread to the labourers has been insufficient, thus revealing that the diet of labourers has changed relatively little in thousands of years.

Western civilization is based on the cultivation of wheat, a pratice that seems to have started in Mesopotamia, the area that is currently Iraq. Wheat is a member of the Grammacidae, i.e, it is a member of the grass family. The cultivation of wheat spread from the Middle East across Europe. Settlers took wheat seeds with them to the Americas and started to cultivate wheat there. Those settlers from Great Britain took wheat that had evolved to grow in British conditions. These wheat varieties would grow on the eastern seaboard but were not successful in the American Midwest. Subsequently, however, wheat from Eastern and Central Europe was found to thrive in the Midwest. The cultivation of wheat also spread to Canada and Australia.

In Great Britain, the industrial revolution in the nineteenth century was initially good for the farming community – as people moved from subsistence agriculture to the factories it created markets for agricultural products. This situation continued up to the 1880s when quantities of imported grain started to become available. This imported grain was much harder than English wheat and created a problem since the wind and watermills could not grind it. A solution appeared in the form of the roller mill, a Hungarian invention, which could cope with hard Noth American wheat. These roller mills could easily produce much whiter flour than the old stone mills. The large milling companies set up mills 1 on dockside sites as the most economic way of handling imported grain. The large wind and water mills that had supplied the cities started to close as they could not compete with these new dockside roller mills. Small rural mills, though, continued to trade locally. The imported grain triggered a farming recession that ran from the 1880s to 1939. British governments became aware of the strategic problems caused by relying on imported food. Research on wheat breeding led to varieties of wheat with good bread making potential that would grow in the British climate. Other research led to the Chorlywood Bread Process that was intended, among other things, to reduce the dependence on imported wheat. The next stage was Britain's accession to the European Economic Community [EEC, commonly known then as the Common Market, and now known as the European Union (EU)], which meant that the Common Agricultural Policy (CAP) applied. The policy in the form then current sought to penalize the use of food crops from outside the EEC when the crop could be produced inside the EEC.

Originally, the policy had sought to support small farmers by guaranteeing a stable high price for their products. When the supply of a commodity exceeded the demand the surplus was bought and placed in store. This process was called intervention.

Keeping stocks of intervention wheat was easier than some other commodities as neither refrigeration nor freezing was needed, unlike the position for butter and beef.

There was also the distinct possibility that a bad harvest would allow the grain to be brought out of intervention. The other way of disposing of intervention wheat was subsidized sales on the world market. This was the feature that the traditional wheat-exporting nations objected to most strongly. If the EEC price was higher than the world price, which it usually was, then imports from outside the EEC had to pay a levy. This provided strong financial motive to try and move from using Canadian wheat. The British wheat that was mainly used instead was not, and is not, as fundamentally well suited to making bread by a long process.

Thus, although there were other issues in the move to shorter processes for bread making, the CAP supplied a push because it provided financial advantages for using EEC wheat. At the time of writing, the World Trade Organisation is pushing for the abolition of agricultural subsidies. If this happens, wheat imported into the EU will no longer be at a financial disadvantage. However, the baking industry is most unlikely to shift back to longer bread making processes. The one area where the use of long processes for bread making has increased is in domestic bread machines, which have increased domestic bread production markedly. Because these machines use a fairly long process the demand for very strong bread flour sold retail has also increased markedly. The baking industry is not just concerned with the production of bread, there is an important difference between bread and other baked products. Bread is regarded as a staple food and as such attracts regulation of its composition and sometimes price. Biscuits, cakes, pastries and pies are regarded as discretionary purchases and avoid regulation. Bread production is an extremely competitive business while the production of other baked goods is not quite so competitive. Some supermarkets use cheap bread to attract customers. The supermarket management, knowing that bread is a basic necessity, reckon that if the customer can be lured into the supermarket with the offer of cheap bread then their trade can be captured. Producing the cheapest possible bread does not have a positive effect on quality. Some small bakers use a variant of the same trick by arranging the shop so that customers need to queue for bread in front of a display of cakes and pastries- which is intended to produce impulse sales. Another modern trend is the increased sale of filled rolls and prepacked sandwiches. The sale of filled rolls provides many small bakers with a very satisfactory source of profit.

The manufacture of pre-packed sandwiches is now a large industry, consuming large quantities of bread. Such sales growth is obviously caused by a population that is short of time rather than money. The two hardest decisions in writing this book are what to put in and what to leave out. While the length is decided by the publisher there is no room to produce an encyclopedia. An attempt has been made to cover examples of the commonest types of product. Inevitably there has to be a great deal about bread in this work but it is not solely about bread, other baked goods have their place in the book just as they do in the bakery industry.

In deciding what to put in and what to leave out, preference has been given to items that are thought likely to be useful to the reader or give an understanding of the current situation. This leads to information on nutrition being included while the genetics of yeast have been left out. It is a sign of the times that information on nutrition has been included ; if this work had been written some years ago it is doubtful if information on nutrition would have been included. At the time of writing there is considerable pressure on the food industry over the unhealthy diet of the general population. The major dietary problem of the western world at present is a diet with too much energy and, particularly, too much fat and salt.The excess energy might be explained by changes in working life as employment becomes less physical and more sedentary. A diet that would be entirely satisfactory for a manual labourer contains far too much energy for an office worker.

Nutritional facts of bakery and confectionary:

There are many nutritional facts for bakery and confectionary. when coming to bakery it provide various nutritional aspects like it provide many calories, in the form of fat, protein and carbohydrate, etc..

For example: Moon Pie

Nutritional facts for chocolate Moon Pie

- Serving size 1 (57g or 2 oz)
- Calories: 226 Calories from fat: 51
- Total fat: 5.79 g (saturated fat 3 .5g) Cholesterol: 0mg
- Sodium: 188mg
- Total Carbohydrate: 40g(dietary fiber 0g, sugars 12.5g)
- Protein: 4g Vitamin A:0% Vitamin C: 0% Iron:5%.

When considering about confectionary there are many providences such as they provide Energy carbohydrates, sugars, Dietary fibres, Fat, saturated, Vitamin C ,Calcium, Iron, Sodium.

Nutritional facts for Skittles candy

Nutritional value per 100 g (3.5 oz)

Energy 1,680 kJ (400 kcal)
Carbohydrates 90.7 g -
Sugars 75.6 g -
Dietary fibre 0 g
Fat 4.4 g -
saturated 3.9 g
trans 0 g
Protein 0 g
Vitamin A equiv. 0 μg (0%)
Vitamin C 66.7 mg (111%)
Calcium 0 mg (0%)
Iron 0 mg (0%)
Sodium 15.1 mg (1%)

Present trends of bakery and confectionary:

Peppiatt led a purchase of 121 of the former Three cooks shops in November 2006, saving 900 jobs, under the new brand Cooks the Bakery. The chain has since refurbished a number of existing Three cooks stores to the new brand, although a number of shops remain branded Three Cooks.

Peppiatt has since left the business, which is now run by Richard Prime(Managing Director) and Steven Greaves (Director). Cooks the Bakery is no longer involved in Van Delivery or Schools catering.

The company has B0 remaining shops, which it is slowly reducing". In example, the location in Horley, Surrey has been sold, and although not listed on the companies location directory, still carries the "Three Cooks" brand and uses branded packaging.

Many international brand companies are also providing many jobs and many products as respect to bakery.

Nutrient facts of Bakery and confectionery goods

Nutritional consideration in formulation of bakery product development in bakery technology- biscuits based on composite flour, biscuits with different flavours, special biscuits vitamin fortified, high fibre, low sugar and fat biscuits.

Protein in terms of quantity and quality is a vital nutrient. Wheat flour protein- 12-16% deficient in lysine essential amino acids- 80 the quality of bread is below mild and meat class.

Enrichment programme: Adding vitamin and minerals and improved protein quality at low cost evaded implementation. Now wheat protein addition-deteriorate the texture of bread. Low volume and organoleptic qualities. Each addition has its own draw back spending for commercial marketing.

Soya flour- soyaprotein isolates, sodium soy protein are valuable additions for bread – high quality protein also contain 3.2% to 3.8% lysine as compared to 0.35% in wheat flour. If 12g of soya flour is added to 100g of wheat flour, the lysine content will be doubled 0.76% - 0.83% product provide exceptional vehicle for nutritional improvement. High quantity improved quality – loaf volume, crush grain freshness retention etc.).

Milk protein – dried whole milk solids and low fat dry milk solids – in bread is cost effective, rich in protein abundantly available. 20 % protein bread, not successful and acceptable.

In order to attain 20% protein (dry wt) in bread using nonfat dry milk (as protein source) minimum 19% must be added to every 100 parts of wheat flour. Expt- more than six parts nonfat dry milk to 100 parts flour – causes – darkening, thickening, toughening of crust, low loaf volume, coarser grain, rougher texture less soft crumb.

Gluten – wheat gluten – 70% protein. Same addition has a desirable effect in bread. Four parts per 100 parts flour also causes undesirable shiny open texture/ grain bread. Also wheat gluten deficient in lysine. Addition of lysine mono hydro chloride is required for correction . Gluten change the task of bread, so unsatisfactory in taste, appearance and cost.

Key to protein enriched bread:

Calcium and Sodium stearoyl 2 lactylates: CSL and its sister product SSL successful food additive. CSL inc the tolerance of the dough to mixing and thus widens the mixing range to produce good quality bread –(mixing time) CSL inc gas retention capabilities of the dough – due proofing time inc loaf volume. It counter acts the dec in loaf volume usually bec of high level of fortification – soya flour, soya cone and milk solids.

CSK & SSL improves efficiency tolerance of bread dough – produce uniform quality. Knock back – prevent 'cripples' in bread dough – dec volume.

SSL- and in prot: Fortification of wheat flour.

Inc in SSL in wheat flour- inc high level of nonglutens flour without resulting in loss in volume and grain. Soya fortified wheat flour containing SSL is most successful bakery ingredient.

Glycolipide inc protein fortification level without unipouring consumes acceptance of high protein bread- No change in dough making process, formulation of production schedule or equipment. Natural and synthetic glycolipds – low priced, protein enriched bread and other baked product. Protein above referred to include soyaflour, defatted soyaflour, edible yeast and fish flour. Without adding glycolipids, a medium high level of protein supplement improves bread quality. High level of protein supplement with glycolipids – maintain consumer acceptance of enriched bread – protein content of 70% triple the cone of nutritionally limiting lysine.

Nutraceutical and Health additions.

Dietary guidelines introduced at global level to deal with malnutrition – Battle won in developed countries. Today amended to take care of predominant disorders. Healthy benefits of food and creating awareness. Nutraceutical can be defined as products that may be able to enhance health but which are not official drug.

Our country is not far behind the world as far as application of nutraceutical is concerned. India lacks in creating the awareness. Many product fell in this category- bread, biscuit, cookies, bakery filling, breakfast cereals, expanded snacks, unleavened bread.

Basic bakery ingredient – flour, salt, sugar and fat. Cannot bring a change in salt, sugar only flour can be modified by adding soya, amaranth – isoflowones, high protein, high fiber and solualve claims.

Another option – addition of whey solids to biscuits, cakes and bread – not only inc protein but BCAA content.

Saturated fats in bakery can be substituted by soya, corn or safflower oil. Alterosclrosis – in bakery filling partially fat can be substituted by low DE maltodextrins or chicory solids to reduce caloric contribution of filling. Jaggery can help in increasing the nutrial content of product – never it is tried by industry. Artificial sweetener if allowed in India more products can be developed to meet need of diabetics. Nutra centrial can take care of several disorder- osteoprosis CVD premenstrition syndrome and indigestion.

Blends blu – soya ragi, soya amoranth, soyaturmeric.

Product district nutracentrial calims

Product	Active ingredients	Claims
Cake, biscuits containing Cocoa etc	Phenylalamine	Antioxident enhance immune system function
Unleavened bread chapathis	Soyabean	Isoflewon fibre foli acid, protein
Eggless cake	Whey protein	Branched chain amino acids, easily digestible prot if highest PER and NPU. Immunoglobuline
Garlic bread	Dialyl sulphide	Lowers cholestero/ deactroates, cancer promoting ----, lower LDL cholestero, total cholesterol and triglyceides.
Biscuits	Tiger	Max calcium
Britania	Nutra choice	Max fiber better digestion
Modern bread	Whole atta bread	Max fiber

Limitation in use of soyabean:

Cannot be used as an additive as the CHO is not metabolized by the body. It cannot be purchased from grower and used in cooking – defriate processing is required.

Anti nutritional factors

- Trypin inhibitors – interfer in digestion of protein.
- Lectus – Haemogglutius interfer with O2 and iron exchange in blood.
- Goitrogens- interfer with iodine metabolism and lead to goitre.
- Flatus factors – Lead to excessive flatus generation.
- Beahy fishy grassy flavour – critical factor that lusts people away from Soyabean.

These factors are heat labile, - must be eliminates completely by processing.

The market for ‘farsan’ in India is Rs 7,000 cr. Hence the market for soy based product estimated at app. Rs 20cr. Most revert and hascent industry in the small scale unorganized sector. Other soy products leading are Miso form Pune, they manufacturing soyamilk and shubhanam from Nasik who manufacturing a combination atta (defatted soyaflour and wheat). The residue from oil extraction process is very rich in protein and used as animal feed or even human consumption as an additional ingria- in recipe formulation or as a substitute for basic ingredient. Nutrela, histri Nuggets. Soya offers therapeutic nutritional support.

Consumer product sector

Biggest segment of the market for processed soya products. Joglekar of Mumbai introduced ‘Soratan’ a soyaflour that can be easily incorporated into all types of food items cake, sev, chakki, kachai, vada, idli, dosa, khichidi, sulji and raita.

Therapeutic nutritional products are available chemis- like Delpro, - dry powder – natural fibre, Delsoy a ready- to drink soya liquid prep used for liver disorder, tube feeds, acidity ,cancer. Delpro Ep a dry soya based fine high protein powder useful in pregnancy lactation.

Improved remo material:

Apart from gulab jamun and idlies Pillsbury is providing cake mixes. The Company turnover is 2.5 cr for the first year after the launch. Pillsbury launched cooker cake mixes in India in 2000 Oct. The unique feature of this product is the ‘wet baking’ technique invented for pressure cooks. Same company owns Bethy crocker cake mixes- unique range in lis- those are for ovens.

Cakes, pastry and speciality western baked goods items oncet for 7% in terms of volume and 4% in terms of volume of Rs 4000 cr bakery industry in India. Primary challege for Pillbury instant mixes was to in bibe the cake making culture. Develop habit of cake making. This mix comes in three flavours, chocolate, sponge, strawberry.

Cooker cakes today sell 20 times more packs than those of actual packs of oven cake mixes. Pillbury tied up with mahila mandal to give demonstration and give samples for trial. Pan pizzas, baking coffine, brouning 60% of total sale from cake mixes.

Freeze and gain

Frozen dough in retail or bulk pack that can be thowed and baked or without some proofing available in western market slowly appearing in Indian scene. Amul introduced frozen pizza. Advantages of frozen dough- skilled labour not required, less labour, same time storage of raw material and cost of equipment.

Three types :- frozen products

- Bake off products that need to be thawed, proofed, and then baked.
- Fully baked products that need to be heated only to thaw and warm them before consumption.
- Paraboiled products that are partially baked and frozen these need thawing and then finish baking before consumption.

Freezing process put severe strain on the dough the wheat flour must have a moderate protein content in order to have a good dough strength inedibility with fully developed gluten in order to have good volume and crumb structure. Another problem freezing deleterious to yeast activity. Dough develop during mixing- reduced fermentation. Salt and yeast added in beter part of mixing.

Dough should be fully developed before freezing without rise in temperature. Freezing carryout rapidly- thawing, fermentation baking. Double yeast is added. Fresh/ compressed.

Frozen dough – proper solution of emulsifiers – (0.1-0.3% esters or ethoxylated monoflycerides and SSL) enzyme amylose, xylanase, etc) and dough conditions (bromate ascorbic acid etc) also give better frozen dough.

Germ and stabilizers are very important in the texture of final products, these additives have coated holding capacity give proper texture and control crystals formation and damage to gluten structure.

Variety of products like wafers, pancakes, coffins – frozen – refrigerated dough, paraboiled products developed – reduce labour.

Lecture-2
Raw materials used in Bakery

Flour

Flour used in bakeries, is obtained by milling wheat. Flour is the most important single ingredient, without which production of white bread, as is known in present times, would be impossible. It will, therefore, be well to know something about wheat – particularly U.S. Wheat which is ideally suited for a multitude of uses.

Wheat is a classified according to the hardness and colour of the kernel. Wheat, therefore, vary widely in properties depending on the variety and area where grown. They may be loosely grouped into two general headings as hard and soft. The hard wheat include hard spring, hard winter and durum. The hard spring and hard winter wheats are the types most desirable for bread production.

Durum wheat is produced principally in two varieties, amber durum, which is used chiefly in making elementary pastes such as macaroni, spaghetti, noodles, etc, and red durum which has very little value for milling and is used principally as feed.

The quality of wheat is determined by several factors including climate, variety of wheat sown, and the soil.

The physical structure of wheat consists approximately of:

Bran	
Outer skin or epidermis	
Second skin or epicarp	
Third skin or endocarp	15%
Fourth skin or testa	
Fifth skin or aleurone layer	
Germ	2.5%
Endosperm	82.5%

In the production of flour for baking both bran and germ are removed during the milling process. Removal of bran is necessary because sharp edges of bran will tend to cut the cell structure of the loaf during proofing thereby affecting volume of bread. Fermentation and proofing are the processes which take place after mixing when the dough is kept under controlled conditions. Bran is high in nutritive value, and is mostly used for animal feed. The germ is removed from the wheat during milling, because the germ which is high in oil will affect and keeping quality of flour.

From 100kg of wheat, 72% extraction is known as 100 percent straight flour consisting of all the streams. The word ‘stream’ is used in milling technology which means flow of flour in continued succession from different stages in the flour milling process.

The remaining 28 percent consists of bran and shorts, which is akin to resultant atta. This is mostly used for feed and industrial purposes in the United States.

During milling the endosperm particles must themselves be classified according to their size. The manner in which these particles are separated is called ‘separation’. Extraction refers to the percentage of flour which had been extracted from wheat kernel.

Therefore, an average flour, depending upon extraction and separation, will consist of the following:

Starch :70%
Moisture :14%

Protein	:11.5%
Mineral(ash)	:0.4%
Sugar	: 1%
Fat (liquid)	: 1%
Others	: 2.1%

All flours are not of the same composition percentage-wise. The variation noticeable throuogh analysis, when dough is made, are due to the effects of climate, breed of seed, the type of seed, the type of wheats blended and proportions of the wheat used during blending. The storage period of wheat will also affect the quality of flour.

Types of flour

Different types of flour are used for different types of end products. Flours are identified as First Patent, Short Patent, Medium Patent and long Patent. Characteristics of these flours are determined by percentage of separation obtained from a 72% extraction.

First Patent constitutes 70% separation from 72% extraction. Short Patent constitutes 80%, Medium Patent 90% and Long Patent 95% separation from 72% extraction.

First Patent is used as cake flour and is obtained from soft wheats.
Short Patent is used for premium brands of breads
Medium Patent is used for featured brands of breads.
Long Patent is used for competitive brands of breads.

Cake flours should contain less than 10% protein and 0.4% ash, and should have low absorption. Ash content of flour is considered as a measure of the degree of separation of the flour from a particular wheat blend but is not a reliable index of baking industry.

The value of wheat over other cereals lies in its gluten forming properties. It is believed that the proteins contained in the outer portion of the wheat berry (aleurone portion) are stronger and harder than those contained in the inner portion (endosperm). However the quality of the proteins may vary depending upon the varieties of wheats, which make up the mill mix, and the condition under which the crop was grown. Quality of proteins is a more important factor in determining baking properties of a flour than the protein quantity. Therefore, because of variations in protein quality, the protein quantity cannot be considered as a reliable index of baking quality. Loaf potentialities are determined by gluten quality and quantity.

Flour Enzymes, Characteristics and pH value

Enzymes

Flour contains two enzymes which are essential to bread production. These enzymes are Beta-amylase and Alpha amylase. These enzymes develop in the wheat berry during the initial stages of sprouting.

Beta-amylase converts dextrins and a portion of soluble starch to maltose which is essential for an active yeast fermentation.

Characteristics

It is wish of every baker to use flour having the following characteristics for the production of quality bread:

1. Colour
2. Strength
3. Tolerance
4. High absorption
5. Uniformity

Colour: Flour should have a trace of creamish colour; otherwise, the bread will have a dead white crumb. Bleaching of flour contributes towards the control of degree of creaminess. In the case of bread it can be controlled by modification in baking formula,mechanical tratment of the dough, and by addition of ingredients which will effect the colour of flour.

Strength: It is often said that the flour is strong or the flour is weak. Such statementws refer to strength of flour which is capable of producing a bold, large volumed, well risen loaf. For the production of quality bread, strong flours need a longer fermentation period than weak flours. The quality of flour is decided by the amount of fermentation it will stand. Bread flour should be such that the dough made from it will retain its shape after being moulded.

Tolerance: The ability of flour to withstand the fermentation process and to produce a satisfactory loaf over a period of time, in excess of what normally is required to bring about the correct degree of ripeness for that practical process means tolerance.

High absorption: This refers to the ability of flour to take on and hold the maximum amount of moisture without additional mixing for full development of dough. It the dough is not given the required mixing time because of limited mixing capacity, or for other reasons, the baked product will lack volume and have a dry crumb and inferior eating and keeping qualities.

Uniformity: This is also an important aspect which should not be overlooked. If the flour lacks uniformity it will require constant checks and modification which are mostly considered as unproductive chores.

pH value

The pH value of water solution is a number between 0 and 14 and represents the acidity or alkalinity of the solution. When the pH is 7, the water is said to be neutral. When the pH, is below 7, the solution is said to be acid. The lower the pH, the more acid is the solution. Conversely, when the pH is above 7, the solution is alkaline, the higher the pH, the higher is the alkalinity.

Flours with pH value below 5 are generally too acid and give poor result in bread baking; the range for satisfactory flours is usually between pH 5.5 and pH 6.5.

Acidity plays a part in maturing gluten during fermentation and increase gas production by increasing enzymic activity. The acidity produced in fermentation improves flavour and palatability; flour acidity can be increased, if desired, by controlled chemical treatment.

If the pH value is lower than 6.1 to 6.2, it is customarily taken as an indication of chlorine treatment in the bleaching process. This treatment is of extreme importance in the control of quality in high ratio cakes where pH value would be expected to fall in the range of 4.6 to 5.0 depending on the characteristics of the wheat being milled.

The measurement of pH value is normally performed either colorimetrically by means of standardized indicator solutions, or more accurately by means of a pH meter.

Starch, Flour Testing and Storage

Starch

On an average, 100 kgs of flour contains 70kgs of starch. Starch is carbohydrate-a compound made of carbon, hydrogen and oxygen. A starch granule is made of several hundred molecules of dextrose. A molecule is a very tiny particle. Dextrose is a type of sugar but is not as sweet as sucrose.

Several hundred molecules make one granule. Starch granules are very resistant to mechanical alterations and also resist chemical changes. A raw starch granule will only absorb water to about one third of its weight but when cooked absorbs several times its weight of water and also increases to several times of its original size.

When starch is cooked in water the small granules do not change until a temperature of about 135^0 to 140^0F or 57^0C to 70^0C is reached. This process is known as gelatinization. Complete gelatization takes place at 190^0F or 88^0C. Therefore, generally speaking when starch is heated in water to a sufficiently high temperature the granules absorb water and swell to a larger size.

Alpha-amylase, which is an enzyme found in flour, is essentially required for yeast fermented goods, because due to its actions good fermentation and good gassing power results. If the percentage of alpha-amylase is less in flour, diastatic malt is added. If an excess of diastatic malt is used in a dough the crumb of the bread may be sticky or gummy. This sticky material is called dextrin.

In fermenting a dough, starch must be changed to sugar for good gassing power. Enzyme amylases change starch to sugar. During fermenting dough, amylases act on damaged or broken starch granules which result during the milling process. The amount of damaged or broken starch in bread flour is usually 5 to 7%.

Flour Testing

There are several methods of testing flour. Some of these tests are grouped into four categories, namely (a) chemical analysis (b) Physical methods (c) Physical Examination and (d) baking test

Chemical Analysis includes following tests:

i). Moisture: Normally flour should have 14% moisture. Excessive moisture adversely affects the keeping quality of flour and is undesirable from an economic standpoint also.
ii). Ash: It determines mineral matter in flour and therefore is considered as a measure of the degree of separation of the flour from a particular wheat blend but cannot be considered a reliable index of baking quality.
iii). Proteins: This will give the quantity of proteins but for baking purpose both quantity and quality are required.
iv). Maltose and gassing power: This will indicate activities of Beta and Alpha amylase.

Physical Methods are those where sophisticated equipment is used for determining quality of flour. These include:

i). Amylograph which measures alpha-amylase activity.
ii). Farinograph measures strength of flour for commercial mixing operation.
iii). Extensograph indicates the loaf volume potentialities.
iv). MacMicheal Viscosimeter indicates the amount of bleaching that flour has undergone. Bleaching incidentally weakens proteins.
v). PH value indicates the acidity or alkalinity.

Physical Examination will include following:

i). Pekar Colour test indicates the separation.

Baking test: A standard lab-scale baking test will indicate in a general way the baking qualities of a given flour, although slight difference may be noted when large commercial batches are made up in the machine-equipped bakery. Some bakers, inspite of the shortcomings in this method, are of the opinion that actual baking test gives the best overall evaluation of the flour quality.

Water

Sources, Types, Functions and Usages of Water

Water, like any other common ingredient of bakery products, must be uniform in order to obtain uniform results in the products, If the water supply is constant in hardness and pH, then once the formula has been adjusted to meet the requirements of the water there probably will be no problems from the water. If, however, the water supply varies then adjustment in the formula will need to be made.

Sources of Water

There are several sources from which water can be obtained. These have been classified into the following categories :

1. Sea water which is the salt water from oceans and certain seas and lakes without outlets.
2. Deep Earth water which results from volcanoes and geysers.
3. Natural water that comes from rain or snow, and is present in fresh water lakes, streams, springs and wells.

Water can contain minerals, can easily get contaminated, and can pick up natural impurities.

Types of Water

Water may be classified into six different headings consisting of soft water, hard water, Alkaline water, Acid water and Turbid water.

Soft water has low content of dissolved minerals whereas Hard water contains dissolved minerals in an appreciable amount. Hard water can either be of temporary hardness or of permanent hardness.

When alkali is present in the soil, water tends to become alkaline. Acid water is often found in areas where there are mines, mine wastes, and in water receiving the waste from industrial processes. Acid water is a rarity from a natural source.

Saline water contains traces of common salt there by making it sensitive to taste.

Functions of Water in Baking

Water has functions in bread making. It makes possible the formation of gluten. Gluten as such does not exist in flour. Only when flour proteins are hydrated, gluten is formed. Water controls the consistency of dough. Water assists in the control of dough temperatures and warming or cooling of doughs can be regulated through water. It dissolve salts; suspends and distributes non-flour ingredients uniformly. Water wets and swells starch and renders it digestible. Water also makes possible enzyme activity. Water keeps bread palatable longer if sufficient water is allowed to remain in the finished loaf.

Correcting Water for Usage

Water, which is low in minerals, is used during fermentation of the dough the gas production will be practically nil and gas retention will be poor. Resulting doughs will be sticky. For correcting this situation the amount of mineral yeast foods may be increased a little or the amount of salt in the dough may be increased slightly.

Medium hard water does not affect gas production and the gas retention is also good. This water is best suited for the bread production.

Very hard water due to temporary hardness retards fermentation due to tightening of the gluten. This water should be boiled, cooled and filtered before use. Any mild edible acid may also be used as a corrective agent.

Very hard water which is due to permanent hardness also retards fermentation due to tightening of the gluten. Several ways can be used in correcting this situation. These include use of enzyme supplements, longer fermentation periods, decrease of mineral yeast foods, usse of edible acids, increase of yeast, or mixing with soft water.

When water contains Sodium Chloride, commonly known as table salt; the gas production will be reduced due to its action on the yeast. It also toughens gluten. This situation can be corrected by simply reducing the salt in the formula.

Presence of iron in the water gives an undesirable colour to the doughs. The simplest correction method would be to filter water and remove the iron traces.

Water containing more than normal acids will hasten fermentation. The gas retention will be poor because acids will soften gluten. Here again the simple method to correct this situation would be to use lime and filter the water before using it in the bread production.

Alkaline water, which, is more than normal pH, will retard fermentation. It dissolves and weakens gluten. Several simple methods can be applied in correcting the situation. If the water is medium hard, use vinegar, or lactic acid, or calcium acid pyrophosphate; if the water is soft then use edible acid and mineral Yeast food.

Salt

Common salt or table salt is used for bringing out the flavour of other ingredients which are used in cakes, and other products. Instead of reducing sugar in the cake formula, salt should be used as an adjustment of sweetness if the cake is too sweet. One of the functions of sugar is to retain moisture in the cake. It is therefore, better to increase salt to tone down the excessive sweetness. Salt also lowers caramelization temperature of cake batters and aids in obtaining crust colour.

In bread production, salt is mainly added for taste. It brings out the taste of other ingredients, and helps to improve the flavour and characteristics of bread. Salt is a toughner. Without salt the doughs are wetty. It therefore, improves grain and texture of loaf by strengthening the dough, thus indirectly helping colour, grain and texture.

Salt helps to control in yeast raised doughs, the action of the yeast and thereby controls the rate of fermentation. Salt also aids in preventing the formation and growth of undesirable bacteria in Yeast-raised doughs.

Amount of salt to be used depends on several factors but mainly upon the type of flour. Weak flour will take more salt, because salt, gives strengthening effect to proteins. Another factor which will determine the amount of the salt is the formula used.

Table salt should have the following characteristics for use in the bakery:

a) It should be completely soluble in water.
b) It should give a clear solution. Cloudy solution will indicate presence of certain impurities.
c) It should be free from lumps.
d) It should be as pure as possible.
e) It should be free from a bitter or biting taste.

Lecture-3

Yeast

The function of yeast in bread making is to lighten the dough and impart to it a characteristic aroma and flavour. This has been the function of yeast for centuries and remains so even though its activities have been improved over a period of time through scientific modifications in its manufacture and a broader understanding of breadmaking methods.

Yeast is a microscopic one-celled plant belonging to the fungus order, which ordinarily multiples by a process known as budding and which causes fermentation when placed under suitable conditions.

There are about 3,300 known species of yeast. Only a few of them have been grown for the baking trade. Yeasts have been found in nature wherever there is sugar.

Initially yeast was produced by using the German grain process which yielded both yeast and alcohol. The yeast produced, because of its insolubility, did not meet with the requirements of the bakers and therefore, this process had to be discarded.

Enzymes

Yeast is a very potent source of supply of enzymes. An enzyme is produced by living cells, either animal or vegetable. When an enzyme is brought into relation with certain organic compounds, its action usually, though not always, tends to decompose them into simpler combinations without itself undergoing any change. An enzyme acts only in solution. Enzymes are sensitive to hat and pH. Yeast contains small amount of several enzymes including Protease, Lipase, Invertase, Maltase and Zymase. The important enzymes in yeast are Invertase, Maltase and Zymase.

Protease: The protease can soften flour proteins and therefore, it can cause great changes in the structure and properties of the dough. However, the Protease in normal healthy bakers yeast are intracellular enzymes meaning that they are not able to pass through the cell membrane.

Lipase: It seems to be intracellular and acts on the fats which it encounters within the yeast, especially during sporulation. These fats are the reserve products for the cell during the maturation of the reproductive spores. The Lipase of a few species of yeast is able to diffuse through the cell membrane.

Invertase: In most species of yeast, Invertase is an intracellular enzyme. The sucrose, cane sugar, enters the cell wall, is changed by Invertase to glucose and fructose which are simple sugars. These sugars then diffuse through the membrane.

Maltase : This enzyme, found in yeast, splits maltose sugar into two units of dextrose.

Zymase Zymase is the enzyme that finally turns the trick in dough fermentation of sugars by yeast. It is encompassed by the complex group of enzymes collectively termed as 'Zymase'.

In bread production certain molds and bacteria can produce alcohols, but yeast is the most efficient agent.

Functions in dough making:

The carbon dioxide produced by fermentation makes the dough rise. The carbon dioxide is a colourless, tasteless, edible gas obtained during fermentation or from a combination of soda and acid. In order for yeast to work at its best, the following requirements are needed: a) a balanced nutritional diet of sugar, nitrogen, minerals, vitamins and water and b) air, optimum environment of temperature, enzymes, oxygen, acidity, nutrient concentration and time.

Yeast derives fermentable sugar from four sources: a) the yeast cell, b) the flour, c) hydrolysis of starch and d) sugar added intentionally in the formula.

Yeast ferments and grows best in acidic environment, tolerating as low as pH2 and then adjusting to its preferred pH near 4.5.

Properties:

Compressed bakers yeast as compared to dried yeast perishes more rapidly under normal conditions. Compressed yeast loses comparatively little of its fermenting power under domestic refrigeration (35^0F or about 2^0C) for four to five weeks. It can be stored in the frozen state for much longer periods. Storage at temperatures below 26.6^0F or 3^0C destroys the life and hence the fermenting power of compressed bakers yeast. Compressed bakers yeast is approximately 30% solids and 70% moisture.

Dried bakers yeast is in the form of small dried pellets and is normally packed in nitrogen filled tin plate containers to ensure the longest possible life. Active dried yeast is approximately 92% solids and 8% moisture.

Storage

Since compressed and dried yeasts consist of live vegetable cells, they, therefore, require careful storage.

The compressed bakers yeast must at all times be stored under refrigeration as mentioned above.

The dried bakers yeast need not be stored under refrigeration, but if this facility is available, such storage will considerabley increase the useful life of the yeast, the ideal temperature for storage of dried bakers yeast over prolonged periods is 45^0 F or 7^0C, and it should be kept reasonably constant.

Lecture-4
Sugar and Milk

Sugar

It is reported that the sugar cane was cultivated in India as early as 400 B.C and was later introduced into Europe. The refined granulated sugar commercially produced in India is derived from sugar cane. It is also produced from sugar beets in several countries. It is 99.9% pure sucrose. Sucrose is a term used to mean refined cane or beet sugar. Chemically speaking there are two types of sugars: a) simple sugars which include glucose or dextrose, fructose and glalctose and b) Compound sugars which include sucrose, maltose, lactose etc. The functions in the bakery products are not performed by all sugars to the same degree.

Sugar properties:

Hydrolysis: Compound sugars like sucrose are split into their component sugars by specific enzymes or acids. Maltose and sucrose are hydrolyzed by the enzymes maltose and invertase, respectively. Both these enzymes are present in bakers' yeast. Those reactions take place in the dough before the sugars are fermented. Sucrose is converted into two simple sugars, fructose and dextrose, so rapidly that the hydrolysis is complete a few minutes after mixing and it is so thorough that practically no sucrose is detectable in the finished bread. In contrast, almost all of the original lactose content remains in bread because yeast does not have an enzyme to hydrolyze lactose.

Yeast Fermentation: Glucose, fructose, sucrose and maltose are readily fermented by bakers' yeast to produce carbon dioxide and alcohol as principal end products. Lactose is not fermentable because baker's yeast lacks the enzyme which could split this compound sugar.

Residual sugars: About two per cent of the sugars added, based on flour, are used up during the bread fermentation. The remaining sugars which are present in bread are called 'residual sugars'. Therefore, the higher the percentage of sugar used in the formula, the higher is the amount of residual sugars.

Sweetness and flavour: since there is no physical or chemical test for sweetness it must, therefore, be related to taste.

Hygroscopicity and Hydration: Hygroscopicity is the ability of a substance to absorb moisture and retain it. Some sugars are more hygroscopic than others.

Heat Susceptibility: When sugars are heated, molecules combine to form coloured substances called 'Caramel'. Sugars vary in their heat sensitivity, i.e the temperature at which they begin to caramelize. Fructose, maltose and dextrose are more sensitive and lactose and sucrose are the least. By lowering the pH of the sugar solution, fructose and dextrose become less sensitive.

Browning reaction: Reducing sugars, when heated with proteins, react to form dark compounds called melanoidins.

Solubility and Crystallization: The difference in solubility of sugars can be used to control crystallization in products that require higher amounts of sugar.

Siftening: The tenderising action of sugars in baked products with the resultant improvement in texture, volume and symmetry may indirectly be attributed to the ability of sugar to hold water.

Functions of sugars in Bread:

Sugars perform several functions in bread. Sugars are the source of energy for yeast activity. Sugars are either provided by starch hydrolysis or by direct addition to the formula. The flavour of bread is improved and the crust colour is darkened by addition of sugar. The texture and grain become smoother and finer with added sugar. The basis for this is not well understood. It may be related to the action of sugars on delaying the gelatinization of starch and the denaturalization of protein.

Milk

'Bread is the staff of life' and should be of best quality. If a baker is to maintain a reputation for his bread, he must never let down on the quality of the ingredients used. Quality flour, yeast, sugar, shortening and milk all impart something to finished loaf.

Definition and composition:

Milk is actually an emulsion of tiny parts of fat in a water solution of protein, sugar and minerals. Emulsion may be defined as a stable solution of fat, water and other ingredients which will not separate on standing. The composition of milk differs somewhat depending on a number of factors. However, the average composition will be approximately as given in the table below:

Composition of Milk

Water	:	87.75%
Tatal Solids	:	12.25%

The 'total solids' portion may consist of the following:

Fat (butter fat)	:	3.50%
Proteins	:	3.25%
Minerals (or ash)		0.75%
Lactose (milk sugar)		4.75%

The 3.25% protein consists of 80% casein and 20% albumin. The specific gravity of milk is between 1.025 and 1.035.

Types of Milk:

There are several types of milk and milk products that are available and could be produced. These can be classified into three general groups namely: 1) Fresh products, 2) Concentrated products and 3) Dry products.

Functions of Milk

While using milk in bakery products, it should be considered in two parts. These refer to 1) water 2) total solid contents in milk.

The water in liquid milk could range between 12 ½ % to 90% depending on the type of milk. The water has a number of functions when present in proper quantities. It contributes towards eating qualities. The water in milk combines with the other ingredients. In order to have flour develop structure water is absolutely necessary. In order for sugar to be a tenderizer, moisture must be present. Thus the moisture of the milk is neither a toughner not a tenderizer, but when combined with other ingredients may contribute to both toughness and tenderness in the products.

The milk solids have a binding effect on the flour protein, creating a toughening effect. They also contain lactose which helps to regulate crust color. They improve the flavour and are important moisture retaining agents.

If liquid forms of milk are used, the water content should be taken into consideration for adjusting the formula.

Advantages of using Milk solids in Bread Production:

There are several advantages that could be derived from adding milk solids in the bread dough. These are listed below:

1) *Increased Absorption and Dough Strengthening*
2) *Increased Mixing Tolerance*
3) *Longer Fermentation*
4) *Better Crust Colour*
5) *Better Grain and Texture*
6) *Increased Loaf Volume*
7) *Better keeping Quality*
8) *Better Nutrition*

Storage of Liquid Milk

Fresh or pasteurized milk should be stored under refrigeration at 38^0-40^0F or 3^0-5^0C before use to prevent changes due to bacterial growth. Though harmless the bacteria in milk increase at a very rapid rate at higher temperatures. Pasteurizing is usually done by heating milk and maintaining it between 140^0-145^0F or 60^0-63^0C for 30 minutes then quickly cooling it to 50^0F or 10^0C or lower.

The primary purpose of pasteurization is to kill disease producing bacteria. Some harmless bacteria survive pasteurization, and these will cause the milk to sour if it is not properly stored.

Lecture-5
Leaving Agents

For many years man has preferred baked products which are leavened. The main reasons for this preference are:

1) Baked products so made are light, and therefore easily chewed

2) Because baked products made with leavening have an open or more porous grain than unleavened products, the digestive juices come in contact with the food more readily and digestion is greatly facilitated.

3) Baked products made with leavening agents are more palatable and appetizing than those made without leavening.

Any process by which dough or batter is filled with holes which are retained upon baking is a leavening process. Any material which brings this process is called a leavening agent.

Types of leavening :

The leavening of baked products may be brought about by four general methods:

1. By means of air (mechanical)
   a. By creaming action- The old fashioned pound cake is a representative of the class of cake raised by this process, where the air is 'whipped' into the shortening and sugar during creaming and expands when heated in the oven to cause the cake to rise.
   b. By beaten eggs- We all know that when eggs are beaten they become fluffy and foamy because of the whipped in air.
2. Liberating carbon dioxide gas in the dough by means of yeast action- An example of this method is bread.
3. Producing leavening action by use of chemicals- Examples of such chemicals are:

a. Baking Soda	b. Baking Powder
c. Baking cream	d. Ammonium Carbonate

4. Water vapour – As the temperature of a cake batter or bread dough increases (in the oven) water is changed into water vapour (and some eventually steam), thus exerting a greater pressure.

Baking Soda as a Leavening Agent:

Baking Soda is known chemically as sodium bicarbonate and has the formula $NaHCO_3$. Baking Soda will liberate carbon dioxide, a leavening gas, when heated. It will also liberate this same gas, when it is mixed with an acid, either hot or cold. When baking soda is heated the products formed are carbon dioxide, water and sodium carbonate (washing soda). The chemical action is as follows:

$$2NaHCO_3 \xrightarrow{\text{Heat}} CO_2 + H_2O + Na_2CO_3$$

From the above chemical action we can see that if soda alone is used as a leavening agent a residue of washing soda will remain in the cake. This residue, when present in excess, gives the cakes a dark colour and taste. The reason for this is that the washing soda so formed will act upon the shortening which is in the cake batter forming soap. This causes an unpleasant taste and brown colour.

Baking Soda+ an Edible Acid Ingredient:

It has been recognised since early times that soda will produce a better cake if some type of acid ingredient is added to the batter. The ingredient will react with the soda, producing the leavening gas, carbon dioxide and an edible residue in the cake. This edible residue does not harm a cake as does the residue formed when soda alone is used.

Some of the acid ingredients used with soda are:

1. Sour Milk
2. Honey
3. Molasses
4. Invert sugar
5. Lemon juice
6. Butter Milk

Leavening by use of one of the above ingredients is not practiced in commercial bakeries today because it is extremely difficult to achieve uniform results. The result of this search was the mixture commonly known as baking powder.

Baking Powder:

Baking powder is the leavening agent produced by mixing an acid reacting material and sodium bicarbonate with or without starch or flour as filler. Since all baking powder must consist of baking soda the only way in which these can differ is in the type of acid ingredient used. Generally tartrate, Phosphate and Sulphate powders are used as acid ingredient. A baking powder should release its gas in the batter to saturate it with carbon dioxide gas and then liberate the gas uniformly during baking to hold the raised batter until set. This tends to give a uniform crumb and prevent shrinkage and cakes from falling.

Double acting Baking Powder:

This type of powder consists of two acid ingredients- one fast acting and one slow acting.

The fast acting part of this type of powder usually consists of calcium acid phosphate. These are the powders which release a good share of their leavening gas in a relatively short time after mixing and continue to release gas rather rapidly during the depositing operation and while the batter is on the bench.

The slow acting ingredient will be either sodium pyrophosphate or sodium aluminium sulphate. These are the powders which do not release the greatest percentage of their leavening gas until the batter is heated in the oven. It is important to use a powder which has delayed action that a minimum of the gas is lost in the batter stage. This will be appreciated if one considers that a proper amount of carbon dioxide gas set free in the batter stage makes the batter smooth flowing and acids in scaling and panning.

Ammonium Carbonate and Ammonium Bicarbonate:

Either ammonium carbonate or ammonium bicarbonate is used t a small extent as a leavening agent. Its use is primarily limited to certain types of cookies. The advantage of this type of leavening agent is that it decomposes into two gases and does not leave a solid residue.

There is distinct disadvantage in using either of above leavening agents in baked products with a higher moisture contents because of ammonia gas being soluble in water remains in the baked products and imparts to it a very disagreeable taste and odour. It is for this reason that the use of ammonia salts as leavening agents in baking is limited to those products which are small and porous units so that the ammonia fumes can bake out.

Amount of Baking powder to be used:

Amount of baking powder to be used depends upon the type of product, the character and amount of ingredients (like shortening, eggs) employed and the altitude of the place.

It is highly important to be sure that the exact amount of baking powder required is carefully scaled. If the quantity of baking powder is excessive the cake will collapse or shrink after rising in the oven. The crumb colour of the cake will be dark and the taste will be foreign or salty. If too little is used the cake may not be sufficiently leavened resulting in a dense, heavy structure which lacks volume and good eating qualities.

Use of starch in Baking Powder:

As we have pointed out previously any baking powder consists of three parts namely:

1. Sodium bicarbonate (baking soda)
2. An acid salt
3. Filler – usually starch

We have discussed the soda and acid part of baking powder so at this point we will discuss the filler. A filler in baking powder is necessary for several reasons. The most important of which are the following:

1. To keep the soda particles and acid particles from intimate contact and thereby minimizing the possibility of premature action.
2. To act as an absorptive medium for free moisture incorporated into the powder during manufacture or assimilated in the course of storage.
3. To facilitate handling and measuring in actual use.

Pure white, redried corn starch meets all the requirements of a good filler and is the one usually used.

Always use the freshest possible baking powder and store in a clean dry room with lid tightly covered when not in use.

Lecture-6
Spices

The spices are used in comparatively small quantities in the baked products. These are quite important ingredients-even indispensable, as their presence, even though in small quantities does improve the eating qualities of the products as well as the physical characteristics.

A baker can add a variety of tastes to the baked products by choosing fresh and high quality spices.

Cinnamon

This is the most widely used spice. This plant is grown in China, Indo-China and Indonesia. Cinnamon is used in making of cakes, cookies, pies and custard fillings. It is also widely used in various varieties of Danish pastries.

Cardamom Seed

Cardamom is mostly grown in India and Sri Lanka. Cardamom is mostly used in nankhatai, cookies, Danish pastries, and in the fillings of éclairs and pies.

Ginger

Ginger is the root of tuberous plant mostly grown in India, Jamaica and Africa. Ginger grown in Cochin is considered to be of the best grade for baking.

Cloves

Cloves are the dried, unopened buds of an evergreen tree grown in Indonesia, Zinzibar, Madagascar.

Nutmeg

Nutmeg is the seed of evergreen tree grown particularly in Molucca Islands, Indonesia and the West Indies. This Spice is used mainly in doughnut and pastry crusts.

Mace

It is aromatic spice consisting of the dried external fibrous covering of a nutmeg. This is mainly used in sponge and pound cakes, cream fillings of éclairs.

Poppy Seeds

Poppy is raised in Turkey, Iran, India, Netherlands, Russia and Poland. There are two varieties of poppy-creamish white and blue poppy. Blue poppy seed is considered the best as it is used for grain as well as for flavour. The seeds are mainly for sprinking on tops of variety bread and rolls.

Caraway Seeds

Caraway seed is the fruit of the tree belonging to the parsley family. It is grown in Europe particularly in the Netherlands and Poland. In the baked products it can be used as whole as well as ground. This is a must in the making of rye bread and it is also used in rich fermented cookies-known as ‘Surti Butters’ –most popular variety of the baked products on West Coast of India.

Seasame seeds

Seasame seed is a small honey coloured seed grown mainly in Turkey and India. It is used for topping the bread and rolls and when baked imparts delicious, roasted nut flavour to the crust.

Allspice

It is a fruit of the pimento tree which is grown in Jamaica, Mexico and other parts of central and South America. These fruits are dried and then ground. Their flavour resembles the blended flavour of nutmeg, clove and cinnamon. Its uses in baking are for making fruit cakes and cookies and also in filling of pies.

Storage of Spices

The volatile oils in the spices contain the aroma and flavouring of the spices. In order to retain the strength of these oils, spices should be stored in an airtight container. Storage room should be dry, cool and airy.

Flavourings

Flavour may be defined as the sensation of smell and taste mingled. Flavour is an important ingredient in a sweet goods formula. Flavour is really the ingredient which helps the baker to add a uniqueness to his product. Appearance may be an eye-catching factor in the first sale of any baked product but flavour holds the key to all subsequent sales. The general accepted components of taste are: "Sweetness, sourness, saltiness and bitterness."

There are various sources through which the baked product can acquire its unique bakery flavour.

1. It can acquire the flavour during the processing of the product, i.e during baking, fermentation etc.,
    a. Fermentation
    The total fermentation time has a profound influence upon the end flavour of the baked product due to the biological changes that take place during the fermentation. Breads made from sour dough or overnight sponge have a different flavour from the breads made from short sponges and straight dough process.
    b. Baking
    The process of baking brings about two important changes which add flavour to the product:
        i. Brown reaction
        ii. Caramelization

Flavour Additives

These additives can be divided into three groups:

Natural, synthetic and imitation (with unlimited combination of all three)

1. Natual:
    a. Basic ingredients added to the formula: forms of sugar and syrups i.e honey, molasses malt syrup etc, ground fresh fruit, cocoa, chocolate etc.,
    b. The essential oil of citrus fruits such as oil of lemon and oil of orange and vanilla extract
2. Synthetic: The quantities of flavours present in the fresh fruit are very small. If the flavour from the fresh fruit was to be used singly alone in the formula, large quantities of ground, sliced fruit will be necessary to bring about the

desired level of flavour. This will not only unbalance the formula but will make it impracticable. If this natural flavour is fortified with synthetic flavour it will have more taste appeal than the use of natural flavours alone.

3. Imitation: The imitation of natural flavours are rarely used alone but are blended with fruit juices and essential oils to give a better result. Imitation flavours are not found in nature but used to reproduce the natural flavour.

Classification of Flavours:

i. Non-alcoholic flavour: These are prepared by dissolving ingredients in Glycerine propylene, glycol or vegetable oil. These help to retain the flavour during baking by reducing vaporization.
ii. Alcoholic extract: These flavours are dissolved in ethyl alcohol. They are too volatile for use during baking but are very suitable for icing and fillings which do not undergo baking.
iii. Emulsifiers: These flavouring oils are dispersed in gum solution which help to obtain an even distribution through batter and dough and also maintaining stability during baking.
iv. Powdered flavourings: These are prepared by emulsifying components in heavy gum/water solution, then spray dried to form powders.

Anything can cause off flavours in the baked products and some of the causes are:

1. Inferior Ingredients: These are the prime causes for end products having off flavours-musty flour, mouldy cake or bread crumbs, eggs which are not fresh, shortening low in anti-oxidant, spoiled milk etc.
2. Unbalanced Formula: The formula should be balanced in such a way that the total effect of this should have an appealing blending of the foundation flavours of all the ingredients included in the formula.
3. Inferior flavourings: Not only the inferior flavourings but too much of the flavouring will also give the product an off flavour.
4. Wrong pH: This can happen if an excess of soda is added in the formula or if there is too much of acidity produced in the product.
   Excess of Soda in the formula will have the undermentioned defects in the end products:excessive caramelization, crumbliness and poor texture, dryness and discoloration of the crumb and soapy taste. Each of these faults individually or in combination has a direct effect on the flavour and aroma of the finished product.
5. Faulty baking as well as faulty processing: These will cause either excess or lack of flavour.
6. Unclean pans: If the pans used for baking are not thoroughly cleaned of residual material, it may cause an off flavour in the product. Wrong pan grease and improper storage of cleaned and greased pan should be avoided.
7. Cheap and wrong type of packaging and wrapping material: These will effect the flavour of the finished product.
8. Poor ventilation and lack of proper air circulation: Within the bake house these conditions may cause off flavour.

9. Improper storage of finished products: This should be totally avoided. The finished products having separate flavours should not be stacked together at the time of the cooling and packaging.
10. Dirty and defective transportation: This will also cause off flavour in the finished product.

Nuts and Fruits

A variety of dried and preserved fruits and nuts can be used in baked products to produce different types of flavours and finishes.

It is usually necessary to wash dried fruits before use with a liberal amount of water and swirled around for about one minute. Care must be taken so that the fruit does not absorb too much water and become soft. If fruit absorbs too much water it will break down during mixing and discolour the dough. The flavour also diminishes if the fruit is soaked too long. After washing the fruits should be drained in sieve. After draining the fruits should be carefully picked over by spreading the fruit on a dry cloth to remove the excess moisture. The fruit should always be added last to ensure even distribution throughout the batter / dough with minimum damage.

Dried fruits:

Among all the dried fruits, the products of different types of grape vines take the foremost place in the confectionery.

Currants

Currants are the dried form of small black grapes. Good quality currants should be bold, fleshy and clean of even size and blue black in colour. The currant should not contain red shriveled berries which due to their extra acidity spoil the flavour of cakes. Currants prior to their use should be soaked in boiling water for 2 minutes and then dried to get rid of the frit, stalks and stones.

Sultanas: Sultanas are made out of seedless yellow grapes.

Raisins:

Ripe grapes are converted into raisins and sultanas in different ways. In the case of raisins, the bunches of grapes are partly dried by twisting the stalks while still on the vine and then are finished off in open sheds.

Dates

Dates are dried fruits of Iraq and North African palms. They are very sweet and rich in sugar. Dates should always be soaked in about half of their weight of water for an hour or more until they are soft.

Sugar preserved Fruits and Peels

The skin or peel of the citrus fruits such as lemons, oranges and citrons are abundantly used in fruit cakes. Thick rind fruits are the best for the preparation of peels. These fruits are cut across the middle and the pulp is removed. The halves known as caps are soaked in brine for several days to remove the acid taste of the rind.

Cherries are available as glace and as crystallized.

Glace cherries

Good quality fruit is bleached in a solution of water, calcium carbonate and sulphur dioxide until the fruit is colourless. The fruit is stoned and washed. Cherries are then soaked for a few minutes to soften the skin and flesh. After draining, cherries are immersed in weak syrup which is coloured usually red, but also green or yellow. The syrup strength is increased daily by boiling over a period of 9 days.

Crystallized Cherries

The crystallized cherries are made by draining the preserved glaced cherries and rolling them in fine castor sugar.

Crystallized fruits

Crystallized fruits are mostly used in the decoration of rich fruit and other cakes. Before using, the crystalline sugar from the fruits is washed off and the fruits are cut to the desired shapes and placed on the cake. After baking the fruits can be washed with a good syrup to enhance the brightness of the fruit. Pineapple, peaches, apricots, plums and pears are generally used to make crystallized fruits.

Angelica

Angelica is large green plant of which only the stem is used. It is preserved in a similar way to cherries, using green syrup. Apart from the bright green colour it has an aromatic flavour.

Ginger Root

Only the tuberous root of the plant is used. It is washed well and boiled in a weak sugar solution until soft. The sugar strength of the syrup is to be gradually increased as in the candying process of citrus peels. It is stored in syrup as root, chips or crushed.

Crystallized Flowers

Rose petals are laid out on wires and suitably coloured syrup is allowed to drip on to them. When thoroughly saturated, the petals are dried over gentle heat. They can be used as a decoration, owing to the colours but also have a scented flavour of the original flower.

Nuts

Nuts offer various flavour texture, bite and appearance in baked products- especially in the products of cookies. There are several nuts available in various shapes and all have a high food value. Most of the nuts are expensive which restricts their use only in speciality items.

Almonds

Among the nuts the almonds have richness and fineness of flavour but due to their high cost are used in speciality items and for decorations. There are two types of almonds: the sweet and the bitter. The bitter almond is used in the preparation of essential oil of almond. Bitter almond is not suitable for eating and is used to boost up the flavour by blending with sweet almonds.

In confectionary almonds are used either whole or split or ground or a combination thereof according to the type of desired end products.

Walnuts

Walnuts have a strong flavour and due to high fat content have a tendency to go rancid after a long storage.

Pistachio Nuts

Pistachio Nuts are sparingly used in the baked products because of their high price. They are about ½ " in length and have a purplish brown skin which can be removed by blanching.

Cashew Nuts

They have a bland flavour. They are largely used for decorative purposes.

Groundnuts (Monkey Nuts or Peanuts)

They contain about 40% of oil which is used in making vegetable fats. Because of price advantage, groundnuts are generally used in various cookie recipes.

Coco Nuts

The white flesh known as copra is removed from the shell of the nut and is dried either in the sun or in the shade. A better colour is produced by shade drying. When dried, the copra is cut according to confectioners requirements such as shredded, coarse, medium or fine dessicated coconut. Cut coconut can also be coloured by mixing well with a liquid colour and then drying off the excess moisture. Owing to high oil content, coconut is liable to develop rancidity. Coconut has a tendency to be contaminated with salmonella bacteria which is harmful for health.

Lecture-7
Food Colours

The use of colour is important as the use of flavour. The eyes appeal of the product is enhanced by the use of colour. The correct colour should be used to complement directly the flavour added in the product.

The following are the guidelines for the use of colouring materials:

a) To supplement deficiencies in colour, e.g yellow colour is used to conceal the lack of butter and eggs in a dough.
b) To increase the eye appeal and to complement a definite flavour.
c) To introduce varieties and interest to decorated products.

For a colour to be acceptable for use in food stuffs, the main condition being that it should be harmless to the human health.

The three primary colours red, yellow and blue will produce secondary colours when mixed. Thus yellow with blue forms green, yellow with red forms orange, red with blue forms violet, yellow with red and blue forms chocolate or brown. The shades of the colour depend upon the proportions of one colour to another. Colours should be first tested on a trial basis before using them in production. This will help to check their reaction under the previously mentioned conditions and also under long and adverse storage conditions. Colours should always be determined in daylight for proper estimation.

Natural Colours

Cochineal or Carmine

Cochineal is a red from which many pinks are derived. It is prepared from an insect which lives on a variety of cactus originating in Mexico and cultivated in the Canary Isles. The dried insects are powdered and then boiled to extract the colour. The filtered liquid is known as Cochineal. Carmine is prepared from this liquid by the addition of acid.

Saffron

Saffron is a yellow to orange colour prepared from the flowers of a crocus grown in southern Europe and Kashmir. The dried stigmas are available in cake forms or loose. The colour and flavour of saffron is extracted by making a hot water infusion which should be prepared when required, since the colour soon decomposes.

Turmeric

Turmeric is prepared from the dried and ground root of the ginger family plant grown in India. Its colour closely resembles eggs.

Annatto

Annatto is yellow colour prepared from the fermented fruits of a plant grown in the West Indies and Sri Lanka. The colour is hardly soluble in water but is readily in alcohol. It is used for colouring butter, cheese and margarine.

Chlorophyll

The green colouring matter chlorophyll is extracted from the leaves of Spinach etc.

Caramel

Caramel or black jack is a dark brown colour prepared by heating sugar until it is decomposed and then adding boiling water to form a thick syrup. Caramel will impart a distinctive flavour of burnt sugar.

Setting Materials

For the manufacture of jams, jellies and icing, ingredients are required either to cause thickening of a fruit syrup (jam or jelly) to set a firm gel or in preventing stickiness of icings. These ingredients are known as gums. Most of the gums are carbohydrates from sundry plant sources as sap, seeds and sea weeds and are known as plant gums. Gelatin is an animal protein which is not a gum but is included as a stabilizer.

Gelatin

Gelatin is derived from cartilage or bone of the animals. Pure gelatin is transparent brittle substance without colour, smell or taste. It is available in sheet form and as crystalline powder. It has a longer shelf life if it remains dry. When moistened it will deteriorate rapidly. It dissolves only in boiling water. When placed in hot water it swells and will absorb about ten times its own weight. Solution is thin bodied when hot, but at 1% concentration will set on cooling. Prolonged boiling destroys the gelling properties. Excessive amounts make products tough and rubbery.

Agar-Agar

Agar-Agar is a jellying agent derived from a variety of seaweed available in southern Asiatic waters. It is available in powdered or fibrous form. It is also called vegetable gelatin. It is insoluble in cold water but will absorb large quantities of water and when dissolved in boiling water produces a slightly cloudy gel which is slightly less tough than the one formed from gelatine. At 10% concentration the solution will set on cooling. Boiling is necessary to dissolve agar-agar but boiling does not detract from its setting powers.

Pectin

Pectin is the setting agent used in the production of jams. It is present natural to a greater or lesser degree in most fruits. It is water soluble which when in solution the presence of sugar and acid is capable of forming a gel. To obtain a firm setting it necessary that the fruit contains not only Pectin but also acid. Fruits that are deficient in either or both can be supplemented by the addition of acid or Pectin or by a second fruit that is rich in either or both. Commercially Pectin is prepared from citrus fruit pulp or from papaya, guava etc.,

Isinglass

Isinglass is an extremely pure form of gelatin obtained from the swimming bladder of various fish. It dissolves in hot water and sets as a jelly when cool. Due to its high price it is not widely used.

Irish Moss or Carragheen

Irish moss is also derived from seaweed and is widely used as a setting or stabilizing agent in emulsions. It is generally used for setting the milk products because it reacts with the casein of the milk to form excellent firm but tender gel.

Cocoa and chocolate

Cocoa and chocolate are used very widely in the production and finishing of cakes, pastries, pies and cookies. They provide for variety of products and the characteristic flavour and colour in the product and also supply body and bulk to the cake mix or icing.

Chocolate and Cocoa are produced from cocoa beans which are the fruit or seed of the cacoa trees. Cacao trees grow in tropical areas mainly- Ghana, Indonesia, Brazil, Sri Lanka and Venezuela. The cacao bean is the source of cocoa chocolate. The cacao pod is cut from the tree and split open. The beans inside are picked, washed, dried and fibres removed before they are fermented and cured. This process gives the bean the aroma, taste, flavour and coloour.

The beans are then shipped to the processor where they are roasted for further improvement in the taste, flavour and colour. After cooling, the beans pass through rollers to produce cocoa nibs. This action loosens the husks which are discarded. The nibs are crushed and reduced to a thick mass called chocolate liquor.

The chocolate liquor contains approximately 54% cocoa butter. Cocoa butter is removed by pressing melted chocolate liquor in filter presses to obtain the cocoa butter needed in the manufacture of sweet chocolate coatings. The dry looking residue in the press is reground to make cocoa powder.

Dutch-Process cocoa

Dutch-process cocoa is a modified form of natural cocoa. In this process the cocoa beans are treated with an alkali. A solution of alkali (usually sodium bicarbonate) is added to the partially roasted beans and the excess water is evaporated off. The beans are then treated as for the manufacture of natural cocoa. The purpose of dutching the cocoa is to darken the colour, modify the flavour and to improve the dispersibility of the natural cocoa. This process also reduces the natural acidity of the cocoa because the alkali neutralizes some of the acidity. Dutching not only darkens the colour, but also makes the cocoa less bitter and easily dispensible.

Test to distinguish between dutch-process cocoa and the natural cocoa:

Take approximately 25 gms cocoa from each sample along with 1 tsp baking soda, stir it into about 200 gms warm water. You will notice that the natural cocoa solution will foam and turn darker. The dutched cocoa will not foam and may turn somewhat darker. This will distinguish one cocoa from another and be able to make the necessary adjustments to the recipe.

A colour test may also be done. Since dutched cocoa is made darker by an alkali, if you add a teaspoon of acid (cream of tartar) to a solution of dutched cocoa the colour will turn lighter. If the same acid is added to a solution of natural cocoa there will be little change in colour. Leavening agents have a notable effect upon the colour, aroma and flavour of a baked chocolate cake.

Natural Cocoa

Natural Cocoa which is known as the breakfast cocoa has a lower pH (4-5) or greater acidity and requires the use of the more baking soda as the leavening in the mix than the dutched cocoa. The dutched cocoa doesnot have a strong or concentrated flavour. It has a high pH value (6-8.8) or excess alkalinity. This cocoa requires less baking soda for leavening and more baking powder. The type of cocoa used should be known in order to make adjustments in the leavening depending upon the nature of cake. If the cakes are mahogany or reddish brown it is a sure indication that too much soda quantity was used. The cake will also have a baking soda or soapy taste. Adjust the soda quantity used in the mix. If the cakes are light brown or cinnamon coloured then they require an increase in the amount of soda.

Lecture-8

BAKERY UNIT OPERATIONS: MIXING, FERMENTATION, PROOFING AND BAKING

The first stage in dough processing is mixing. During mixing both the development of the dough and the temperature of the dough are established. If one or both is not achieved during the process, the product quality will suffer. It cannot be stressed enough that mixing is the most important stage of the entire process. If you do it wrong, there is no possibility to correct it later.

Mixing is normally a discontinuous step in an otherwise continuous process. Therefore, discipline is required. It is not easy to repeat every 12 or 15 minutes the exact same process; it is, however, necessary and of the utmost importance. Someone who wants to be proud of the product he has made must also be proud of the fact that he is capable of repeating over and over again the same process. And that is really a challenge.

Mixing Process

Scaling Of Ingredients

Another aspect of the process, of course is that all ingredients must be correctly weighed and that all ingredients should be added to the dough. An easy method to check whether there is yeast in the dough or not is to put a little piece of dough in lukewarm water. After a while it should start kating because C02 is produced, which changes the specific weight of the dough. The dough becomes lighter, so it begins to kat in the water. To check whether or not there is salt in the dough one can taste a little piece of dough to establish that the salt is there. One must avoid allowing the yeast to come into direct contact with the sugar and, especially, the salt. Because of its hygroscopic nature, the salt will start to suck water out of the yeast cell 245 (osmotic pressure), and the yeast will dehydrate, a process that can be compared with that of a grape becoming a raisin. If salt is put on the yeast, it will start to dissolve, and the mixture will start to liquefy.

Objectives of the Mixing Phase

Most of the characteristics of the final product are determined directly or indirectly during the mixing stage. If the dough is under mixed or over mixed, the handling properties of the dough will be different. Scaling is very important. If the scaling of the ingredients is wrong, the bread will show various faults, depending on which ingredient is weighed incorrectly. The importance of the dough temperature also cannot be underestimated. If the temperature isn’t right the fermentation rate will be faster or slower, and that, in turn, will influence the volume of the bread and the color of the crust. Finally, if the mixing time is not respected, the texture and the grain of the crumb will suffer. The mixing of the dough has a number of objectives: To uniformly incorporate all ingredients, To hydrate the kur and the other dry ingredients, and To develop the gluten. To develop the gluten one has to put in energy to mix the water and kur. Slowly but surely the gluten network will start to develop. The art is to develop them to the proper consistency so the dough will have an excellent machinability as well as good gas retention properties.

Mixing Time

In a conventional spiral mixer, the mixing time for a dough of about 165 kg will be around 12 minutes, depending on such factors as the quality of the kur and the mixing method (e.g., the moment when salt is added will influence the mixing time; delayed salt addition will shorten the mixing time). During these 12 minutes one can distinguish a number of stages:

Pick up: dough is sticky, cold, and lumpy. Initial development: dough is getting warmer, smoother, and drier.

Clean up: dough is at maximum stiffness and comes together as one mass. The color will change from yellowish to a whiter, creamy color.

Final development: dough is at its correct temperature and handling quality. A gluten film can be easily obtained by stretching a piece of dough.

Letdown: dough is too warm and becomes sticky, lacks elasticity, and has too much kw.

Breakdown: dough will begin to liquefy.

The mixing time is influenced by a great number of factors, including the . . . .

- Speed of the mixer.
- Mixer design.
- Dough size in relation to mixer capacity.
- Dough temperature.
- Efficiency of cooling systems.
- Quality of the kur.
- Water absorption of the kur (infienced by the particle size).
- Amount of shortening: mixing times increase with more shortening added.
- Amount and type of reducing and oxidizing agents.
- Amount of milk solids and other dry ingredients that compete for the water: the higher their concentration is, the longer the mixing time will be because there is less water available for gluten development.

Temperature Control

During the mixing process the temperature of the dough will rise due to heat generated by the frictional forces and the heat of hydration of the kur. The frictional heat is the result of the mechanical energy one has to put into the dough in order to overcome internal and external (dough in contact with the side of the mixer bowl) friction that is caused by the dough mixing process. The amount of friction to be overcome is related to the water absorption and to the gluten development. As mixing time changes, the friction factor changes as well. The heat of hydration is the energy that gets liberated when a substance absorbs water. The amount of 254 Part 111: Principles of Baking heat liberated varies with the degree to which water is absorbed. In the case of soluble substances, energy is needed to dissolve them, so the change in energy level is of a negative nature, as are the amounts of heat withdrawn from the system. The temperature of the dough is also influenced by other factors such as temperature of ingredients, size and type of mixing equipment (artofex mixer compared with a high-speed mixer, for instance), batch size (too small batches in too big mixers), mixing procedures (time, speed), and room temperature.

To cool down the dough and to remove the excess heat generated during the mixing process, the baker can use one of the following methods: add ice to the dough, use chilled water to make the dough, refrigerate the mixing bowl (mainly done in horizontal mixers), use a saturated salt solution which can be cooled down to below 0°C instead of granulated salt, cool down the ingredients (mainly kur, which can be easily cooled down with the injection of liquid C02 during the pneumatic transport).

Fermentation

Fermentation in bread making is the process by which the well-mixed ingredients for bread making are converted, under controlled temperature and humidity for an appropriate time, to a soft and expanded dough, with changes in both structural and rheological properties. The ingredients for bread making include kur, water, yeast, sugar, fats and oils, and improvers. The volume of the dough usually is expanded by several times.

The fermentation process changes the dough in two respects. First, the yeast converts the available carbohydrates (sugars) to carbon dioxide gas that enables dough volume expansion and at the same time decreases the dough pH value. Secondly, hydrolysis by the enzymes softens the gluten and changes the dough characteristics to allow more gas retention.

In general, the bread making methods are classified into two broad categories: straight dough and sponge dough. The natural-sponge and boiled-sponge methods have become more popular in recent years, so these methods in bread making.

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Straight-Dough Method

Among all the bread making methods, the straight dough method is the most commonly used and the simplest. In this method, all the ingredients in the recipe are put into the mixing bowl in an orderly manner and mixed into a dough, followed by a sequence of steps for fermentation, dividing and rounding, molding, final proof, and baking. Based on differences in fermentation time, the straight-dough method can further be divided into two types: straight dough and no-time dough.

Straight Dough

Straight dough is now the most widely accepted method in bakeries. Making dough through the straight-dough method implies putting all the dry ingredients such as flour, sugar, milk power, improvers, and yeast into the mixing bowl, mixing them evenly at low speed, then adding the wet ingredients such as water, ice, and egg, and continuing the process. After all the ingredients are evenly mixed, adjust the mixing speed to its medium level and continue to mix until the dough reaches the stage of expansion. Then add fats and oils, and continue to mix until the dough reaches the stage of complete mixing, which means the completion of the mixing process. The dough goes through the mixing process for only one time. The appropriate temperature range of the mixed dough is between 26 and 28°C (78.8 and 82.4°F), fermentation temperature is 27°C (80.6°F), relative humidity is 75%, and fermentation time is between 1.5 and 3 hours.

The fermentation process requires punching steps. The purpose of punching is to equalize the temperature and fermentation of the dough. The release of carbon dioxide and alcohol through punching will bring in more oxygen needed to enhance the fermentation function, accelerate gluten expansion, and increase gas retention. The exact time for punching, in principle, starts when the volume of the dough increases by one and one-half times after going through the fermentation process. Whether or not the dough has reached the time for punching can be judged based on the reaction of the dough after being pressed by the fingers. If a gentle push of the finger into the dough from the top doesn't encounter much resistance, and after the finger is removed the indentation in dough remains, the dough is ready for punch down. If the finger feels stronger resistance after pushing into the dough, and the indentation gets filled up immediately, it indicates an insufficient degree of fermentation; let fermentation continue.

Over and Under Fermentation

Fermentation stage is important in as much as the taste, volume, and keeping qualities of bread are affected when there is too much or not enough fermentation. Without proper fermentation good tasty bread cannot be made.

When doughs are fermented at a higher temperature they tend to become acidic and the crumb colour has a tendency to become grayish. Bread made from over fermented doughs stales quickly. The crumb has a tendency to crumble.

Over fermented doughs are inclined to become soft and sticky. They yield less bread of unappetizing appearance as quite a bit of dusting flour must be used during scaling and makeup. Over fermented doughs yield less breads and are hard to bake out.

Under fermented doughs do not bake out properly and the crumb is darkish and very close. They also tend to crumble easily. Under fermented doughs have the tendency to flatten out. This can be noticed during the intermediate proof time.

Proofing

Proofing is really the stage where the production of gas in the dough is at the final stage giving volume to the bread. The ripening of the dough have been achieved during fermentation, the continued production of gas render this process complete. Average proof box temperature is normally 95^0—98^0F and humidity is 80-83%. The humidity is important to keep the crust moist and bread will not form a crust as quickly in the oven which will allow it to bloom or expand more.

Proper amount of moisture is also important proper gluten conditioning. Gluten is developed and partly conditioned by mechanical mean.

Under-proofing will produce bread of small volume. At time it will brust on side and in as much the volume is less ,it will be as a rule, unbreaked. There are time when oven temperature is low that the bread should go to the oven under proofed.

Over proofing to a certain degree is justified if the bread is baked in hot oven . The more open grain will allow the heat to penetrate more easily and bread will break out quickly. Excessive over proofing of bread will cause shrinkage and at time the bred may collapse in the oven.

An unfermented, also known as 'young dough' will not stand as much heat than a properly fermented dough and it should be proofed less than normal. Bread made from over fermented dough also known as old dough should be full proof and if possible baked in hot oven.

Baking

Baking is generally defined as the process in which products are baked through a series of zones, with exposure to different time periods, temperatures, and humidity conditions. As an example, in white pan bread baking.

Cold ovens

At times there is no option but to use a cool oven. In this case the bread should be underproofed so that it will not expand too much which causes shrinkage and sometimes collapsing.

The routine in a bakery, especially where a direct fire brick oven is used, is to bake the small bread first which requires a hotter oven than the medium size bread and then the larger loaves, which require a cooler oven. The last to be baked is the very sweet breads, which carry a high percentage of sugar, and so forth and so on.

Hot ovens

Between a cold oven and a hot oven, one would choose a hot oven, if one has more resources. For hot oven one must ferment doughs well, use less sugar and allow the bread to proof more than normal. With a hot oven the baking is done in a shorter time and there is not the danger of having bread overproofed or doughs overfermented.

The situation of cold or hot oven can happen frequently with the direct fired brick ovens wherever they are in use.

Lack of proper insulation covering the dome of the oven is also undesirable. This may be sand, which is the least expensive. It should not be less than 30 inches or 75 cms thick at the top-most part of the dome. In order to do this, the wall of the oven should be build up, both front side and rear to hold this sand.

The flue should be set in the chimney at the other extreme from where the firewood is burnt. Firing of an oven is very important. As a rule the oven should be fired for at least two hours. Then the flue is closed and the door shut tightly. When firing, open the door just enough to allow sufficient air to enter for proper combustion.

After firing, the oven should be allowed to rest at least half an hour before starting to bake. This is done so that the heat will be evenly distributed throughout the oven and the hearth or floor is heated evenly. This is done for the following reasons.

When firing an oven the dome and to a lesser degree the walls collect or accumulate this heat. The thicker the dome and the better the insulation on the top the more heat will be accumulated and the longer baking can be done before refiring.

Lecture-9
Formula construction and Computation of Yeast raised products

There are many different formulas for bread and yeast-raised products. Some of these formulas contain little or no enriching ingredients (eggs, fat and sugar) and would be called ‘lean’. Others have high percentage of these enriching ingredients and are referred to as ‘rich’. There are many formulas between these two extremes.

Optimum Temperature Ranges-

The optimum temperature ranges for the ingredients and the different phases of the dough are as follows:

1. Flour storage, 75^0F
2. Ingredient ice water, 40^0F
3. Bread doughs, 78^0 to 82^0F
4. Mixing room, 75^0 to 80^0F
5. Fermentation room or cabinet, 80^0F, 74 percent to 77 percent relative humidity
6. Proof boxes or cabinets, 95^0 to 100^0F, relative humidity 83 percent to 88 percent;
7. Bread slicing and wrapping temperatures 95^0 to 105^0F;
8. Inside temperature of a loaf of bread out of oven, 208^0 to 210^0F;
9. Pan temperature at time of panning, 80^0 to 110^0F;
10. Wax and cellophane wrapping paper storage, 55^0 to 85^0F, relative humidity 45 to 65 percent.

Mixing Stages

1. Early mixing stage
Rough, lumpy, wet, sticky (no trace of dough development).

2. Minutes later:
Dough becomes smooth, semi-elastic, pliable, starts to dry, (start of development).

3. Further mixing:
Dough attains the cleanup stage and becomes dry, elastic; does not stick to back or sides of mixing bowl (dough development).

4. After cleanup
Dough softens becomes wet, sticky and breaks short as mixing is continued (over development of breakdown).

Methods of Bread making

Straight Dough Process	Sponge Dough Process
Preparation of Ingredients	Preparation of Ingredients
Weighing	Weighing
Sifting and Blending Flour Tempering of water Preliminary Mixing of Yeast Dried milk etc	Sifting and Blending Flour Tempering of water Preliminary Mixing of Yeast
Dough Mixed	Sponge Mixed
Dough placed in Trough	Sponge placed in Trough
Dough allowed to rise turned and folded	Sponge allowed to Mature
Dough sent to bench or divider	Sponge placed in Mixer

Dividing and Scaling

Rounding

Intermediate proof

Moulding

Panning

Pan proof

Baking

Cooling

Slicing

Sponge broken up and mixed with dough ingredients

Final dough placed in Trough

Allowed to rise sometimes turned and folded

Dough sent to bench or divider

Dividing and Scaling

Rounding

Intermediate proof

Moulding

Panning

Pan proof

Baking

Cooling

Slicing

Bread faults, their causes and remedy

The following gives some of the more prominent faults in white bread production:

1. Lack of volume
   a) Use of weak flour
   b) Too much salt
   c) Lack of shortening
   d) Yeast dissolved in hot water
   e) Too much or not enough dough for the mixer
   f) Under mixing
   g) Over mixing
   h) Young dough
   i) Extremely old dough
   j) Too much machine punishment
   k) Too long an intermediate proof
   l) Insufficient pan proof
   m) Excessive steam pressure in oven

n) Oven too hot

2. Too much volume
    a) Not enough salt
    b) Use of wrong type of flour
    c) Dough slightly overaged
    d) Too much dough for pans
    e) Over proofing
    f) Cool oven
3. Crust colour too pale
    a) Too lean formula
    b) Flour lacking diastatic activity
    c) Excessive mineral yeast food
    d) Old dough
    e) Insufficient humidity in proof box
    f) Cool oven
    g) Under baking

4. Crust colour too dark
    a) Too much sugar
    b) High milk content
    c) Old dough
    d) Oven too hot
    e) Over baking

5. Blisters under the crust
    a) Young dough
    b) Excessive steam in proof box
    c) Over proofed
    d) Rough handling at oven

6. Crust too thick
    a) Insufficient shortening
    b) Low sugar content
    c) Old dough
    d) Lack of moisture in proof box
    e) Excess steam in proof box
    f) Cool oven
    g) Over baking

7. Shell tops
    a) Green or new flour
    b) Stiff dough
    c) Dough too young
    d) Lack of moisture in proof box
    e) Not enough pan proof
    f) Excessive top heat

8. Lack of break and shred
    a) Weak flour
    b) Excessive amount of mineral yeast
    c) Young dough
    d) Extremely old dough
    e) Excessive proof

9. Crumb is grey
    a) Use of too much malt
    b) Old dough
    c) Excessive proofing
    d) Pans too large for amount of dough

10. Streaked crumb
    a) Improper incorporation of ingredients
    b) Sponge or dough crusted over during fermentation
    c) Sponge not broken up properly
    d) Excessive trough grease
    e) Scrap dough picked up during make up
    f) Excessive use of divider oil
    g) Excessive dusting flour
    h) Dough crusted during intermediate proof
    i) To much machine punishment
    j) Rough handling at oven

11. Coarse grain
    a) Weak flour
    b) Improper mixing
    c) Slack dough
    d) Young dough
    e) Old dough
    f) Improper moulding
    g) Excessive proof
    h) Rough handling at oven
    i) Cool oven

12. Poor Texture
    a) Weak flour
    b) Lack of shortening
    c) Improper mixing
    d) Slack dough
    e) Excessive trough grase
    f) Young dough
    g) Old dough
    h) Excessive use of divider oil

i) Excessive dusting flour
j) Improper moulding
k) Cool oven

13. Flavour and taste are poor
    a) Improper storage of ingredients
    b) Poor quality ingredients
    c) Off-flavoured ingredients
    d) Improper amount of oil
    e) Under fermented dough
    f) Old dough
    g) Unsanitary shop
    h) Dirty pans
    i) Under-baking
    j) Over baking
    k) Bread cooled under unsanitary conditions

14. Poor keeping qualities
    a) Too lean formula
    b) Poor quality ingredients
    c) Improper storage of ingredients
    d) Old dough
    e) Stiff dough
    f) Over proofing
    g) Cool oven
    h) Bread cooled too long before wrapping

15. Holes in Bread
    a) Unbalanced formula
    b) Flour too strong
    c) Improper incorporation of ingredients
    d) Under mixing
    e) Over mixing
    f) Excessive trough grease
    g) Young dough
    h) Old dough
    l) Excessive use of divider oil
    m) Excessive dusting flour
    i) Too much machine punishment
    j) Proof box too hot
    k) Over proofing

In checking these faults an analysis of the various causes will show inferior ingredients, unbalanced formula, improper mixing, incorrect fermentation time, poor control of temperature, time and humidity throughout the production process, poor makeup procedures, poor oven conditions as well as improper handling in cooling, wrapping and shipping account for most of bread faults.

A process of elimination must be instituted, the possible cause or causes determined and the proper remedy applied.

Lecture-10
Biscuits

Scientists and technologies love classifications but, unfortunately they find that natural products, or articles based on natural products, tend to form groups that overlap, thus confounding attempts at neat classification biscuits are no exception the problem even arises in attempts to

Definition:

'These products are cereal based and baked to moisture content of less that 5%'.

Ingredients:

There are three major ingredients wheat flour, fat and sugar.

The problems in defining the boundaries between biscuits and cakes, and biscuits and sugar confectionery one may be reasonably consider that the boundaries are not important, and well they might not to be until authority decide that different packaging.

Grouping have been made in various ways based on:

- Name, eg., biscuits, crackers and cookies, which is basically on the texture and hardness.
- Method of forming of the dough and dough piece eg fermented, developed, laminated and cut, moulded, and wire cut and co extruded.
- The enrichment of the recipe with fat and sugar.

As technologists it is useful to be able to characterized biscuits from their external and internal appearance as these helps in deciding likely, recipe and means for forming and baking.

In all cases, recipes are of biscuits which have been commercially produced with in the last 20 years. The recipe are of dough's mixed before various late additions like puff fat, crackers filling or garnishing sugar have been added. There are not therefore representations of finished biscuits but of basic mixed dough's.

Each recipe has been adjusted to be relative to hundred units of flour including other cereal products such as cornstarch, vital wheat gluten, malt flour.

The sugar level is on a dry bases and it is assumed that liquid sugar has 67% solids, invert syrups 80% solids, malt extract 80% solids, glucose syrups 80% solids.

The fat values on pure fat, so margrines and butter are only 85%.

The water level is the total added water. This is principally as liquid water but may be as fresh milk (87.6% water), butter and margarine (15% water), fresh eggs (75%), syrups (20%), liquid sugar (33%) etc.,

Cereals and some other ingredients have natural moisture content, so the water values do not represent the total dough moisture level even though these important for calculating the losses during baking.

In other biscuits text, reference is often made to the ‘percentage’ of fat or sugar in dough.

Types of biscuits:

1. Cream crackers
2. Soda crackers
3. Savoury or snack crackers
4. Water biscuits and matzos
5. Puff biscuits
6. Hard Sweet , Semi Sweet & Garibaldi Fruit Sandwich Biscuit
7. Short dough biscuits
8. Deposited soft and sponge drop biscuits
9. Wafers
10. Miscellaneous biscuits-like products

Processing of biscuits:

- Take the wheat flour and mixed with water and to make dough, the dough requires a conditioning period in which to allow many changes to take place. This period is referred to as the fermentation period.
- The changes have a great influence on the finished product, so it is important that the total fermentation of the dough permit only desirable changes to take place.
- Timing and temperature must be regulated to control the fermentation to preclude undesirable changes.
- Baker’s fermentation of dough beings when the dough is mixed and ends when it is make up.
- True fermentation of dough being when the dough is mixed and ends when the yeast is killed in the oven.

Conditions:

- Dough consistency is also related to the type of flow or other cereal flour used the level of alkaline leveling agents, and of course dough temperature.
- The increases in the level of fat are usually accompanied with higher level of sugar, but sugar solutions do have a softening on gluten resulting in lower water requirements for dough, the effect of sugar alone on the dough water requirement is not usually sufficient.
- The greatest fundamental differences between all the biscuits group areas shown is in the existence or otherwise in the dough of a three dimensional structure of gluten that imparts extensibility and cohesiveness to a dough.
- Dough’s which very soft and pourable, known as soft are or deposited doughs, are always rich in fat and sugar.
- Water is a catalyst in biscuit making. It is added at the doughing stage then is driven of during baking.

The layering of fat between the dough to make puff biscuits occurs in the low sugar types. Layering of fruit between and extensible dough gives sandwiches like garibaldi.

After baking, the biscuits may be fat sprayed (mostly savoury types) sandwiched with sweet or savoury fat creams or marshmallow or variously enrobed with chocolate, chocolate substitutes or water icing. All of these types and processes will be described in subsequent sections.

A simple comparison of how different parameters or properties change as the recipe becomes enriched with fat and sugar

	Crackers	Semi sweet	Short high fat	Short high sugar	soft
Moisture in dough	30%	22%	9%	15%	11%
Moisture in biscuits	1-2%	1-2%	2-3%	2-3%	3+%
Temperature of dough	30-38 ^{0}C	40-42 ^{0}C	20^{0}C	21^{0}C	21^{0}C
Critical ingredients	Flour	Flour	Fat	Fat & sugar	Fat & sugar
Baking time	3 min	5.5 min	15-25 min	7 min	12+ min
Oven ban type	Wire	Wire	Steel	Steel	Steel

The baking industry is very much craft based on the inventive skills of engineers is not at much in evidence in terms of biscuit types.

Wafer biscuits represent a special type of baked product because they are formed between a pair of hot plates and not on a baking bond wire as are most other types the recipe is similar, low in enrichment with fat and sugar, and is mixed to a fluid, pumpable batter. Baked wafers are UN interesting to eat on their own but form useful, rigid, carriers for other more favours' some mixture like sugar cream, caramel toffee and marshmallow.

Lecture-11
Cream crackers, Soda crackers, Wafer biscuits & Matzos, Puff biscuits

Cream crackers

Origins

Cream cracker biscuits were first introduced in about 1885 by the Irish firm of Jacobs. Since then they have maintained a significant place in the sales of biscuits in Britain and have also become popular in many other countries. In most cases they owe their introduction to British influence and transfer of technology. In contrast to most other biscuits, cream crackers are distinguished by being made from fermented dough.

The name 'cream cracker' is traditional and does not indicate that cream or even milk is to be found in the recipe. Cream crackers have a simple unsweetened basic recipe of flour, fat and salt. The dough is always fermented with yeast and is then laminated prior to cutting and baking. The combination of flour protein modification, achieved during fermentation, and lamination gives rise to the characteristic flaky and variously blistered biscuits.

Position of cream crackers amongst other crackers:

Crackers are biscuits which are all more or less unsweetened, salty, thin and crisp. They are in effect bread substitutes and are usually eaten with butter, cheese, cold meat etc, as a convenient snack. The basic expectation is of a crisp but not hard, flaky biscuit with a bland flavour. The biscuits are usually relatively large and rectangular (about 65x75mm) and have a pale bake with darker coloured blistery areas on both top and bottom surfaces.

CRACKERS

Unsweetened | Slightly sweetened

Non-fermented | Fermented | Enzyme modified

	Laminated Without fat	Laminated With fat	Laminated with center fill	Laminated without center fill	
	Water matzo	Puff	Cream cracker	Soda cracker	Ritz Tuc Savoury cracker
%of fat in dough:	6%	19%	11%	10%	7-9%

Fig: Relationship of cream crackers to other crackers

In terms of the eating quality, the texture should be fairly soft, not hard, such that when bitten the biscuit does not shatter and crumble but 'melts' fairly readily in the mouth.

The open texture and unsweetened nature makes cream crackers susceptible to oxidative rancidity of the fats and it is this factor which will probably be most noticeable as the product ages.

When produced, the moisture content of the biscuits should be 3-4%, which is relatively high for biscuits.

Dough brake method

In the old and traditional method, fermented dough was divided into handleable masses and laminated on a reversing brake by hand. Although this is a most rare procedure now, it is worth describing as it has a bearing on the advantages and disadvantages of automatic laminators.

A rough dough sheet was pressed out with hands, then the dough was floured and passed back and forth through the brake till a sheet of about 9 mm thickness was formed. A weighed quantity of cracker dust (a fat/ flour crumbly mixture) was spread over two-thirds of the sheet. The sheet was then folded into three to interleave the cracker dust, the whole was then turned through 90^0 again and was reduced down to about 11mm before being cut into sheets about 800mm long. The sheets were fed, by hand, one after another with slight overlapping into the first gauge roll of the cutting machine. The dough was turned through 90^0 for a third time at this point.

Mechanical laminators

Sheeting and laminating is always by machine now. Mechanical laminators are relatively large machines and there are several different types. Basically the fresh dough is sheeted into either one or two sheets. When the cracker dust is introduced varies. The commonest types of laminator produce a single sheet of dough that after reduction to about 4mm is piled up with cracker dust introduced between the layers. The pile may be formed by folding the dough or placing cut sheets one over another.

Final gauging and cutting

Typically the laminated dough is reduced through three pairs of rolls to a final thickness suitable for cutting. The dough is usually cut at about 2mm thickness. Typically there is a shrinkage of about 18% in the length of a baked biscuit compared with the length of the cutter. The length of the baked biscuit may be controlled to a certain extent by adjusting how much the dough can shrink prior to the cutter.

Baking of cream crackers

As with other biscuits, baking creates the texture, dries the product and colours the surfaces. The best oven spring ang texture is obtained for cream crackers with very hot baking. Thus efforts are made to raise the temperature of the dough pieces quickly as they travel into the oven by using high temperatures followed by lower temperatures to effect the drying out. Considerable power is needed t raise the dough piece temperature and this is aided by using very light wire bands often combined with band pre-heating. Cream cracker dough is one of the wettest biscuit doughs, and weight losses of around 26% dough piece to biscuit, occur in the oven. This means that provision must be made for adequate extraction during baking.

The desired background colour of a baked cream cracker is fairly pale and relief is given because the blisters colour preferentially. If the spring of the dough is not good during baking the colour will seem pale because of lack of this relief.

There are at least three common problems associated with the baking of cream crackers and they act together to compound each other. If the blisters are too pronounced, they will tend to colour or burn very easily. These big blisters will be damaged in post-oven biscuit handling, giving the biscuits an untidy, damaged appearance.

A second problem of baking is the phenomenon of checking- delayed fracturing of the biscuit structure such that the biscuit falls apart as if broken. This becomes apparent only some hours after the biscuit is baked. It is caused by stresses built up in the biscuit during baking and appears as a crack as the biscuit moisture equilibrates.

A third common baking problem is in the flatness of the baked biscuit. It is extremely important that the biscuits are relatively flat for packing. Domed or dished crackers can be easily damaged at the packaging machine, or in the feeders immediately prior to it. The flatness can be controlled by the disposition of the heat above and below the band at the front of the oven.

Flour strength and fat type

It has been found that flour with a protein content of about 11% forms the best crackers but with attention to fermentation times, lower or higher protein levels can be used. Normal biscuit dough fats are commonly used.

Sheeting of cracker dough

If a complete, smooth, lively looking sheet is formed, the chances are hopeful for a good dough piece and baked cracker. If the dough continues to show some shrinkage after lamination and again before cutting, these are good signs. As the dough is relatively soft, very great care is needed to ensure that it is not crushed or pulled at any of the gauging stations.

Yields from fermented doughs

There is a considerable production of carbon dioxide gas and volatile alcohol during fermentation. The longer the ferment, the more gas is produced. It has been calculated that between 2 and 6% of flour dry matter will be lost during fermentation. In a one hour process the losses are however, insignificant.

Soda crackers

The soda cracker is a square biscuit about 50x50mm and 4mm thick. Each biscuit weighs about 3-3.5g and the moisture content is about 2.5%. The biscuits are produced with scrapless cutters so the edges are white and broken after baking.

Dough preparation

The fermentation typically is in two stages with a wet sponge lying for 18hrs, followed by a dough stage which is left to ferment for about 4hrs. The reason for the long fermentation seems to center principally around flavour development, though protein 'mellowing' is also important. It is the latter that give rise to flavour and it would seem that in soda cracker ferments the lactic acid bacteria are particularly important. However, no attempt is normally made to control the types or levels of these bacteria.

There is a big change to alkaline conditions at the dough stage because sodium bicarbonate is added and as stated earlier, the cracker should be alkaline after baking(pH 7.2 –8.0). It would be possible to determine the flavour reaction and the sodium bicarbonate addition rate if a suitable titration method was used on the sponge dough.

The function of yeast and proteases is the same as that discussed for cream crackers and since a wide range of flour protein levels and qualities will inevitably be used for soda cracker production, the systematic use of standard proteases is an obvious development. Thus one sees an early and satisfactory elimination of the long fermentations of soda crackers, it being replaced with mechanical dough development in small batches, or continuously with perhaps a one-hour fermentation before sheeting and lamination. Flavours and pH will be adjusted by additions of appropriate salts.

Outline of typical soda cracker manufacturing techniques

The sponge dough has about 55-75% of the total flour to be used in the recipe. About half the shortening is added at the sponge stage but usually none of the salt. The protein content of the flour is important. A high protein flour produces a well sprung cracker but a harder texture; a low protein flour gives less spring and a softer texture. A flour blend having a protein content of about 10% and including 30% hard wheat yielded the best soda crackers in terms of separation of the laminations during baking.

Some yeast foods, old dough, malt flour or other amylases may be added as felt necessary. The dough is gently mixed till clear and a target temperature of 23-27^{0}C is achieved by adjusting the dough water temperature. The dough is left in a room at 27^{0}C$\pm$ 0.5^{0}C and relative humidity 78%$\pm$ 2% for 18hrs. during these 18hrs the pH will have fallen, and the temperature risen by 6-7^{0}C.

At the dough stage the following are added to the sponge dough batch as detailed above:

Flour (as before or lower protein, 8.0 –9.0%)	50
Shortening	7.5
Salt	2.25
Sodium bicarbonate	0.875 (variable quantity)

Some sugar, diastatic malt extract and buffer salt (diammonium phosphate) may be added as required.

Note that no further water is added and the mixing continues till a clear dough with well distributed soda is achieved. More mixing is said to reduce the spring of the cracker and make it tough and hard instead of short, tender and flaky.

This dough is fermented for a further 4hrs in the warm humid room.

The ripe dough is sheeted, laminated, gauged and cut. There is no specific filling introduced between the laminations as there is for cream crackers, but a surface dusting of flour is often used to aid passage through the rolls. The dough is not very lively and great care should be taken to roll and reduce it gently. A two to one reduction at each gauge roll is considered maximum.

At the cutter the size is about 54x50mm which gives a cracker of 50mm square. Thus the shrinkage in length is only about 8%- considerably less than for cream crackers. After cutting and before baking, fine salt is dusted onto the dough pieces at about 2.5%.

Typically the baking is fast. Baking times of 2.5 –3 minutes are usual. Baking is on a heavy wire or steel band and typical temperatures are around 300^{0}C at the first zone, decreasing to 250^{0}C at the end of the oven. The oven temperatures depend on type of heat transfer and amount of turbulence.

A heavy gloss means that the oven is too humid and a greenish tinge means that there is too much soda in the dough. A dull grayish surface is produced if too much flour is used to dust the dough. After the oven, the strips of crackers are broken into appropriate groups with rollers known as cracker breakers and the biscuits are usually stacked at once. During cooling perhaps 1.4-1.8% of moisture is lost, bringing the biscuit to about 2.5% moisture. The baking loss, dough to biscuits out of the oven is around 28% which involves a high oven power requirement.

Savoury or snack crackers

There is a broad group of cracker type biscuits that are variously salted, flvoured and fat sprayed after baking. Depending upon their size, because they are made in a very wide range of shapes and sizes, they can be regarded as savoury snacks, nibbles or biscuits fro cheese. These biscuits are a group characterized by very open textures and soft eating mouth feel. Usually they are simple biscuits but sometimes they may be cream sandwiched with a savoury, non-sweet, cream often based on cheese powder.

Their methods of manufacture are usually based on a well-developed dough modified with sodium metabisulphate and/or protease or based on fermentation and lamination like cream or soda crackers. They are nearly all of very delicate texture, often with great deal of aeration achieved with ammonium bicarbonate.

Those doughs that are fermented with yeast or modified with protease and are laminated should be handled in a similar way to methods described for cream or soda crackers. Those without lamination, with or without enzyme modification, are mixed and sheeted as for semi-sweet doughs. The high level of ammonium bicarbonate often makes the dough very extensible but the fat level and extra flavouring ingredients such as cheese and cheese powders tend to make the dough weak and rather short.

Flavouring of these crackers has presented much difficulty. The conditions in the oven effectively subject volatile flavouring materials to a condition of steam distillation, resulting in their loss to the oven atmosphere. It is important that flavour enhancers such as salt and monosodium glutamate are used at optimum levels to help these aromatic flavours. It is best that the biscuits have an overall acid reaction with pH around 5.5 like other savoury foods. It is common for savoury cracker recipes to include a small proportion of sugar or syrup. This reduces the dryness of the mouth feel and flavour, and the sweetness is therefore acting as flavour enhancer.

Many savoury crackers are decorated with poppy, sesame or celery seeds and garnished with salt. It is usual to apply these materials after cutting and before baking. Doughs rich in ammonia and salt are particularly corrosive to bronze/gummetal dough piece cutters. Since most savoury crackers are cut from a very thin dough sheet it is important that the cutting edges, docker pins and print are maintained in good condition and at correct relative levels to achieve clean cuts. As these are relatively lightweight biscuits with low densities, baking can be critical because excess heat will cause ‘ringing’ (brown round the biscuit edges) and bitterness in flavour. Column packed biscuits such as Cheddars or Tuc must be handled gently to prevent damage, and care is needed in baking to ensure that the product is flat and not domed or dished. Many savoury crackers are jumble packed so the thichness and weight of the individual pieces is not quite so critical. All savoury crackers are baked on some form of wire to allow maximum and quick development of structure.

Immediately after baking while the biscuits are still hot, they are sprayed with vegetable oil. This fat spray is most important for both improving the mouth appeal of the crackers and enhancing their appearance. Attempts have been made to apply flavour after baking in the form of flavoured oil or savoury dustings, as for potato crisps and expanded snack foods. On the whole, these methods are not very effective or have severe production disadvantages. The surface area of a biscuit relative to its weight is very much lower than for potato crisps etc. so the flavour has to be applied very heavily to give a satisfactory overall effect. It is important that a well-refined oil with low unsaturated fatty acid content be used for the fat spray. This is because the very large surface presented by the fat coated area will be liable to oxidative rancidity during storage of the biscuits. It is usual to use coconut or palm kernel oils which exhibit relatively great resistance to this form of rancidity.

The spray is achieved with high-pressure nozzles, high-speed spinning parts which atomize the droplets of fat, or by an electrostatic spraying technique. In all cases it is necessary to pass the biscuits over an open wire conveyor and through a special oil spray unit. Recipe costs of savoury crackers tend to be relatively high. Typically the weight of oil applied as a spray will be between 10-20% of the product weight.

Water biscuits and matzos

Matzos are made from flour and water only, and water biscuits have a little fat added. The shape of matzos is variable, being either conventionally round or rectangular like water biscuits, or in large sheets which are broken up by the consumer.

Typically the matzo recipe is about 100 parts of flour to 38 of water. This mixture is gently rolled together in mixer to form a crumbly ‘dough’. There is no dough development. The sheeter presses the mix together to form a sheet which, after reduction, is simply laminated with 2-6 layers. After further gauging, the sheet becomes clear and strong. This sheet is heavily dockered and cut and is then baked for a very short time in a very hot oven. Baking times of around one minute at 400^0C are not unusual.

The oven is often an indirect-fired brick oven to withstand the high temperatures, and the oven band is very open to allow maximum heat transfer to the product. The high temperature cause much blistering but the heavy dockering means that the blisters are small. The blisters take up colour but the rest of the biscuit remains very pale. Some moisture continues to be lost after the oven exit but a final moisture content of about 3% is typical.

Water biscuits are a slightly more variable group. There are some that are very similar to matzos with a simple recipe of flour, fat, salt and water in the ratio 100:6.5:1:29. The dough is undeveloped and crumbly or in balls after mixing. There may then be a conditioning period before sheeting when some form of proteolytic activity mellows the gluten to make it a little more extensible. A tough sheet is formed which, after laminating, is cut and baked in a very hot oven. Water biscuits are usually round and quite large, about 70mm in diameter. As longitudinal shrinkage occurs in the oven, the cutters must be oval and the shape is controlled by relaxation of the dough before the cutter.

By no means all water biscuits are made in this simple way. There are some that have a more elaborate recipe including low levels of sugar, syrup or malt extract. These are then fermented in a similar way to cream crackers but usually for only 3-4 hours. Thus these biscuits with 5-11 units of fat to 100 of flour are more like lean cream crackers. Cream crackers typically have about 16 units of fat per 100 of flour in the dough. Water biscuits made by the fermentation method are baked in 4-5 minutes in only moderately hot ovens, very similar to cream crackers.

All water biscuits, like matzos, have strongly blistered surfaces. They are fairly hard and crisp and bland in flavour. They are very suitable as a carrier for butter, cheese, or other savouries. Compared with their softer-eating cracker relatives, they remain crisp rather longer when spread with butter so can be prepared as snacks well before they are to be eaten. An important feature of matzos and the unfermented water biscuit doughs is their tough and crumbly nature. This makes sheeting more difficult and the power and strength of the sheeter should be carefully checked.

Puff biscuits

The dough is not fermented and is invariably cold and underdeveloped. The methods for distributing the fat in the dough determine the type of mixers and laminators needed. The eating quality of puff biscuits is determined very largely by the nature of the fat used for laminating. Unlike puff pastry for sausage rolls and vol-au-vents which are best eaten hot, puff biscuits are eaten cold so the fat used must not have a waxy tail after eating.

Puff biscuits may be used as unsweetened carriers for butter, cheese, jam etc or as shells for sweet or savoury cream sandwiches. Where used as ‘sweet’ biscuits, it is usual to garnish the surface prior to baking with sugar so that a glossy, lightly browned surface is produced. Puff dough made into very small biscuits may be sold as ‘snacks’ of various flavours, often in jumble packs. Palmier is one such type made from puff dough. The dough for palmier is folded after laminating and is then sliced across the laminations to form pieces of baking.

Puff Dough Formation

The preparation of layers of dough separated by a film of fat is the basis of puff dough. Thus an extensible dough is required, and a fat that does not have too high a liquid fraction and thus become incorporated in the dough and that is plastic enough to form thin films between the dough layers.

Since the fat must have relatively high solids at processing temperatures but with little solids melting above blood heat, it is necessary to select a partially hydrogenated fat with steep dilatation and to use it well plasticized at cool or cold dough temperatures.

Extensible doughs for bread or other types of biscuits involve a significant amount of development by mixing, with or without the help of yeast, and dough temperature are usually 30^0C or above. So the dough recipe is simply flour, water and salt perhaps with a little milk powder to soften the biscuit texture and enhance surface colouring during baking. As a consequence, the dough tends to be rather sticky and this feature limits the level of water that can be used while making sheeting and gauging possible. The fat may be introduced either as lumps in the partially mixed dough, or in some way between two sheets on the forming plant. It is then necessary to gauge and laminate in order to build up the structure. The lamination is that on cut sheet laminators, because the center of the dough is exposed in the cut edges, fat placed between two sheets and thus exposed will form surface marking which will be unacceptable later in the process. Thus mechanical laminating must suit the type of dough preparation involved.

If the laps are too few the biscuit structure will be coarsely flaky and may be irregular in development. If there are too many laps the rolling and stretching involved will exceed the elasticity of the dough causing breakdown and loss of laminations. It will be necessary to dust the dough with flour through successive gauge rolls to prevent sticking and tearing of the delicate layers as they are rolled.

It is a matter for debate whether the passage through the gauge rolls should be done slowly or rapidly. The use of SMS has reduced the need for relaxation, but it is still possible to exceed the elastic limits of the gluten in the dough if processing is too severe (either by pressure or speed).

Although it is not commonly used by biscuit makers at present, it is worth noting the special puff dough method offered by the Rheon company of Japan. This is built primarily for the flour confectionery trade rather than for biscuits but it does offer some interesting techniques. Dough is extruded in a tubular form and a lining tube of fat is coextruded within it. The double tube is flattened, gauged then laminated before being gauged and laminated again. The gauging is by means of what is known as 'stretcher' which consists of an endless chain of rollers arranged behind one another.

Baking of puff biscuits

Baking presents no particular problems. Optimum development is obtained with an oven temperature profile that is very hot at the front. If the front bottom heat is too high relative to the top heat, the biscuits will tend to curl into a saucer shape with the edges high. Increasing the top heat will encourage the centers to rise more giving either fat, even thickness, or a doming with the centers high. Control of top and bottom heat at the front of the oven is easier if light, wire mesh bands are used. Final moisture contents are not very critical as far as checking is concerned so, in this respect puff biscuits are not like cream crackers. Moisture of around 2.5% are quite satisfactory.

The molten sugar glaze frequently found on puff biscuits results from fine sugar melting during baking. If development is poor, the surface temperature is held down and the sugar will not melt and begin to caramelize. Alternatively, a mixture of dextrose monohydrate and sugar used as the garnish will more readily melt and give a pleasing surface colour and gloss.

Lecture-12

Hard Sweet , Semi Sweet & Garibaldi Fruit Sandwich Biscuit

Semisweet biscuits

All biscuits in this group are characterised by doughs which contain a well developed gluten network but, with increasing amounts of sugar and fat , the gluten becomes less elastic and more extensible. The prime requirement is a biscuit with a smooth surface which has a slight shine or sheen and an open even texture giving a bite that ranges from hard to delicate. This is achieved by a subtle balance between the requirements of recipe and processing.

Best biscuits are made from flour with low protein, in the range 7–8%, but such flour is often difficult to source. When flour with higher protein is used the gluten is not extensible enough (it is too tough and elastic) and some form of modification technique is required. Usually this is done with SMS, but increasingly proteolytic enzyme is being used. The latter does not act in the same way as SMS but it does produce doughs that are easier to Sheet.

The most common method of dough preparation involves a vigorous or extended mixing to produce a developed dough. As a result of the mixing action heat is developed. Dough is normally used at 35–40°C. However , there is another mixing technique common in mainl and Europe where the dough is made in a two-stage process similar to that used for short doughs. Mixing is much less vigorous and final dough temperatures lower. These doughs are referred to here as 'continental semisweets'. Their baked texture is generally softer and less crisp than biscuits from developed doughs . These doughs usually require less water.

For developed doughs there are maximum levels of fat and sugar that can be used. If these levels are exceeded it is not possible to produce an extensible dough: the dough is short. The following sets of recipes serve to illustrate the lowest and highest levels of fat and sugar that are encountered in biscuits of this group.

Semi sweet biscuits are 'basic' biscuits which are significant in the markets of many countries, particularly developing countries where the low cost of the formulation is attractive. They provide useful carriers for very sweet additions such as cream, chocolate and icing applied during secondary processing.

Critical ingredients

Flour quality:

If the protein content of the flour is higher than 10 % there could be problems in sheeting the dough even after treatment with SMS. The fat should be semi solid and plasticised , if the fat must be added as liquid oil it is desirable to add the sugar as a solution.

As fat level is critical to both the recipe cost and the eating quality of the biscuit the use of some emulsifier like lecithin allows the fat to be more effective in its shortening properties. Despite the name Petit Beurre biscuits do not always use butter ! If butter is used it should be at about 25 °C (not melted) to allow good dough development . Flavouring of these biscuits is difficult because the water removal during baking strips out volatile chemicals.

Mixing:

Normally an all mixing method is used . A two-stage method to allow some dissolution of the sugar in the water or plasticising of block fat is not uncommon. Disperse the ammonium bicarbonate in some of the water before adding to the mixer. Keep the acid salts away from the soda if possible.

Adequate time must be allowed for dissolution of the sugars, hydration of the flour and development of extensible gluten. To achieve this , to keep the dough water level as low as possible and to have a good dough consistency.

It is best to mix until the dough reaches a set temperature (40 °C is recommended for SMS doughs) rather than mixing to time.
Doughs made with proteinase will probably be mixed to lower temperatures and be stood before use.

Dough handling:

Except where the dough is cured with proteinase the dough should be used without delay and kept warm.

Dough piece forming:

With extremely rare exceptions (when rotary moulding is used) the sheeting and cutting method is used . In many cases laminating Is used but this is only necessary where the extensibility of the dough is not as good as it should be. In these cases laminating may help a little as it gives more work to the dough and provides some relaxation before cutting. Adequate dough relaxation is required before cutting and this also provides a process control technique for maintaining the correct shape of biscuits due to shrinkage after cutting and during baking. Occasionally a milk wash or a dusting with sugar is given to the dough pieces before baking.

Baking:

Usually on a wire band but sometimes (particularly for Marie) a steel band is used. Bake times are about 5 to 6.5 minutes at 200, 220, 180°C. Keeping the first part of the oven humid will give an attractive sheen to the biscuit surface. Baking to a moisture level of less than 1.5% will normally prevent the problems of checking.

Hard sweet biscuit

Around the world one can find endless varieties of biscuits, cookies and crackers, which differ in terms of taste and shape, decoration and other unique features that individual bakers add to their products to differentiate them and set them apart in their own market.

Having dealt with so many different types of dough in every part of the world since the early 60s, Imaforni has developed vast and unparalleled experience. Biscuit-making processes can be summed up in four main categories.

Hard sweet biscuits are manufactured on forming lines which consist of a sheeter and a set of gauge rolls. The line ends with the rotary cutter – of the one- or two-roll type – the scrap pick up and the return conveyor. Devices such as a sugar/salt sprinkler, egg wash, glazer or ink printer can be fitted onto the sheeting line to increase the variety of products. Our experience shows that a more regular final biscuit and fewer production problems are obtained by processing the dough sheet very gently. The recipe used for the dough and the way it is handled throughout the gauging process are key factors in avoiding stress to the sheet.

Baking usually takes place in a hybrid oven consisting of direct gas-fired or radiating heating in the first two-thirds of the oven, followed by convection heating. The conveyor through the oven is made of steel band or wiremesh.

Crackers are manufactured using the same equipment as described above, with the addition of a cut & sheet laminator between the sheeter and the first gauge roll. Cream-cracker production differs as it generally requires a fat-and-flour sprinkling system between the layers of dough during the lamination stage. As these products require a huge amount of heat when baking, the ideal oven is of the direct gas-fired type followed by direct convection heating. The conveyors used in these ovens are made of light- or heavy-duty wiremesh.

Rotary moulded: Here the recipe has more fat but less water - dough pieces are formed by extraction from a special mould. This is the most commonly used type of biscuit shell for sandwiched biscuits, due to the strength of its structure. A broader range of products can be made with this technology simply by adding further auxiliary equipment. Baking usually takes place in a hybrid oven with direct gas-fired or radiating heating in the first section, followed by convection heating. The conveyors used in these ovens are made of steel band or wiremesh.

After baking, all the types of biscuits described above usually follow the same path: lengthy, natural but hygienic cooling is necessary for all of them in order to avoid checking effects. Product stacking is a critical stage where expertise is essential in order to obtain a high level of efficiency in production. Imaforni excels in each of these processes in terms of the reliability of its lines and its technical innovation.

Garibaldi biscuits

The Garibaldi biscuit consists of currants squashed between two thin, oblong Biscuit- a currant sandwich. In this respect, it has elements common with the Eccles cake. Popular with British consumers as a snack for nearly 150 years, the Garibaldi biscuit is conventionally consumed with tea or coffee, into which it may be dunked in informal social settings. The biscuits also exist under different names in other countries including New Zealand.

Appearance

When bought in supermarkets in the UK (under several brands , including own labe l, all remarkably similar), Garibaldi biscuits usually come in four strips of five biscuits each . They hav e a golden brown , glazed exterior appearance and a moderately sweet pastry , but their defining characteristic is the generous layer of squashed fruit which gives rise to the colloquial names *fly sandwiches*, *fly cemeteries* , *dead fly biscuits* or *squashed fly biscuit s*, because the squashed fruit resemble squashed flies.

History

The Garibaldi biscuit was named after Giuseppe Garibaldi, an Italian general and leader of the fight to unify Italy. During the war they had to use limited rations to prepare food, the result was a simple biscuit. Garibaldi made a popular visit to Tynemouth in England in 1854. It was first manufactured by the Bermondsey biscuit company Peek Freans in 1861 following the recruitment of one of the great biscuit makers of Scotland , John Carr. In the United States, the Sunshine Biscuit Company for many years made a popular version of the Garibaldi with raisins which it called "Golden Fruit ". Sunshine was bought out by the Keebler Company which briefly expanded the line to include versions filled with other fruits . Plain chocolate covered and milk chocolate covered varieties have also been marketed in the past, but appear not to been available for many years.

In popular culture

Garibaldis are the favourite tea biscuit of DCI Gene Hunt in the BBC shows Life on Mars (TV series) and Ashes to Ashes (TV series). They are also mentioned briefly in the prologue of Meera Syal's debut novel *Anita and Me*. Naomi Campbell, a character in British teen drama, *Skins* is quite fond of them. Inspector Japp offered one to Poirot in the episode in which Poirot's dentist was murdered. In the Doctor Who audio episode *The Stuff of Nightmares*, the fourth Doctor has a soggy Garibaldi. In Dinnerladies Mr.

Michael, the boss of HWD Components is quite fond of them. They are also mentioned in the British program, The Young Ones (Episode, S2E1, "Bambi.") in the British sitcom Men Behaving Badly, Series 1, Episode 6, "My Brilliant Career" (1992), George (played by Ian Lindsay) tells his co-worker Anthea (played by Valerie Minifie), after Anthea hands him a package of biscuits, "I was wondering Anthea, maybe next week we could experiment, tentatively, with some Garibaldi."

Garibaldi or fruit sandwich biscuits

The extensible nature of British type semi-sweet dough make it suitable for containing , in a dough sandwich, a filling of fruit. When this fruit is currants, the product is called Garibaldi.

The process is quite difficult to perfect and it is important that very little fruit is allowed to break through top and bottom dough layer, otherwise it dries too much in the oven and a tough leathery product is produced after baking.

Essentially two dough sheet must be produced and filling of fruit must be introduces before final gauging. The dough sheet at cutter is not much thicker than a Osborne semi sweet type and difficulty is often encountered in obtaining an even almost complete , fruit layer which is well enclosed in the dough.

There are at least three different forming systems for introducing the fruit between two layer of dough, but the most successful way is to have two sheet each with two pairs of subsequent gauge rolls, to give dough sheet of about 8 mm thick. A carpet of fruit is evenly over the lower sheet (this is an engineering challenge) the top sheet is then laid onto the fruit , and reduction to the final sandwich thickness should be achieved with one further pair of gauging rolls. If more than one gauge roll used after compressing the fruit and the dough together, there is an increased chance of fruit breaking through the dough causing poor biscuit quality and sticking to the gauge rool or cutter**.** It is almost essential that small currants are used , as larger fruit will be broken in the gauging.

Garibaldi must be cut to have minimum scrap as fruit dough is very difficult to re-use; it is either incorporated into the lower sheet of the sandwich or must be returned to the mixer to be incorporated with the new dough. Thus garibaldi is usually produced as slabs with a minimal amount of edge cutter scrap. With care this can be fed back onto lower dough sheet prior to its first gauging. Good quality Garibaldi will have about one third of the product as fruit. Too much fruit will give tough biscuit, too little will give hard dry biscuit. The ratio of fruit to dough also a very great effect on the backed biscuit thickness. Thus it is important to keep the spread of fruit even , prior to making the sandwich. Broken currants are exceedingly sticky and it common to have trouble with sticking at cutter. Reciprocating cutter seems to be more reliable than rotary type.

Lecture-13
Short Dough Biscuits, Wafers

Products in this group are distinguished from others in that they are made from a dough that lacks extensibility and elasticity. Wheat flour or some other farinaceous material is the major ingredient, but the quantities of fat and sugar solution present in the dough create a plasticity and cohesiveness of the dough with minimal formation of gluten network. The structure of the baked biscuit consists of a mixture of protein, starch and sugar glass (supercooled molten sugar). There is no continuous protein matrix and the fat is present in the form of large globules or of larger interconnected masses between the starch protein masses. The texture is typically relatively coarse as there is much coalescence of the gas bubbles that form during the baking.

Thus the features of the doughs of this group result in biscuits which tend to become larger in width and length as they bake, rather than shrink as for crackers and semi-sweet types. Control of this increase in size or 'spread' is the biggest single processing problem.

Recipes and Ingredients

Since the quantities of fat and sugar are relatively high in short dough recipes, the qualities of these ingredients are important. It has been shown that gluten is of very low importance, so the protein content and quality of flour is of little significance.

The method of forming dough pieces is determined very much by the consistency and stickiness of the dough. Many short doughs are formed with a rotary moulder.

As regards the quality of fat used in these recipes, the flavour will come through to the biscuit and this may or may not be a good thing. It is recommended that there are at least 15-20% fat solids at the dough temperature.

It is usually best to prepare a fat/ water/ sugar/ syrup etc emulsion before adding the flour. A stable emulsion is not easy to prepare if the fat solids are too high or very low (functions of temperatures and fat type). Preparation of the emulsion and also the effectiveness of the fat to form a soft eating biscuit are aided if certain special emulsifiers are used at appropriate levels.

Dough Mixing

Although the water level in these doughs is low, it is possible to develop gluten if the kneading action of the mixing is excessive. To produce the best quality of biscuits the amount of mixing must be at a minimum.

Thus in a typical two-stage mixing, all the ingredients except the flour are placed in the mixer and, at gentle speed, mixing proceeds for several minutes. The objectives are: to dissolve as much of the sugar as possible in the available water, to disperse and dissolve the milk solids, chemicals and flavours and to emulsify the whole with the fat. The result should be a semi-stiff white 'cream' which supports any undissolved sugar and all the water. The flour is then added to this cram and mixing proceeds again at a gentle rate for a period calculated to be the minimum to get reasonably uniform dispersion of the 'cram' over the flour. This stage is known as the dough-up and will give at one extreme a more or less crumbly dough which can be pressed into a sheet or moulded with a rotary moulder, or at the other extreme a soft plastic mass suitable for extrusion on some different types of machine. The second stage of mixing is desirably less than one minute and it is hoped in this time that a homogeneous mixture will have been formed but that there will have been very little opportunity for hydration of the flour protein and the formation of gluten. In all cases, at the completion of this mixing the dough will appear softer than it is after standing. During a standing period, water (sugar syrup) will be absorbed, passively, into the starch and protein etc. in the flour and the dough will appear to have dried out and become less sticky. In fact, the dough does not dry out, i.e, is not lost to the atmosphere, so ‘drying in’ may be a better way to think of it. The hydration of the flour is a very important stage and must not be hastened by over mixing. It is probable that the hydration continues over a very long period, but the changes are most noticeable in terms of consistency change and loss of stickiness over the first 30 minutes and after this time it is normally satisfactory to use it on the forming machinery. If the dough is not stood for 30 minutes or so, it is probable that toughening will occur after agitation (working) in the sheeter, moulder, etc, which will result in harder and possibly distorted biscuits.

Dough Piece Forming

Short dough is formed into pieces for baking in a number of different ways. In order of importance the main methods are:

1. Rotary moulding
2. Wire cutting
3. Extrusion, including coextrusion
4. Sheeting, gauging and cutting

Baking

Baking causes an expansion of the dough to form the desirable texture. In many short doughs the rise of the dough piece in the oven is quite spectacular, so that almost hemispherical pieces may be formed.

Factors affecting the dough piece spread

Since the size of short dough biscuits is so influenced by the spread during baking, it is not surprising that much investigation has been done and much published on this aspect of biscuit making. The findings may be summarized thus:

Factors allowing greater spread	**Factors which reduce spread**
Factors related to flour in the formulation	
Coarse flour particles	Higher flour water-absorption value
Minimum mixing prior to dough standing	Over mixing of dough
Factors related to sugar in the formulation	
Fine sugar particles	Coarse sugar or lower level sugar
Factor related to fat in the formulation	
Soft doughs due to higher temperature	Cold doughs
Factors related to aeration in the formulation	
High dough pH, more ammonium or sodium bicarbonate	
Factors related to dough age and dough piece weight	
Very fresh dough	Old dough
High dough piece weight	Low dough piece weight
Factors related to oven conditions	
Greasy oven band	Flouring of oven band
Cold oven band at time of deposition of dough pieces	

Low temperatures in front of oven High oven temperature in first zone

Lecture-14

Cakes

The following methods can be used for cake making

1. Sugar batter method
2. Flour- batter method
3. Blending method
4. Boiled method
5. Sugar water method
6. All in process method

Sugar-batter method:

In this method all the fat and equal amount of sugar is creamed together. Shortening or fat used for cake making should be plastic in nature. Shortening used for cake making should not melt by the heat produced due to friction during the process of creaming. All the fat should be first creamed together in order to blend them thoroughly. Then sugar is added gradually continuing the creaming process. All the sugar should never be added to the fat at a time as it will adversely affect the aeration process. And it may take extra time to achieve derived results. When adequate aeration is achieved in the fat -----mixture, eggs are added gradually. It is a good practice to whip the eggs to a stip froth before adding to the creamed mixture. Colouring agent may be added to eggs. Eggs should be at room temperature at the time of adding to the cream. Egg is added the mixture little at a time and mixed gently. If the cold eggs are used, then the fat will solidify soon after come in contact with eggs which will also prevent perfect blending of fat and eggs. After mixing egg the mixture should have a smooth, light and velvety appearance.

Next stage is to mix flour in the mixture. Flour should be rifted thrice with baking powder, in order to ensure a through blending. Mixing of flour in the cream is a important stage in cake making. And even slight mishandling of the mixture will spoil the cake. The flour should be evenly mixed with a minimum possible of mixing. This is to formation of ---gluten in the mixture.

The flour should not be added in one lot. It should be divided into two or three portions of convenient size and each portion should be added at a time. If any fruits are to be mixed, these should be added alternately with flour.

When all the flour is mixed, it may be necessary to add some mixture to bring the consistency of the mixture to a definite level of softness. If milk or milk solids are already used along with flour, then water is used for this purpose. Otherwise milk is used. The mixture is now ready for baking.

Flour-batter method

In this method fat and equal quantity of flour is creamed together. Fat should be smooth and in plastic state and the flour should be added gradually. The whole mixture is whipped till it becomes light and fluffy.

Eggs and an equal quantity of sugar is whipped to a tiff froth. The mixture of eggs and sugar will whip better if the mixture is slightly warmed on a double boiler. Direct heat should be avoided in this case on even slight rise in temperature will cause co-operation of egg protein will lose its air entrapping capacity. Unless the egg-sugar mixture comes down to the room temperature, it should not be added to creamed mixture.

At this stage the remaining sugar is dissolved in milk or water and added to the mixture. Any colour and flavour is added along with milk.

Lastly the remaining flour, is added and mixed. During last stage of mixing if the formula is rich, the mixing should be light. A vigorous mixing will know out the air-cells and the cake will have poor volume.

Advantages of Flour-batter method of cake making:

As major part of flour is coated with fat before any liquid is added, the development of gluten is avoided. Very small quantity of flour remains to be added at the last stage of mixing. As the amount is small it does not require much mixture operation to be carried and there is not much of toughening of gluten.

Egg and sugar is whisked to a stiff froth and it is added to fat and flour mixture which is creamed too light and fluffy consistency. Chances of curdling of rich mixture are less.

Flour-batter method is specially suitable for making lean cakes which donot contain much fat or egg and most of aeration is ------through baking powder. Initial creaming of fat and flour, through whisking of eggs and sugar, presence of enough moisture during the last operation of mixing are some of the factors due to which toughening of gluten is avoided and the cake acquires a good texture.

Blending method

This method is suitable for making high ratio cakes in which quantity of sugar is more than the quantity of flour. In this method, shortening or fat, flour, baking powder and salt are whipped together to a very light and fluffy consistency. Sugar, milk, colour and flavour are mixed together and added to the previous mixture. Eggs are added next and the whole mass is mixed together to smooth batter.

Boiled method

This method is used for making good quality machine cakes and geno---sponge.

Butter or bat is placed in boiler and heated till it melts. Remove the bowl from heat and add all the flour at a time and mix thoroughly.

Egg and sugar is beaten to a stiff sponge. Colour and flavour may be added while whisking the sponge. This sponge is added in the fat flour mixture in about 4-5 equal parts. After each addition of sponge, it is thoroughly mixed with a wooden spoon, when the mixture is smooth, it is scaled off into the proper lined tin.

Sugar-water method:

In this method, all the formula sugar and approximately half the quantity of water is agitated in a bowl till all the sugar is dissolved. Then the remaining ingredients except eggs are added and the mixture is well agitated to acquire aeration. Finally eggs are added and the mixture is cleaned.

Due to more aeration and better emulsification obtained in this method the cakes so produced have better texture and longer shelf life.

All-in-process:

In this process all the ingredients are put into mixing bowl together. Aeration of the mixture is achieved by controlling the speed of the mixer as well as the mixing time. Beater with wire (wire whip) is used for this operation which ensures a faster breakdown of ingredients and help to achieve good aeration.

After adding all the ingredients in the mixing bowl, the mixing operation is carried out as follows:

1. Half a minute at slow speed.
   This is done at slow speed so that all the dry ingredients are moistened without flying off from the bowl.
2. Two minutes at fast speed.
   At this stage, all the ingredients break down are incorporated evenly with each other. The mixture is aerated.
3. Two minutes at medium speed.
   Aeration achieved during the second stage is not evenly distributed in the mixture. By mixture at medium speed the layer air cells and the aeration of the mixture becomes even.
4. One minute at slow speed.
   This is done in order to eliminate any possible large air pockets and still finer breaking down of air cells.

Preparation of moulds or pans

Moulds should be properly greased and dusted with flour. Excessive greasing of moulds is undesirable because it will have a frying effect on the bottom part of the cake and the cake will have a greasy feel. After dusting the mould should be turned upside down and tapped gently in order to remove excessive flour which, otherwise will adversely affect the appearance of cakes.

When the batter is ready, the mixture should be put in the moulds in a large portions as possible. Putting the mixture in small portion at a time may cause entrapping of air pockets between one portion and the other. These air pockets will create holes in the cakes. They should only be filled to about two-third of its height leaving sufficient space for the cake to expand.

After the batter is weighed in the moulds it should be leveled properly in order to have even expansion of cakes. Back of hand moistened with milk may be used for leveling the batter. Slight moisture in the upper surface helps the cakes to expand evenly and due to caramelization of milk sugar, the crust acquires a desirable golden brown colour.

Baking of cakes:

Different kinds of cakes are baked at different temperatures. The temperature is adjusted according to richness of the formula, size of cake and number of units required to be baked at a time. Richer the cake (formula) lower the temperature of baking. Rich cakes contain more amount of fat and eggs and they acquire all its aeration during whipping of eggs. If the rich cakes are baked at high temperature, these will be a faster crust formation on cakes. The crust will prevent heat from penetra time inside the cake resulting in an underbaked product. There will be much concentration of heat on the crust giving it too dark colour. When there is expansion of the internal part of the cake, the crust may burst open spoiling the appearance of the cake.

Rich formula cakes contain very little baking powder. Lean formula contain less amount of fat and eggs. All the aeration in such cakes is achieved by baking powder. Lean cake batter is thinner than rich cake-batter. Such cakes are baked at higher temperature so that the evolution of gas from baking powder, acquirine volume by cake and setting of structure of cakes take place simultaneously. If such cakes are baked at low temperature, there will be evolution of gas from baking powder which will expand the cake. But due to low temperature the structure of cake will not set and the cake will collapse.

Cakes baked as large units should have a slow and gradual expansion in the oven which is possible when the baking temperature is low. Smaller units of cakes require less baking time. Faster setting of structure is made possible by baking at higher temperature.

When the oven is not filled to capacity, it is necessary that the temperature of oven is reduced. Place a pan containing water in the oven, so that the water absorb some of the heat at the same time the water vapours delay the process of crust formation on cake than allowing the cake to rise evenly and aquire proper volume.

Lining the pan or mould with paper, connecting the cake in the oven with wet brown paper, placing the mould on baking sheet while baking, are some of the means to cut down the absorption of heat by cakes and these measures should be adopted while baking such cakes which require too long baking time or while baking a small batch of cakes in a large oven.

Changes in cake during baking:

During baking the air obtained from creaming and beating is joined by the carbon dioxide given off by the baking powder or soda. There is also some steam developed , steam is also an aerator.

A cake batter contain gluten and starch with the application of heat the starch get--- and the gluten coagulates. Egg produce present also coagulates to give structure to the cake.

The size of the sugar crystals in cakes affects its texture. Small crystals give better cake texture than cause sugars. Fine, whole sugars used in cake recipes results in better cake.

Fast heat penetration is derived in cake baking. The dull iron pan absorbs and transmits heat faster and more effectively than the pans having a shiny surface. Dull pans result in faster browning.

Allow free air circulation around the --------. If they touch each other or the sides of the oven the rate of heat transfer is increased whey they touch.

Allow the cakes to cool to 60^0C (140^0F). This may take a long time. At least let them cool for 10-15 minutes so that their centers will be partially cooled.

Lecture-15
Pizza and Pastries

Thee can be little doubt that pizza originated as a way of using up scaps of bread dough. Various origins are claimed for pizza, ranging to Naples in the nineteenth century, classical antiquity and the USA.

Pizza or something like it could have been produced by the Phoenicians, the Greeks or the Romans. Given the tendency of people to eat their food off a piece of flat bread the inventive step of cooking the other ingredients with the bread could have occurred to any number of people.

It is said that the soldiers of Darius the Great (521-486 BC) emperor of Persia baked a kind of flat bread on their shields and then covered it with cheese and dates when on campaign. Cato the Elder, i.e, Marcus Porcius Cato (234-149 BC), wrote of 'aflat round of dough dressed with ovive oil, herbs and honey baked on stones'. Shops were found in the ruins of Pompeii apparently equipped for the manufacture and sale of flat breads, possibly pizzas.

The modern era of pizzas is normally taken as starting in 1889 with a visit by king Umberto I (1844-1900) and his queen Margherita di Savoia (1851-1926) to their summer palace near Naples. They sent for one Raffaele Esposito, a leading pizza maker who produced a pizza in the colours of the Italian national flag, red, white and green. The red was produced by tomato puree, the white was mozzarella cheese and the green was basil. This pizza was christened pizza Margherita in honour of the occasion. Italian immigrants took the recipe to the USA, where made with American flour a different product emerged. The first American pizza parlour opened in 1905 in New York city. The next American development was the Chicago deep dish pizza in 1943. Pizza seems to have arrived in the UK from the USA rather than via Italy – visiting American service men possibly had something to do with it. The effect of increased European travel and visits to Italian restaurants has led to a demand for authentic Italian pizza. The problem is, what is meant by pizza?

The classic Neapolitian pizza is supposed to be similar to Margherita but with added anchovies. This is a thin light product that is cooked by placing it on a very hot bake stone (around 600 BC) on top of a wood fired oven for 0.5 – 1min.

Bread making 199 Pizza is, bcause of its history, one of the more variable bakery products. Pizzas made from Italian soft flour are never going to be the same as an American pizza made from American flour.

Chicago style pizza is made in a pan or dish with the cheese going in first and then sauce on top. The crust is then formed up the side of the pan – even with crusts with sauce in between, known as a 'stuffed crust'.

The St Louis style pizza is a thin crust pizza using local Provel cheese in place of Mozzarella. This product is crisp with a seasoning of oregano, other spices and a slightly sweet sauce. Hawaiian pizza uses pineapple and Canadian bacon, giving a rather sweeter product.

British pizzas probably started from a point where they would be unrecognizable to either Italians or Americans. As in other fields the demand for authenticity has led to the production of products that are much closer to the original. The variations possible are limitless; however, pizza essentially is bread dough with other ingredients added. If the pizza is to be thin a douogh is needed that spreads rather than lifts. If the pizza is to be thick then the dough needs to be nearer to British or American bread dough.

The British practice for thin pizzas is to use flour based on a high proportion of soft English non-bread making wheat. This gives a dough that spreads but does not rise. Such a flour is likely to have a low falling number, i.e, an appreciable amount of amylase activity, which again assists in the spreading of the dough. If a thick pizza is desired a stronger flour would be used. American practice is to either use flours with approximately 12% or 14% protein, depending on the product. Alternatively, an American pizza maker might stock just the 12% protein flour and add dried vital wheat gluten to those products where the higher protein content is felt to be needed. The processing given to pizza doughs is very variable, ranging from large plant bakeries to small pizzerias (pizza makers) where the dough is kneaded by stretching it and folding where the customers can see it.

Some pizza doughs are mixed, kneaded, given a short proof, and sheeted out for use. Other doughs are mixed, divided and rounded, followed by 24 hours in a retarder at 5-81^{0}C. This gives the effect of a very long fermentation step. The dough is then sheeted and the pizza is made up and baked. Lastly, frozen pizzas are often not yeast raised at all but are chemically leavened. The usual leavening agent would be a double acting baking powder.

Pastry

A sweet baked food made of dough especially the shortened paste used for precrust and the like. Pastry is the name given to various kinds of baked foods made from ingredients such as flour, milk, butter, shortening, baked powder or egg. Small cakes, tarts and other sweet baked goods are called pastry.

Danish pastry, the principle factors are size, shape and uniformity of the units. Weight determines the size of the unit while the shape will depend upon the skill of the baker during make up.

Basic formula for Danish pastry;

Dried yeast	-	30g
Water	-	200ml
Milk powder	-	50g
Sugar	-	100g
Salt	-	15g
Egg	-	120g
Flour	-	1000g
Shortening	-	50g

After allowing the short rest, roll out dough into a rectangular shape about ¼ thick. Divide the shortening into three equal portions. Again the dough rolled out into a rectangular shape about ¼ thick. Another portion of the roll in fat is distributed over 2/3 of the dough. After a short rest the dough is to be rolled again ¼ thickness to distribute the remaining portion of the shortening.

The following report include in Danish pastry:

Proofins:

It has lot of spring action, so it donot require great deal of proof it required half proof before placing in oven it has desirable temperature range of 80 to 85^{0}F with relative humidity 80%.

Bakins:

Oven temperature should be about 400 to 450^{0}F depending upon the size of the pastry unit. A glaze should be applied immediately after baking. A glaze should be prepared by good boiled three parts of glucose to one part of water by weight. The pastry should be ice.

Filling:

Left over cake crumbs can be converted into filling by mixing following proportions of ingredients.

1. Cake crumbs -130h
2. Icing sugar -50g
3. Whole egg -20g
4. Cinnamon powder taste

Lecture-16
Setting up of a Bakery Unit

Bakery organization

The bakery section is one of the most important units in a catering establishment. Nowadays the people are passionate to have fast food and ready-to-eat food items in their diet. The bakery products are one of the most soled products among them. At the same time bakers have been convinced to maintain the quality product and to produce new variety of consumer choice. So it requires that the bakers should have keen interest, so involvement and have through knowledge in the bakery industry.

The organization of a bakery will vary according to the size and type of the establishment, customer expectation as well as the variety and size of menu and the type of service given. Often the quality and quantity of production determine the number of persons required to run the section. In a small bakery unit, there will be a head chief, pastry man, confectioner, baker and one or more assistant to get the job done.

Duties and responsibilities

In a small bakery unit the **head chief** carries the full responsibilities of the department. He should have a deep knowledge in bakery products, present market trends, consumer needs, capable to control and coordinate the staff, to plan the menus, and controls expenditure and waste to meet the profit percentage required.

The **pastry** man have to prepare hot and cold products, sweet sauces, pastries, gateaux and cakes.

The **confectioner** needs great skill, experience and artistry. He has to prepare marzipan, chocolate, pastillage, sugar work, decorative and display items, patties flours, wedding, birthday, and celebration cakes and ice-cream varieties.

The **baker** makes all the yeast goods such as bread, rolls and buns, fancy products, biscuits and cookies. Besides, he has to tend the ovens.

In private sectors, the **production manager** carries all the production of bakery goods, quality and quantity control, prevention of wastage of ingredients and losses due to bakery.

The **assistant manager** has to assist the production manager. The **supervisor** has to supervise the production at the various stage of manufacturing. And he has to prepare the daily production report for the production manager as well as mention any other points which require attention in or around the plant. His main responsibility is to check the weight of each product and maintain the same quality throughout the production.

The **purchase officer** will receive the instructions from the managers of various departments and will purchase the requirement for the production and maintenance purpose. He has to check and maintain the stock register for receiving and issuing the ingredients.

The **sales manager** takes the roll to market their products and create the interest among the people to buy the products with the help of sales man and canvassers.

The **maintenance manager** maintains all the major equipments as well as the electricity, water supply, lighting and ventilation, building repairs and vehicle in correct condition.

When you plan to start a small bakery or confectionary unit, you should consider the following points:

5. Population and purchasing capacity of the area.
6. Material availability in that area
7. Transport facility
8. Electricity and other fuels availability.
9. Availability of water
10. Communication
11. Customer needs and expectations
12. Government procedures and legal aspects of the industry.

Bakery equipments

Nowadays many modern equipment and tools are used in the bake shop industry because the modern technology continues to develop more and more specialized and technology advanced tools to reduce labour. Much of our bakers art and craft involves simple tools. Large machines like mixtures, oven and dough kneader need a high level skill. The large equipment help the production in large quantities with greater speed besides reducing the labour cost.

The bakery tools and equipments are classified under two categories:

1. Small equipment
2. Large equipment

Small equipment and their use

1) Mixing bowls: A variety of stainless steel bowls are used for whipping eggs, mixing of creams and storage purpose.
2) Muffin pan: The different size of baking pans with cup shaped indentation for baking muffins.
3) Savarin moulds: Small ring shaped doughnut shaped moulds for baking savarins.

4) Ordinary and textured rolling pin: Ordinary rolling pins help roll the dough and the textured rolling pins are useful to make design over the biscuit dough, and on sheets of marzipan and pastillage.
5) Table scraper: Use to cut pieces of dough. It is available in plastic or metals.
6) Baking tray: Use for baking goods. It is available in various sizes.
7) Pastry brush: Use to brush the items with egg wash, glaze etc.
8) Tart pan: Available in many shapes and sizes. They may be made in one piece or with a removal bottom to make it easier to remove the baked tart from the pan.
9) Bread moulds: various size of mould are used to prepare a variety of breads.
10) Bread knife: Bread knife is a flexible rounded tipped tool used in pastry section for spreading cream, glaze on cakes for mixing and bowl scraping.
11) Pastry bag and nozzles: The plastic, nylon bag is used to pipe the fillings, cream and various toppings. Nozzles are available in different designs and are used for decorating items such as cake icings and whipped creams.
12) Sieves: These are used to shift aerate and helps remove any large foreign raw materials from dry ingredients.
13) Timers: These are absolutely essential for baking.
14) Wooden spoons: To stir ingredients in a bowl.
15) Juicer: To squeeze juice from different fruits and vegetables.
16) Hand blender: To whisk small quantities of egg or cream
17) Sugar thermometer: Used to measure the temperature of the sugar or the density of the sugar syrup.
18) Cooling wire rack: To pull sponge cakes and yeast products and thus prevents from sweetening.

    Beside these small equipments includes weighing scale, Madeleine cups, cream horn mould, chopping board, oven gloves and varies sizes of cake moulds.

Large equipments and their use:

Weighing machines:

Raw material measurement used in proper weighing scale is very important for the quality product for the accurate quantity.


Fig: Weighing machine

Flour sifter:

Flour sifter is an essential part of food safety system (HACCP). It will aerate the flour and other ingredients for getting better volume of finish products.

Spiral dough mixture

Spiral dough mixture is a specially design for making large quantity of yeast dough. There are two models of mixtures available in the market. Most models have a single vertical mixing arm or hook. Another model machine is having two agitator arm which are mounted on vertically on circular poles.

Planetary cake mixture

Two types of mixture are available in the market:

1. Bench model
2. Floor model

These mixture usually have three operating speeds and their mixing attachments, namely

1. Wire whip
2. Flat beater
3. Dough arm

Dough divider

The dough divider machine divides the bulk dough into desire size. The dough density should be even otherwise the weight might change. Single pocket divider will be easier to use.

Burn divider and rounder

Burn divider and rounder divides the doughs into many pieces at once and it then automatically rounded all of them, greatly speeding the makeup of the dough products.

Bread slicer

Gravity feed slicer are best suited to the small, wholesale and large retail bakeries where a great number of sliced breads are produced. All types of white and sweet bread can be sliced without wastage or damage. The cut slices come out at the output end.

Fig: Bread slicer

Dough sheeter

A dough sheeter rolls out portion of dough into sheets of uniform thickness. The machine consists of a canvas conveyer belt that feeds the dough through a pair of rollers.

Deck oven

There are single, double and three decked oven available in the market. Types of oven, the product trays or moulds are placed on the oven floor. Bread baked directly on the flour of the ovens and not in pans is often called hearth breads. Deck oven for baking breads are equipped with steam injectors.

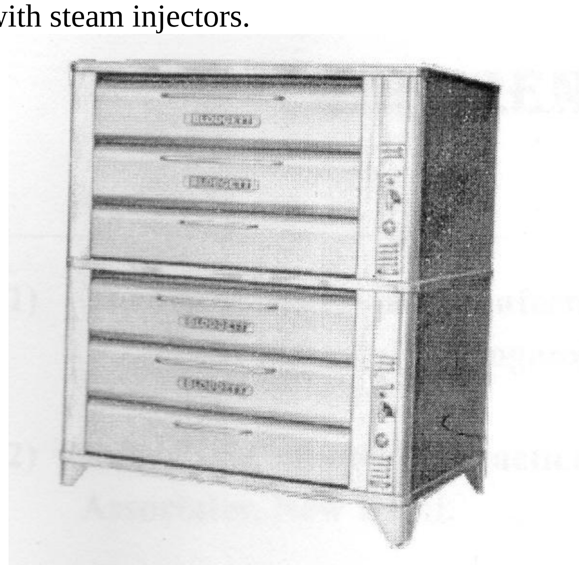

Fig: Deck oven

Rotary rack oven

A rack oven is a large oven into which entire racks full of sheet pans can be wheeled for baking. They are also equipped with steam injectors. Rotary rack ovens are excellent for large scale production. It can be fired with gas or electricity.

Refrigerator

To store the food items at right temperature.

Sorbet machine

Designed to churn puree along with sweetening and other flavourings machines.

Ice-cream machines

To prepare different variety of ice-cream.

Lecture-17
Types of Confectionery

pH, Acidity:

In confectionary, it is probably best described as "active acidity". The pH range covers acidity and alkalinity, although rarely are alkaline conditions met in confectionery. Alkalized cocoa is an exception and possible also aerated products using sodium bi-carbonate- these are slightly alkaline in confectionery, weak acids such as citric and tartaric acids are used for flavourings. Strong acids, for example hydrochloric acids are used for special purpose such as sugar inversion. There is a relation between pH and concentration, for example pH 2 citric acid must have concentration of 2.4% where as HCl has 0.03%.

Acidity of various candies

	pH	% citric acid
Acid drops	2.2	1.8
Pectin jellies	3.3	0.8-1.0
Fruit jellies	4.2	0.5

The taste factor depends on to some extent on the type of confection product.

Acidity is a second of the natural taste stimulations experienced when eating confectionery. Citric acid, lactic acid, and tartaric acid for creating and acids sensations in sweets. Their effect on taste sensation is related to pH value acidity. Their used in the food industry has secondary benefits of preservation and resistance to microorganisms.

ERH:

ERH is known as equilibrium relative humidity. Water activity is expressed as unit whereas ERH is expressed as %. ERH is inverse proportion to the components in solution when expressed as molecular concentration in the syrup. An increase in the molecular concentration varies phases will lower the ERH value. Whereas humectants can be used to minimize the rate of moisture change while a product is being held on store. These include sorbitol, glycerol and various glucose syrups.

ERH of confectionery products

Class of confectionery products	ERH (%)
Wafer cookies, roast nuts	15-25
Hard candy, hard toffee, butter scotch	25-30
Hard caramels, soft cookies, milk crumb	35-50
Gums, pastilles, low moisture jellies, soft caramels	50-60
Soft marsh mallows, fruit jellies, fondants	65-75
Soft fondants, pastes, fudge	60-65

Chocolate coatings, compound coatings, lozenge paste these are related to the hygrosuticity of the ingredients. The moisture content of all these products is low, 1% are less the main ingredients are probably milk solids, sugars and cocoa material with very small amounts of glucose syrup or invert fat also present which is moisture free. Dark chocolates 85% and milk chocolates 78% relative humidity. The ERH of low moisture substance including powders dependends on the absorption properties of the constituents and actual moisture content.

Types of confectionery

Based on sugar content the confectionery of many types , the products are by sugar whether crystallized or not:

11. BOILED SWEETS
12. CAREMAL, TOFFEE AND FUDGE
13. GUMS AND JELLIES
14. LIQUORICE PASTE, CREAM PASTE AND AERATED CONFECTIONERY
15. TABLETS, LOZENGES AND SUGAR PANNING
16. MEDICATED CONFECTIONERY AND CHEWING GUM
17. CENTERS, FUNDANTS, MARZIPAN AND CRYSTALLISED CONFECTIONERY

T.S AND T.S.S

T.S.S means total soluble solids. T.S means total solids. In confectionery the total solids mainly depend on the sugar content.

T.S of boiled sweets 83% where as fudge 75%. TSS of jam 65-68%, jelly 65%, preserve 70%, candy 75%.

Lecture-18

Raw materials- types of sugars

Sugar is infact a generic name referring to a host of carbohydrates, but it has become common usuage for it to refer to one particular substance- sucrose. Sucrose is produced in vast quantities throughout the world and is the basic ingredient for classical sugar confectionery.

Sugar occurs very widely in the vegetable world, in the roots and stem of grasses and root vegetables and in the sap of many trees. Commercially, however, it is extracted from sugarcane, which is grown in tropical areas, and from sugar beet, which is grown in temperature climates.

Production of cane sugar

The harvested sugarcane is crushed and the juice is squeezed out. The juice is heated and treated with lime to remove many of impurities, after which it is evaporated until the sugar crystallizes. The resulting mixture of crystals and mother liquor is spun off is reboiled to produce another crop of raw sugar. The second mother liquor is boiled for a third time. The third mother liquor is economically exhausted of sugar and is called **factory molasses.**

Production of Beet sugar

A cane sugar refinery operates throughout the year, drawing its raw sugar supplies from different parts of the world. Beet Sugar Factories, which draw their supplies of beet from nearby growers, produce sugar only from about October to January. Whilst raw beet sugar can be produced, it is usual to avoid this step and the normal process is as follows:

1st step: Extraction
2nd step: Carbonation
3rd step: Decolorisation
4th step: Centrifugation
5th step: Drying

Types of sugar & their role in confectionery
Some important types of sugar are as follows:

- Granulated
- Caster
- Icing
- Liquid sugars
- Brown sugars
- Molasses
- Micro Crystalline sugars

1) Granulate: This is marked in several grades-

   a) Mineral Water
   This is the purest grade of sugar which is commercially available. It has a lower color and ash content than granulated and was originally produced for the manufacture of mineral water. However, it has found use in sugar confectionery for specific purposes, eg., Wet crystallization.

   b) Granulated
   A white sugar which is sold industrially and domestically and which constitutes a very high proportion of total production.

   c) Industrial Granulated

This sugar has very slight off white-colour and is used where a white sugar is unnecessary. Eg-in the manufacture of Toffee, Fudge, Chocolate etc.,

d) Cubes
These are usually produced now a days by moistening granulated sugar with about 1% water pressing into cubes and drying.

e) Nibs
These are agglomerates of granulated sugar crystals made by dampening the sugar, thoroughly drying and breaking up the resulting hard mass. The product is sieved to various sizes.

2) Caster
A white sugar of small crystal size, for domestic and industrial use. It can be either boiled in the vaccum pans or milled from granulated and these five have the same composition as granulated.

3) Icing
Icing is produced by milling granulated sugar, the best qualities being double milled. Often an insoluble anti-caking agent is added.

4) Liquid Sugars
There are advantages and disadvantages in using liquid sugars, for example ease of handling and being already dissolved against the extra water to transport and to evaporate. When total solids are under 75%, precautions must be taken to avoid microbial spoilage.

Liquid sugars come in many forms. Mineral water or granulated sugar can be dissolved in distilled to provide the highest quality. For most purposes in the confectionery industry, the decolorized liquor from the refining process is supplied, instead of evaporating it to produce granulated sugar. Relatively impure mother liquor (i.e those which contain too much colour, ash etc to produce white sugar) can be sold as such, when these small amount of impurities are not of prime importance and show savings in cost. Still lower grade sugar can be used to provide colour and flavour. All or part of sugar may be inverted and the total solids may be between 66-84%.

5) Brown Sugars
The first is, in effect, raw sugars produced by the sugar factories. These can have good flavour but some may suffer from variation in quality, particularly regarding hygiene and foreign matter.

The second type is produced in sugar refineries. Originally they were ‘boiled’ sugars, that is, impure sugar solutions were evaporated until brown sugar of various qualities were produced. However the process is very slow and now a days brown sugar produced by combining mixtures of ‘impure’ syrups with white sugars of the appropriate crystals size. This process also gives more uniform products.

6) Molasses

A one million tones a year a cane refinery will produce 600-800 tonnes of molasses per week, from which no more sugar can be extracted. Some is used for human consumption, but the bulk goes to cattle food and to the fermentation industries. Eg- alcohol and citric acid.

Treacle is clarified molasses and can be mixed with higher purity syrups to mellow the taste. Within limits, its composition can be altered to simplify product formulations.

7) Micro Crystalline Sugars
Sugar syrup is evaporated to around 95% solids and then subjected to intense shear. The sugar crystallizes instantly as very fine crystals (5-20μm), the dried, milled and sieved final products being agglomerates of these crystals. Sugars produced in this way have special properties- For example-whites dissolves very rapidly and browns are free flowing.

Lecture-19
Alternative bulk Sweeteners

Alternative bulk sweetners can broadly be divided into two categories-

- Sugar
- Sugar Alcohols

Alternative sugars are generally used to replace a proportion of the sucrose in confectionery products in order to modify the sweetness and textural properties. Sugar alcohols (also known as polyols) are generally used to replace all of the conventional carbohydrates in the manufacture of non cariogenic , diabetic or dietetic confections.

Alternative Sugars

1. *Glucose*

The monosacturide glucose occurs widely in nature where it is found together with fructose in most fruits and in honey. It is commonly called as dextrose.

Glucose has a lower sweeteners, lower solubility and lower viscosity than sucrose. It is however a better humectants and provides better preservative properties owing to its lower water activity. It also has a noticeable cooling effect arising from negative heat of solution.

2. *Fructose*

Fructose also known as laevulose or fruit sugar is another monosaccharides found in fruits and honey. Fructose may be manufactured from sucrose by isolation from invert sugar or from starch by isolation from high fructose glucose syrup.

Fructose is considerably more hygroscopic and has better humectant properties than either sucrose or glucose. It is also more reactive, being a ketose rather than an aldose sugar. Hence fructose has an even greater tendency to browning than glucose.

Fructose is metabolized in the liver independently of insulin and may consequently be tolerated by non insulin dependent diabities provides its caloric content is taken into account.

A relatively new application for fructose is in compressed tablets intended for sports man, where its ability to provide a sustained energy source is considered advantageous.

3. *Lactose*

Lactose also known as milk sugar, is a disaccharide molecule comprising glucose and galactose. The main commercial source is whey from which it is extracted by either crystallization or precipitation.

Lactose is usually crystallized as the α monohydrate, which melts at 202° C, although some beta lactose anhydride (m.p. 252° C) is also produced for special applications.

Maximum sucrose replacement levels of 5-35% have been suggested for various confectionery applications. In non grained confections the lactose content should not exceed 10%.

Sugar Alcohols & Its Confectionery Applications

- *Sorbitol*

Sorbitol is primarily used in manufacture of diabetic and sugar free confections. The most important applications includes chewing gum, compressed mints, high boiling, gums, pastilles and chocolates.

In chewing gum sorbitol is typically used together with maltitol syrup which provides the liquid phase and saccharin or aspartame which are needed to boost the sweetness.

A proportion of mannitol may be included in order to inhibit crystallization if desired chewing gum dragees may be hard coated with sorbitol.

Sorbitol cannot be used to manufacture high boiling by conventional means due to its low viscocity. It is however possible to prepare deposited high boiling.

- *Xylitol*

Xylitol is currently used in a variety sugar free and diabetic confectionary products. Xylitol can be used in the hard panning of chewing dragees or of other confectionery centers. Xylitol can act as the sole sweetner in recrystallized hard candies. Fondant is another application for which xylitol is well suited.

Xylitol solutions are lower in both viscocity and water activity then equivalent concentrations of other polyols but do not have particularly good humectants properties.

- *Maltitol*

Maltitol syrups have been used in a wide variety of applications either alone in combination with other polyols. Their function is sugarless chewing gums and in high boilings which can be manufactured simply by adding acid, color and flavor to a boiled maltitol syrup.

Caramels and chews can be prepared from maltitol syrup.

Gums, jellies and pastilles based on gum Arabic or gelatin may be successfully made with malitol syrup.

Malitol syrup is also used to prevent the crystallization of other polyols in hard and soft confections.

- *Isomalt*

Isomalt can be used in a variety of sugar free confectionery products including high boiling, compressed tablets, marzipan, chews, liquorice and chocolate.

In other applications isomaltase best used in combination with other polyols which are needed to inhibit crystallization as well as to increase the sweetners.

Compressed tablets also benefits from the low hygroscopicity of isomalt. A wet granulation stage is required in order to improve the compressibility.

- *Polydextrose*

Polydextrose can be used in the manufacture of high boiling since it forms a stable glass structure.

It also reduces the viscosity thus improving handling properties. In the context it has been successfully combined with xylitol in reduced calorie chews with sorbitol or xylitol in gelatin jellies and with isomalt in fondant. In addition to its application in sugarfree products polydextrose is used in combination with fructose for diabetic lines or with sucrose in standard reduced calorie lines.

Lecture-20
Enzymes

Enzymes in Glucose syrup production:

How then have enzymes improved the range of glucose syrups available to the confectioner?

Specificity:

First of all enzymes give specificity. Provided that the glucose manufacturer could produce a soluble non-retrograding starch substrate at 60^0C, he could avail himself of amylolytic activity to produce starch hydrolysates of controlled/tailored sugar distribution. The need to use mineral acid was not avoided because this was used to provide the non-retrograding substrate and a series of acid/enzyme syrups was created.

The specificity gave the possibility of making sweeter, more highly converted, syrups of good colour and taste widely used in marshmallows, preserves and beer fermentation.

Total Enzyme Conversation:

Total enzyme conversion using thermostable α-amylases and maltogenic enzymes (fungal α-amylases , vegetable β-amylases) allowed maltose syrups of higher maltose levels (approximately 55%) to be produced. These have led to significant improvements in confectionery, particularly in high-boiled products, where better control of the rheology of the sugar mass has resulted in the ability to use higher sugar replacement levels and thus to obtain better texture, better shelf life, low colour formation and other properties.

Hydrogenerated starch hydrolysates:

Hydrogenerated starch hydrolysates from sorbitol to maltitol and hydrogenerated glucose syrups are used increasingly in the so-called ‘sugar-free’ confectionery, sorbitol is also used in diabetic products.

The use of all enzyme hydrolysis has allowed starch hydrolysates of high dextrose (glucose) content to be made (>97%). This has allowed the achievement of higher yields and glucose/dextrose production whether anhydrous or monohydrate, and the manufacture of hydrolysates of specific use in the fermentation industry. Dextrose can be used to produce confectionary tablets with a smooth cooling sensation of the palate.

Fructose:

The most significant advance brought about in the starch industry by enzymes involves the actual isomerisation of the monomeric unit whereby fructose can be produced from starch. With the discovery of an enzyme, an isomerase, which could isomerise glucose to a 42% fructose- containing equilibrium mixture having a sweetness level equivalent to sucrose, a new generation of products was born. These had obvious potential in the soft drinks are, and today many products in the USA contain high-fructose corn syrup (HFCS). In Europe the product is not so widely used due to the imposition of a production quota by the EEC.

Enzymes used in Whipping and Gelling:

The requirements of a god whipping agent are:

1) Solubility in the aqueous liquid phase.
2) They must concentrate at the liquid-air interface.
3) They must denature during the manufacturing process and so form a structure with sufficient mechanical strength to support the form.

Egg Albumen:

Egg albumen crystal is produced by drying liquid egg white in shallow trays, breaking up the sheets and then grinding to finished size. Egg albumen is now frequently used in a spray-dried form. The spray-dried albumen provides a material free from offensive odours and flavours. These spray-dried products include the ‘fluff-dried’ albumen, produced by prewhipping the egg to produce a foam which is then dried rapidly.

Egg albumen is the most commonly used whipping agent because of its excellent whipping properties associated with reasonable stability and the characteristic of readily denaturing with temperature. The temperature of coagulation in a sugar solution rises from 65^0C in a 40% syrup to 75^0C in a 60% syrup.

Gelatin as a Whipping agent:

Gelatin is used as a whipping agent particularly for mallow products. Although it does not produce a mallow as tender as that produced using albumen, it is easy to use and provides a stable product.

The depression of surface tension produced by gelatin is much greater in concentrated sugar syrup than in water, so that tests to evaluate deliveries, based on a water foam test, may be of little value. Equally, a 30-45% sugar solution is needed to maximize the efficiency of the whipping operation.

Gelatin of bloom strength in the range 180-200 is often used for mallow products and a low –viscosity gelatin produces a greater volume of foam.

Whether the gelatin is prepared for whipping or as a gelling agent, it should first be dispersed in cold water to soak. Gelatin is difficult to disperse in hot syrups. The degree of swelling during soaking is dependent on pH. Gelatin can absorb up to 40 times its own weight of water under specific conditions.

Milk proteins:

Native proteins are generally water-insoluble, those which are water-soluble tend to be pH-sensitive and precipitate at their isoelectric point. They are also easily denatured by heat, and the methods of extraction usually result in defects in the fundamental characteristic and adverse flavours. Native proteins have high molecular weight and can ciuse allergic responses in sensitive individuals.

Lecture-21
Gelling and Whipping agents

Gelling and Whipping agents are used to provide a wide range of textures in the sugar confectionary industry.

Agar agar E406:

Agar agar is dried hydrophilic, colloidal polysaccharide from red seaweeds and related marine species. It is available as white to pale yellow agglutinated strips or in flate or powder form. It may have a slightly characteristic odour and mucilaginous flavour. It is soluble in boiling water and insoluble in cold water and most organic solvents. It has a molecular weight of over 20,000.

Agar is extracted from a wide range of seaweed varieties which grow in many areas of the world. The main suppliers are Japan, New Zealand, Denmark, Australia, South Africa and Spain. The gel strength varies according to the source and checks should be carried out on each delivery to determine gel strength.

Normally agar is dissolved in 30-50 times its weight of water, usually premixed with about 10 times weight of sugar to prevent lumping. Very high viscosities are achieved with concentration upto 10%.

Agar provides good gel strenth. It forms a firm gel at concentrations as low as 1% and is usually used in confectionery at the level of 1-1.5% of sugar glucose agar recipe. Agar is not absorbed by the body during digestion and can therefore be used in low-calorie confections. Agar does not carry flavour well, and as a result of this and its sensitivity to acid and particular types of texture it is being replaced by pectins or modified starches.

Alginate E401:

Alginate were first is isolated by Stamford by alkaline extraction from brown algae, a process used for iodine production. Commercial extraction is from seaweeds such as *Laminaria digitata, Ascophyllum nodosum and Fucus serratus*. Each of the seaweeds provides a differing proportion of the main attribute of alginate. It is a white to yellow granular powder, colloidal, insoluble in water, acids and organic solvents.

Alginates are comprised of mannuronic and guluroni acids. These can link to form homogeneous segments in which guluronic acid binds to guluronic acid and mannuronic acid binds to mannuronic acid.

Carrageenans

The name carrageenans is derived from the country of Carraghen on the south coast of Ireland, where Irish moss was used in foods and medicines more than 600 years ago. Red seaweeds were used because of their unique property in gelling milk when they are heated together. The carrageenan coagulates into fibres, leaving impurities in the solution. This product is pressed and washed again with alsochol to complete its dehydration. It is then dried under vacuum, milled and sieved to the exact particle size.

The gelation of *k* and i carrageenans is induced by the association of chains through double helices. In native carrageenans there are ‘kinks’ caused by the presence of *k* and *i* fractions.

In seaweeds there is an enzyme present which carries out this conversion naturally. μ and ν carrageeenans can therefore be considered precursors of the *k* and *i* fractions.

Gelatin:

Gelatin does not exist naturally but is produced by the partial hydrolysis of collagen in the raw material substrate. Collagen is a structural component in animal tissues, present in skin, bone and connective tissue. The raw materials are sourced from slaughterhouses, meat-packing plants or tanneries. The products from tanneries have already been salted or limed for preservation. Collagen is made up of films and fibrils. Industrial modification of collagen to produce gelatin is by stepwise destruction of the organized structure to obtain the soluble derivative gelatin.

The extraction of gelatin from the raw material is initiated by either liming or acidulation, which disrupts the molecular linkages within the collagen. Gelatin is then extracted by hot-water hydrolysis. This is carried out as a batch operation. Several extracts are produced with a concentration of 5-10% gelatin.

A typical analysis of a gelatin would be

Moisture	14%
Protein	84%
Ash	2%

Gelatin picks up water in a moist atmosphere and should be stored in a cool dry store. At about 16% moisture mould growth is possible. Gelatin solutions from an ideal medium for bacterial growth. Hygienic procedures must be implemented when using this product in solution and equipment must be thoroughly cleaned.

Pectin:

Pectic substances are matrix components in the cell walls of higher plants. The compounds are insoluble in aqueous solution and are referred to as protopectins.

Protein consists mainly of the partly methylated esters of polygalacturonic acid and their ammonium, sodium, potassium or calcium salts. The molecular weight is between 20,000 and 100,000. The protopectin is hydrolysed using acid in hot aqueous solution. The aqueous extract contains soluble products such as neutral polysaccharides, gums and others. LM pectins are defined as having a degree of methoxylation of less than 50% i.e less than 50% of the functional groups on the molecule are methoxylated.

The grade strength of a pectin is defined as the number of grams of sugar with which one gram of pectin will produce a gel of standard firmness, when tested under standard conditions of acidity and soluble solids content.

During cooking the product mixture is normally buffered to maintain the pH within controlled limits. Pectins can be purchased pre-buffeered or the manufacturers can add citrates, tartrates, etc, to act as the buffering agent.

Xanthan gum E415:

A plysaccharide gum produced by *Xanthomonas campestris*. It occurs as a cream-coloured powder, soluble in water, insoluble in alcohol. Xanthan gum is a secondary metabolite of Xanthomonas campestris produced during the commercial aerobic fermentation of carbohydrates. Fermentation is carried out in a batch process. The gum is recovered from the broth by the addition of propan-2-01. The precipitate obtained is washed and pressed to remove residual alcohol.

Xanthan gum is a mixed polysaccharide with a molecular weight of approximately 2.5 million. The monomer units are D-glucose, D-mannose and D-glucoronic acid. Xanthan gum is readily dissolved in hot or cold water to produce an opaque solution of relatively high viscosity. This solution exhibits pseudoplastic flavour characteristics, i.e the viscosity of the solution decreases rapidly when shear is applied. As the shear rate decreases there is an immediate return to the high original viscosity. This charecteristic makes Xanthan an excellent suspending agent at low concentration.

Xanthan forms a thermo reversible cohesive gel system with locust bean gum.

Lecture-22
Milk protein, Soya protein, oils, fats related products

Confectionery fats

Vegetable fats generally are used in great quantities in the production of all kinds of confectionery, such as caramels, fudge, nougat, truffles, and pastes for wafer and cooky fillings. The only animal fat normally used in these products is butter.

PRODUCTION AND PROCESSING OF FATS

Fats are extracted from the natural seeds or fruits by combined processes of expeller pressing and solvent extraction. The raw fat so obtained is unsuitable for use in food and must be refined.

Refining is carried out in three stages:

1. Neutralization. The fat is washed with alkali solution, which removes residual fatty acids in the form of a soap.

2. Bleaching. The hot liquid fat is mixed with an absorbent substance (fuller's earth) and decolorizing carbon, followed by filtration. This removes odorous substances, color, and slime.
3. Deodorizing. This process is described under "Cocoa Butter" and removes the last traces of undesirable volatiles. The refined fat so produced is practically unchanged physically and for most confectionery uses must be hardended.

Soya Oil

The soya bean had, its origin in eastern Asia but enormous expansion of its cultivation has occurred in the United States during this century.

Cottonseed Oil

It was long after the plant was cultivated, for cotton that the seed became an important source of vegetable oil.

The mature plant produces fluffy white seeds called cotton bolls with the fiber adhering. The seeds are oval, and yield from 15 to 25 percent of oil.

It is a plant of tropical or subtropical regions.

Sunflower Seed Oil

The plant is very tall (5 to 8 ft), althougp there are dwarf varieties. The flower has a dark-brown center with yellow petals. It is native to, Central America but is now cultivated in many parts of the world.

Sesame Seed Oil

Sesame seed originated in china and India. Today it is also grown extensively in Africa and Mexico. It is a crop that grows in poor soil and is easily cultivated. The seed contains about 50 percent oil, which has uses similar to those of olive oil.

Rapeseed Oil

Rapeseed can be grown in colder climates and in recent years countries like Sweden, Denmark, Poland, and Canada have increased production considerably, thereby reducing consumption of imported tropical oils. The plant is of the Brassica (cabbage) family and fields when in flower are brilliant yellow. Rapeseed contains 35 to 40 percent oil. Rape oil from original seed contained a high proportion of erucic acid that has been shown to be dietetically undesirable. New genetic varieties of seed have been developed giving oil of low erucic acid content.

Olive Oil

The olive tree has been a source of edible oil for many centuries and olive oil, although perhaps now not so important commercially, is the highest-quality vegetable oil and greatly prized for table use. The tree grows in the countries around the Mediterranean, with Spain and Italy the main producers. The fruit contains about 15 percent of oil.

Corn Oil

This has been an important edible oil of recent years, produced as a by-product of the vast starch, glucose syrup, and dextrose industry. Corn oil is pale yellow in color, liquid at normal temperatures but deposits a small amount of stearine at lower temperatures. The oil is almost entirely in the germ, which is separated in the early stages of wet milling and starch extraction.

Corn is a major crop in the united states and as a result of intensive scientific development there is an ever-increasing supply of derived products-not only in the food industry but also such materials as adhesives and paper.

Chemical and Physical properties of Oils and Fats

In the examination of oils and fats, specific chemical and physical tests are used. The significance of the figures obtained by the analyst is of importance to the technologist and the meaning of the more important tests is summarized in the following:

- Saponification value
- Acid value
- Unsaponifiable matter
- Iodine value
- Volatile Fatty Acids
- Peroxide value

Physical Tests

- Specific Gravity and Apparent Density
- Melting or Fusion Point, Slip Point, Complete Fusion
- Softening point
- Flow and Drop point
- Dilation Test (Solids / Fat Index)
- Cooling Curve – Setting Point
- Hardness
- Refractive Index
- Fatty Acid Composition of Glycerides

Milk Proteins

The proteins of milk consist, of casein, albumin, and globulin, and all are high grade and easily digested, and they provide the essential proteins for nutrition. Because of this, milk is rated very highly as a food.

Casein, which mainly imparts the characteristic white color to milk, is present as a colloidal suspension in association with calcium in the molecule as tricalcium phosphate. It is precipitated from milk by acid or the enzyme rennin (rennet), and whereas with the acid the calcium is separated, with the enzyme the calcium remains linked with the protein molecule. The casein of milk constitutes about 80 percent of the total nitrogen content averaging about 2.85 percent.

Casein is prepared for commercial use in the manufacture of plastics, adhesives, paint, paper, and medicinal products. It is used in confectionery as a stabilizing agent and replacement for egg albumen and as an ingredient indirectly when milk powder or condensed milk is included in a recipe. The remaining 20 percent of the protein is now classified as "whey protein" and consists mainly of lactalbumin and lactoglobulin.

According to Muir (1985), the composition of milk protein is

Casein (80 percent)	α Sl and S2	48
	β	36
	κ	13
	λ	3

Whey protein (20 percent)	β- lactoglobulin	50
	α- lactalbumin	20
	other proteins	30

The whey proteins are water soluble and are coagulated by heat, lactalbumin at approximately 100^0C (212^0F) and lactoglobulin at about 72^0C (162^0F). This latter temperature is recognized as the minimum heat treatment required for bacteriological stability.

The stability of these proteins is closely related to the properties of milk powders (Sweetsur, 1976). Instantized skimmed milk powder, for example, used in many beverages as- a replacement for liquid milk, may be subject to feathering or flocculation in the beverage solution. This is avoided by controlled heat treatment of the liquid milk.

Denaturation has been studied in relation to a property known as the casein number. This is the percentage of total nitrogen precipitated at pH 4.7.

For untreated milk, the casein number is 77.6 percent. As milk is heated, this figure rises to 90 percent and powder prepared from it becomes less suitable for beverage use.

Soya Protein

The soya bean (or soybean) is a very valuable source of high quality protein. Of recent years, much research has been carried out, particularly in the United States to produce soya protein concentrates that have a bland flavor free from the "earthy" character previously mentioned. They have also been structured to have a meat fiber character and good cooking stability. They have the advantage of the nutrition of meat without its cholesterol and fat.

These concentrates have found much application in the development of "nutrition" candies as most confections are high in fat and carbohydrate and low in protein.

Lecture-23
Food Colurs and Flavors

Colours

When synthetic colours were first added to foods the dyes used were merely batches of the sort of dye used in the textile industry.

The use of colours in fods is strictly regulated. Governments around the world have lists of permitted colours. Unfortunately, the lists differ throughout the world.

It might be thought that some scientific consistency could be achieved but this is not the case. Manufacturers who produce products for the international export markets are reduced to leaving out all the colours as a way of making the product universally acceptable.

Early fruit flavoured products were probably flavoured with jam and did not have a particularly strong flavour. Even with modern flavours the experiment of putting the 'wrong' colour in the product will cause an appreciable proportion of tasters to misidentify the flavour.

Technical requirements of colours in Bakery products:

To be used successfully in bakery products a food colour needs the following attributes as well as complying with the appropriate legislation:

It should be stable to heat and light, stable to reducing sugars, and raw materials. Resistance to sulfur dioxide is useful. Most colours used in bakery products are water soluble. This is simply convenience; some flour confectionery products contain very little fat any way.

Synthatic colours

Synthatic colours are available for almost all possible shades. Intermediate shades can be produced by blending colours. In general, Synthatic colours are much more stable than natural coloours to light, heat and extremes of pH. Synthatic colours can be supplied as soluble powders, prepared solutions, easily dispersed granules, pastes or gelatine sticks. Blocks of colour in vegetable fat are available for use in fat-based products. The attraction of soluble powders is that they are the least expensive and can be made up as required for use. The other forms have the advantage that they are at a concentration that is ready to use.

The disadvantage is usually financial Synthatic colours are normally so intense that they must be considerably diluted for them to be readily measured and dispersed into the product. Colour solutions made up in the factory have to be prepared not more than twenty four hours before use to avoid mould spoilage. The pre-prepared colour solutions will contain a permitted preservative or will be made up in glycerine, propylene glycol or propan-2-o1. These non-aqueous solvents inhibit mould growth lists some synthatic colours.

Natural colours

There is a belief that natural products are inherently safer and more healthy than man-made ones. This belief is lacking in intellectual rigour. Of the most toxic substances known to man most are natural, eg., aflatoxin, a mould metabolite, and ricin, found in castor oil beans. However, the presence of natural colours is a marketing advantage and so they are used. Natural colours in general are less heat stable, less lightstable and give a less intense and less pure colour than Synthatic colours.

Natural colours have been used in the form of impure extracts rather than pure products. In this form higher doses are needed than with synthatic products. When purified, some natural pigments are more intense in colour and can be used in lower doses than Synthatic colours. One other problem with natural colours is that the range of colours available is restricted. Several sources of natural colours are given in the following subsenctions.

Caramel (E150)

Caramel in this context means a brown colour that is produced either traditionally by heating sugar or as a very intense product that is made by heating carbohydrate, usually glucose syrup, with ammonia. Caramel colour is the product of the Maillardreaction, i.e the reaction of a redusing sugar with an amino group. Chemically the colour is a melanoidin. These substances are extremely stable chemically and can be used in any type of confectionery.

Chlorophyll

This is the green pigment that is responsible for photosynthesis. It is widely distributed in nature, sources are green leaves, grass, alfalfa and nettles. The extract that is used is a mixture of chlorophyll with lutein and other carotenoids. This product gives an olive green colour. Chlorophyll is most stable in neutral or alkaline conditions but has a limited stability to heat and light. Chlorophyll preparations are available for colouring boiled sweets.
Red Allura red AC E129 Red 40 Monoazo
Red Carmoisine E122 not permitted Monoazo
Red Amaranth E123 not permitted Monoazo

Some synthetic colours
Red Ponceau 4R E124 not permitted Monoazo
Red Erythrosine BS E127 Red 3 Xanthene
Red Red 2G E128 not permitted Monoazo
Orange or yellow Tartrazine E102 Yellow 5 Pyrazolone
Orange or yellow 2G E 107 not permitted Monoazo
Orange or yellow sunset yellow FCF
E 110 yellow 6 Monoazo
Orange or yellow quinoline Yellow E104 not permitted Quinoline
Green Green S (Brilliant Green BS)
E 142 not permitted Triarylmethane
Green Fast Green FCF –Green 3 Triarylmethane
Blue Indigo Carmine E132 Blue 2 Indigoid
Blue Patent Blue V E 131 not permitted Triarylmethane
Blue Brilliant Blue FCF E 133 Blue 1 Triarylmethane
Brown Brown Fka E154 Not permitted note 1
Brown Chocolate Brown FB not permitted Monoazo
Brown Chocolate Brown HT
E 155 Not permitted Diazo
Black Black PN E151 Not permitted Diazo
A Brown FK is a mixture of a monoazo and a diazo compound.

Copper Chlorophyll (E141)

This is made from chlorophyll. It is more blue than natural chlorophyll. The chemical modification makes it much more stable to heat and light. It is a more useful material than natural chlorophyll.

Cochineal (E120)

Cochineal is a traditional natural colour. It is made from a Mexican beetle. The only problems with cochineal, apart from expense, is that it is not kosher and it is not animal free. Cochineal is not kosher not because it is made from an insect but because the insect is not itself kosher.

Riboflavin

This is vitamin B2. Riboflavin can be extracted from yeast but is normally encountered as a nature identical substance. Unfortunately, riboflavin has an intensely bitter taste. The colour produced is an orange yellow. It is stable to acid but is unstable in water. Riboflavin is sometimes used for panned goods.

Riboflavin-5-phosphate (E 101 a)

This material is both less bitter and more water stable than riboflavin. It is normally only encountered as a pure synthetic substance. Like riboflavin it is used on panned products.

Carbon Black

This is carbonized vegetable matter, ie, very finely divided char coal. Inevitably it is the most light fast of all colours. Obviously, it is only available as a solid. A common use is in liquorice products.

Natural colours

Colour E number Colour Source

Caramel E150 Brown Burning carbohydrates

Chlorophyll Green Green leaves Copper chlophyll

E 141 Blue green chemically modified chlorophyll

Cochineal E 120 Red Beetles

Riboflavin E101 Orange Yellow Yeast or nature identical

Riboflavin –5-phosphate

E 101 a Orange Yellow Natural identical

Carbon black Black Carbonised vegetable matter

Curcumin E 100 Yellow Turmeric Crocin Yellow Gardenia plants

Beta-carotene E 160(a) Yellow or orange carrots or algae

Annatto E 160 (b) Orange Bixa orellana

Lutein E161 (b) Lemon yellow Aztec marigolds or alfalfa

Betalaines E 162 Red Beetroot

Anthocyanins Purple red Grape skins 94

Curcumin (E100) curcumin is obtained from the spice turmeric, which comes from the plant curcuma longa, of the ginger family. Curcumin is obtained by extraction from the plant to give a deodorized product.

Curcumin is a bright yellow pigment that is oil soluble. It is sometimes produced in a water dispersible form.
The colour of curcumin varies with the pH of the medium. Under acid conditions a bright yellow is obtained but under alkaline conditions a reddish brown hue is obtained. This colour shift occurs because curcumin undergoes keto-enol tautomerism. The most serious problem with curcumin is instability to light. One recommendation is that curcumin should not be used in products that are exposed to light unless the moisture content is very low. A confectionery product that fits this description is boiled sweets. The heat stability of curcumin is sufficiently good that it can withstand 1401C for 15 min in a boiled sweet mass.
The other stability problem with curcumin is sulfur dioxide. If the sulfur dioxide level is above 100 ppm then the colour will fade. Within the restrictions outlined curcumin is a successful natural colour.

Carotenoids

The carotenoids are a wide range of substances. They are extremely abundant in nature. Natural production has been estimated to be 3.5 tonnes s_1. Some 400 carotenoids have been identified to date. They are found in fruits, vegetables, eggs, poultry, shell fish and spices. Orange juice and peel contain 24 different carotenoids.

Several carotenoids eg., b-carotene, are important as pro-vitamins. The ordinary diet contains large quantities of carotenoids, much greater than any quantity that might be used as a colouring agent. Dietary advice is to eat more carotenoids. B-carotene is sometime erroneously referred as vitamin A. In fact it is pro-vitamin A. The human body has a regulatory system that turns off the conversion of b-carotene into retional (vitamin-A) if stocks are adequate. This prevents hyper vitaminosis. Over doses of fat-soluble vitamins can be very serious since the body can not readily dispose of any excess. Thus, using carotenoids as food colours does not pose a risk of vitamin A overdoses. Legally, carotenoids are divided between two E numbers. E 160 covers the carotenoid hydrocarbons b-carotene, lycopene and paprika as well as the apo-carotenoids, e;g, bixin. E 161 covers the xanthophylls and the carotenoids lutein, astaxanthin and canthaxanthin.

Raw materials

Most carotenoids are fat soluble, although preparations that allow them to be dispersed in water are made. The colours available from acrotenoids vary between pale yellow and red. Chemically carotenoids have conjugated double bonds that render them liable to oxidation. This tendency to oxidation can be diminished by adding antioxidants to the product. In the sort of product where natural colours are used suitable antioxidants would be to copherols or ascorbic acid.

Chemically antioxidants such butylated hydroxytoluene might be suitable technically but would not fit the image of an all natural product.

Ascorbic acid could be declared as vitamin C rather than as an antioxidant. Oxidation can be started by exposure to light and so this is best avoided. Carotenoids are generally stable to heat.

The levels required can be as low as 10ppm. b-carotene is available as a nature identical form.

Crocin

Crocin is found in saffron and in gardenias. Extracting crocin from saffron is not economically viable. Saffron is obtained from Crocus sativus.

Seventy thousand plants are needed to produce 500g of saffron, which would contain 70g of crocin.

The commercial source of crocin is the gardenia bush. The town of Saffron Walden in Essex, UK, takes its name because saffron used to be produced there.

Chemically, crocin is the digentiobioside of crocetin. It is one of the few water-soluble carotenoids to produce a bright yellow shade in water. Unfortunately, crocin is bleached by sulfur dioxide levels above 50 ppm. the heat stability of crocin is good enough to use it in boiled sweets.

b-Carotene [E160(a)]

The natural sources that are exploited commercially for b-carotene are carrots and algae. The EU classifies b-carotene as E160(a). b-carotene is an oil-soluble pigment, although forms that can be dispersed in water are available.

The colour obtained varies between yellow and orange, depending on concentration.

b-carotene is stable to heat, sulfur dioxide and pH changes. It is, however, sensitive to oxidation, particularly when exposed to light. b-carotene is successfully used to colour boiled sweets and other confectionery products.

Annatto[E160(b)]

Annatto is classified as E160(b). it is extracted from the seeds of a tree (Bixa orellana), which grows in America, India and East Africa. The extract is a mixture of two pigments, bixin and nor –bixin. Bixin is oil soluble while nor-bixin is water soluble. Both bixin and nor-bixin produce orange solutions. Bixin produces an orange solution in oily media while nor-bixin produce orange aqueous solution. Obviously, bixin is the product of choice for high fat systems while nor-bixin is used in aqueous systems. Nor-boxin is one of the two water-soluble carotenes.

Nor-bixin is damaged by sulfur dioxide if the concentration exceeds 100 ppm. Acidic conditions or divalent cations, particularly calcium, can cause nor-bixin to precipitate. These problems are tackled by producing nor-bixin preparations with buffers and sequestrants. Nor-bixin is relatively stable to heat. The most severe conditions will either isomerise the pigment or shorten the chain. Either of these changes will make the pigment more yellow. Nor-bixin can associate with protein, which stabilizes the nor-bixin. The other effect of this association is to redden the colour.

Lutein [E161 (b)]

Lutein is one of the four most common carotenoids found in nature. The EU classifies it as E161(b). chemically, lutein is a xanthophylls and is similar to b-carotene. Although lutein occurs in all green leafy vegetation, egg yolks and in some flowers the commercial sources are the petals of the Aztec marigold and to a lesser extent, alfalfa. Purified alfalfa gives a clean, bright lemon yellow shade. Lutein is more stable to oxidation than the other carotenoids. It is also resistant to the action of sulfur dioxide. Lutein is oil soluble and is most effective dissolved in oil. Aqueous dispersible preparations based on lutein are available.

Betalaines

The main pigment in the concentrated colour beet red is betanin. This is classified as E 162 by the EU. The pure pigment is obtained by aqueous extraction of the red table beet. Approximately 80% of the pigment present in beetroot is betanin.

In an aqueous solution betanin gives a bright bluish red. The pure pigment is so intensely coloured that dose levels of a few parts per million are satisfactory. The problems with betanin relate to stability. Betanin is extremely sensitive to prolonged heat treatment. Short spells such as ultrahigh temperature (UHT) are tolerated. The conditions that make betanin unstable are oxygen, sulfur dioxide and high water activity.

As confectionery is a low water activity system without sulfur dioxide or oxygen, betanin can be used.

Anthocyanins

Anthocyanins are water soluble and are responsible for the colour of most red fruits and berries. Some 200 individual anthocyanins have been identified. It has been estimated that consumption of anthocyanins is an average of 200mg per day. This is several times greater than the average consumption of colouring material. Ther are claims made that consuming anthocyanins has health benefits.

Chemically anthocyanins are glycosides of anthocyanins and are based on a 2-phenylbenzopyrilium structure. The properties of the anthocyanins depend on the anthocyanidins from which they originate. Anthocyanins are extracted commercially using either acidified water or alcohol. The extract is then vacuum evaporated to produce a commercial colour concentrate.

The raw materials can be black currants, hibiscus, elderberry, red cabbage or black grape skins. The most commonly used commercially are black grape skins, which can be obtained as a by-product . Anthocyanins usually give a purple red colour. Anthocyanins are water soluble and amphoteric. There are four major pH dependent forms, the most important being the red flavylium cation and the blue quinodial base. At pHs upto 3.8 commercial anthocyanin colours are ruby red; as the pH becomes less acid the colour shifts to blue.

The colour also becomes less intense and the anthocyanin becomes less stable. The usual recommendation is that anthocyanins should only be used where the pH of the product is below. As these colours would be considered for use in fruit flavoured confectionery this is not too much of a problem. Anthocyanins are sufficiently heat resistant that they do not have a problem in confectionery. Colour loss and browning would only be a problem if the product was held at elevated temperatures for a long while. Sulfur dioxide can bleach anthocyanins- the monomeric anthocyanins the most susceptible. Anthocyanins that are polymeric or condensed with other flavonoids are more resistant. The reaction with sulfur dioxide is reversible. Anthocyanins can form complexes with metal ions such as tin, iron and aluminium. The formation of a complex as expected alters the colour usually from red to blue. Complex formation can be minimized by adding a chelating agent such as citrate ions. Another problem with anthocyanins is the formation of complexes with proteins. This can lead to precipitation in extreme cases. This problem is normally minimized by careful selection of the anthocyanin.

Flavours

Flavours are complex substances that can conveniently be divided into three groups: natural, nature identical and synthetic.

Natural flavours

These can be the natural material itself; one example would be pieces of vanilla pod or an extract, eg, vanilla extract. Extracts can be prepared in several ways.

One is to distil or to steam distil the material of interest. Another is to extract the raw material with a solvent, eg, ethyl alcohol. Alternately, some materials are extracted by coating the leaves of a plant with cocoa butter and allowing the material of interest to migrate into the cocoa butter.

These techniques are also used in preparing perfumery ingredients, indeed materials like orange oil are used in both flavours and perfumes. In practice some natural flavours work very well; any problems are financial rather than technical. Examples of satisfactory when all natural. Notably, citrus oils are prepared from the skin rather than the fruit.

The image of Natural Products

The view exists that natural products are inherently safer and healthier than synthetic materials. Curiously, any new synthetic ingredient has to be most rigorously tested before it is allowed in foods. Natural products, provided their use is traditional, are normally allowed without testing.

There is a legal distinction applied between an ingredient and an additive. In the UK, additives generally need approval while natural ingredients, provided their use is traditional, do not. Periodically, some natural substance is tested and found to have some previously unknown potential risk.

Natural Identical Flavourings

These are materials that are synthetic but are the same compound as is present in a natural flavouring material. From time to time it emerges that one substance produces a given flavour. Most chemists know that benzaldehyde has a smell of almonds.

Some chemists know that hydrogen cyanide smells of bitter almonds. If a natural flavouring can be represented by a single substance and that substance can be synthesized then the flavour is likely to be available as a nature identical flavour. Vanilla flavour is a good example. Vanilla flavour can be all natural and derived from vanilla pods or nature identical or artificial. The nature identical product would be based on vanillin, which is in vanilla pods and has a flavour of vanilla. An artificial vanilla flavour would be ethyl vanillin, which is not present in vanilla pods but has a flavour two and a half times stronger on a weight basis than vanillin. The claim nature identical does not seem to be much appreciated in the English speaking countries. In some other countries it is an important claim for marketing purposes.

The qualification for nature identical varies between jurisdictions. In the EU, ethyl acetate made from fermented ethyl alcohol and fermented acetic acid is nature identical. In the USA, provided that the ethyl alcohol and acetic acid are natural, i.e, produced by fermentation, the ethyl acetate would be natural.

Practical flavours often contain a mixture of substances, some natural, some nature identical some synthetic. UK law classifies a flavour that contains any nature identical components as nature identical even though the rest of the flavour is natural. Similarly, the presence of any artificial components renders the flavour artificial.

The case for Nature Identical flavours. Although not much appreciated in English speaking countries, nature identical claims are more popular in German-speaking countries.

Presumably the advantage of a nature identical substance is assumed because it is thought to be inherently safe.

This is a paradox since synthetic substances are normally tested for safety much more exhaustively than natural ones. Nature identical flavours do have the advantage over natural products that the price or quality is not affected by adverse harvests.

Synthetic Flavours

These are flavours that are produced synthetically but are not present in a natural flavouring material. The chemistry of flavours is a complex topic that has been the subject of many books.

Synthetic flavours are made from a mix of flavouring substances that have been found to produce a given flavour ‘note’. Those who develop flavours are referred to as flavourists. Flavourists take the musical analogy of notes further by referring to the top notes and the bottom notes of a flavour.

Flavour research is driven by a need to find compounds that produce desirable flavours. In some cases the improvement that is sought over the natural substance is not flavour intensity or cheapness but chemical stability.

One view of the way that flavours work is that they interact with certain receptors in the nose. Any other compound that has the same shape will work as well.

A typical synthetic flavour is a very complex mixture of substances. The mixture used will have been chosen to give the desired properties in the system of choice. Compounding flavours is a mixture of chemistry and sensory skill. Flavourists spend years learning how to produce flavours.

Dosing

Whether the flavour used is natural, nature identical, synthetic, or a mixture it has to be dosed into the product. Although some flavourings are very intense the volume added to the product has to be large enough for the equipment or the people to add it with sufficient accuracy. The flavour of course has to be uniformly distributed in the product. This normally means producing the flavour as a solution. Flavours are prepared for a particular use. As an example, citrus oil based flavours can be dissolved in various alcohols.

Development in flavours

The application of ever improving analytical methods will continue to reveal new flavouring compounds, be they natural, nature identical or synthetic. Not only are ever more sophisticated analytical techniques available but also improved methods of data analysis.

The new science of chemometrics has developed to cope with the situation where chromatograms with hundreds of compounds are obtained. Biotechnology could be applied to produce flavouring substances.

If the gene responsible for producing a given substance can be identified then, in theory, that gene can be expressed in other organisms. No doubt the legislators will examine whether such products qualify as natural or nature identical and will come to several different conclusions.

Conventional plant breeding methods are used to produce varieties of flavouring plants that give flavours with improved characteristics. It remains an interesting speculation what would happen if a mutation of vanilla was produced that produced ethyl vanillin rather than vanillin. The new variety would be much more potent as a flavour.

Lecture-24
Chocolate Processing

Ingredients

The basic ingredients required for chocolate manufacture are cocoa nibs, cocoa liquor, sugar other sweeteners, cocoa butter, butter fat (oil), milk powder, milk crumb and emulsifiers.

Cocoa nibs, cocoa liquor

These are prepared as described under ‘roasting, winnowing and nib grinding’. The type of beans used for both dark and milk chocolate are primarily the bulk or ordinary grade, mostly Forastero.

For special high grade chocolate, trinitario, and occasionally Criollo, beans may be employed.

It is appropriate here to mention imported liquor, which means that it has been produced in the area where the beans are cultivated.

Sugar and other sweeteners

High-grade sugar should be used in manufacturing chocolate; it must be dry and free from inivert sugar. Certain grade of off white sugar, particularly for chocolate manufacture, are available.

Washed raw sugar are sometime used in health food chocolate but they usually contain some and moisture. The presence of moisture and invert sugar causes the sugar to roll into ‘plate’, which are detrimental to the chocolates texture and presents difficulties in the subsequent conhing and enrobing processes.

Dextrose and anhydrous corn syrup (glucose syrup) are used as replacement for sugar. Non sugar substances such as sorbitol, mannitol and xylitol are occasionally used as sweeteners in dietic chocolates.

Cocoa butter

Milk chocolate require cocoa butter with a mild flavour. Fracture and contraction also are important to affort good molding and texture.

Milk products

Whole milk product and non fat milk powder are the primary milk product used. In some countries whey is permitted. Butter fat (or oil) is derived from unsalted dairy butter by dehydration and removal of curd. It is used in conjection with non fat milk powder to make less expensive milk chocolate.

Emulsifiers

The most popular emulsifier is lecithin used to reduce viscosity and save cocoa butter.

Flavour

Some of the flavour of chocolate, particularly dark chocolate, comes from the blend of beans used. With milk chocolate milk cramelization play an important part. Flavour also may be added including vanillin, cinnamon, cassia oil, essential oil of almonds, lemon, orange, varieties of balsams and resins as well as manufactured combinations flavour.

Rework

This is the name given to reprocessed chocolates bars and confectionary. It is possible to reclaim misshapen chocolate units in the form of pastes, syrups, or crumb and utilize them as part of the basic ingredients of new batches of chocolates. This practice has been opposed by members of the EEC and codex on the grounds that it opens the way to adulteration with non chocolate ingredients used in the fillings or centers of chocolate candies.

Chocolate processes

Manufacturing processes, whether for dark or milk chocolate, involve certain basic operations: preparation of ingredients, mixing of ingredients, refining of mixture, pasting or partial liquefaction of the refined mixtures, conching (or an alternative process) and adjustment of viscosity and flavouring.

Preparation of ingredients

Two main ingredients, cocoa nibs and sugar must be pulverized either before mixing or by using a machine with a combined grinding and mixing action.

The equipment is now being developed that avoid sugar milling. Cocoa butter and other fats are liquefied and care must be taken to see that they are not overheated when melting and are not stored as liquids for long period, particularly butter fat.

Milk fat should not be stored in open hopper and should be used as soon as possible after delivery. Moisture content should exceed 3 %; if over 4%, staling will occur. In some cases, milk powder and cocoa powder may be further dried for mixing, but this is more likely with compound coating.

Mixing

In most chocolates plants, the basic ingredients are dispensed by automatic method – punched card or computer – which deliver the correct quantities according to any given formula.

In some instances, the ingredients are metered and mixed continuously, in other it is fed in to batch mixer.

There is no doubt that continuous process has many advantages and they being adopted and more in all braches of food industry.

The mixing process prior to refining should produce a chocolate paste of somewhat rough texture and plastic consistency.

Refining

The refining of chocolate paste is an important operation and produce the smooth texture so desirable in modern chocolate confectionary.

Exactly what constitute smoothness is debatable, as it is clear that refining is carried out to an extreme, producing chocolate with maximum particle size less than 25μm, the texture become slimy, particularly with milk chocolate.

Another factor concerning particle size is whether the large particle are sugar, cocoa material or milk crumb aggregrates-each produce a different sensation on the palates.

Having once decided on the degree of refining for any particular chocolate, the problem is to maintain its consistency.

Today roll refiners are precision made machines consisting of five roll mounted vertically with bottom feed roll offset. These steel rolls are centrifugally cast by pouring liquid steel into permanent molds. By rotation of the molds the steel is forced outward, giving a perfect surface free of lighter material, such as slug. The steel of special composition to the hardest possible surface. The rolls are slightly crowned so that when the machine is working, the pressure exerted ensure that a film of chocolate of even is spread over the entire roll surface.

The speed of the rotation of the rolls increases from the bottom to top, and this known as the deffrential. It allow the chocolate film to be transferred from one roll to the next in shearing action in the nip of the roll.

Lecture-25
General Technical Aspects of Industrial Confectionery Manufacture

The successful manufacture of sugar confectionery products is dependent on a limited but key group of physical and chemical changes which influence recipe composition and methods of production. To development of desirable qualities in sugar confections and in particular good shelf life, fine eating qualities and desirable flavouring.

The development of quality in confectionery dependent on following six factors:

1) Compositional effects
2) Change of composition
3) Change of state
4) Environmental behaviour

5) Evaporation

6) Sweetness or acidity

Compositional effects:

The composition of recipe for the manufacture of sugar confections based on the use of carbohydrates, fats, thickeners and stabilizers and also proteins.

Sugars

The three basic carbohydrate sources are sucrose (cane or beet sugar). Glucose and other speciality syrups produced by the selective hydrolysis of starch, invert sugar prepared from the breakdown of sucrose. These three groups of sugars provide the bulk sweetening material for the different confectionery products.

Sucrose:

The major component used from mainly cane or beet sugar and this ingredient is very nearly pure sucrose. It contains traces of mineral salts when ashing the product. Sucrose is a disaccharide can be split to two simpler monosaccharides (dextrose and laevulose) by hydrolysis.

Transformed sugar:

A free flowing variety of sucrose is available known as transformed sugar. It is composed of micro crystalline agglomerations of sucrose whose surface area differs from the conventional products. This change produces a large absorptive capacity whilst still remaining stable under normal environmental conditions.

Glucose syrup:

It is a mixture of various carbohydrates held in water and is manufactured by utilizing the break down of starch when treated by acids or enzymes under control conditions. The hydrolysis process is followed by a series of purifications stages. The syrup when produced from corn starch called as corn syrup.

Speciality starch syrups:

The most interesting starch syrup is high fructose starch syrup (HFGS or HFCS). This is produced by a further tranche of treatments on conventional glucose syrup using enzymes such as alpha amylase, glucoamylase and glucose isomerase. Around two-fifths of the sugars present in the syrup are fructose, the sweetest of all common sugars. A further range of syrups has been developed by the selective hydrogenation of the base syrup in the presence of suitable catalyst. The resulting products are sweeter and have a reduced tendency to crystallize.

The second class of speciality syrups is high maltose syrups in which maltose can be present at level of up to 60 degree. These are prepared by the use of selective amylase and contain a mixture of alpha and beta maltose. Powder isomaltitol is also high in maltose and is produced by the enzymic conversion of sucrose.

Invert sugar:

It is not a pure sugar but a mixture of dextrose and fructose formed when sucrose is broken down in to two simpler sugars. To break down in to products water is essential feature for reaction.

And also ply dextrose, sorbitol, xylitol, mannitol, lactose hydrolysates, lacitol, with these and also intense sweeteners effect the composition of confections.

Fats:

In confectionery fats, can be tailored chemically to suit the type product being manufactured. One of the commonest fats in use in the manufacture of sweets is hydrogenated palm kernel oil and is relatively simple in chemical structural terms. Most sugar confectionery fats are non lauric in origin. Their brittleness, hardness and flavour carry over are related to their extraction and treatment, and in particular to the type or types of fatty acids that are present and whether the fat is saturated or unsaturated. Fats are used to improve the texture and to lubricate the product to achieve better chewing characteristics.

By an experimental result showed that the sugar phase was supporting medium for the product and below a critical moisture level structural strength depended on the protein (mainly milk protein) content of the product. Fat dispersion appear to be dependent on the degree of agitation.

Thickeners and stabilizers:

These are also known as gelling agents to sugar confections. These are gelatin, agar agar, pectin, starch and gums. Some of these products are extremely complicated in structural terms. Gelatin for example contain prolin, arginine and hydroxy prolin. Pectin contains a high no. of galacturonic acids units in the form of mithylesters. The degree of esterfication controls the rate and quality of the gel produced using the pectin. The rapid set pectins have esterification levels of 75%, while slow set pectins only 50%. These are mainly to improve resistance to water attack from atmospheric deposition and resistance to graining by inhibiting crystallization.

Proteins:

The final class of base materials in the production of sweetmeats is proteins. The presence of proteins in a recipe can give rise to one of the major chemical reactions whcich takes place during the productions of sugar confections the proteins are those found in milk and used in the manufacture of caramel. Carmel have a considerable resistance to deformation flow or deformation can still occur, particularly at the ends of each cut piece (deformation piece) of confection this effect is due to the internal structure of the product which can be visualized as a product with sectional layers sliding under shear forces, this force is due to viscosity contributed by the reaction between milk protein and reducing sugars and to the level of fat present in the confection. The textural responses mainly by the viscosity of the product.

Change of composition:

There are three primary chemical reactions taking place during the manufacture of confections and a number of secondary reactions depending on composition.

Caramelisation:

Cane or beet sugar deteriorates in heated condition to form coloured breakdown products in the process known as caramelisation and also it takes place when minor traces of acidic impurities are present together with fructose. The resultant product is 5-hydroxyl methyl furfural which develops browning in a sugar syrup.

Inversion:

The reaction can be induced deliberately as a means of developing desirable characteristics in a sweet meat. An example is where significant quantities of sugar are required in a syrup phase to produce a flowing eating texture. 100gms of sucrose will yield 105gms of invert sugar when treated in the presence of water, and the resultant mixture will contain 52.5gms of glucose and 52.5gms of fructose.

The presence of high levels of invert sugar can result in problems due to the hygroscopic nature of the comparatively high levels of fructose produced by the inversion, which will attract water from the atmosphere under adverse environmental conditions.

Maillard reaction:

This takes place between the amino groups present in amino acids, proteins and peptides and the so called ‘glycosidic hydroxyl’ groups in sugars. The reaction occur during the roasting of cocoa and milk protein held under heat in the presence of reducing sugars. The later conditions apply in the manufacture of caramel, toffee, fudge. Hydrolysed whey syrups have a greater ability to under go the maillard reaction, improving colour and flavour.

Secondary reaction:

During sweet manufacture involve the breakdown of protein in gelling agents and in whipping agents such as egg albumin these are under the presence of heat and accelerated under acid conditions.

Change of state:

Crystallization:

Crystallization in sweet manufacture is usually induced by adding seed crystals contained in a syrup phase such as fondant or by the use of intense agitation to stimulate the development of crystal nuclei as was used traditionally in the method tempering chocolate.

The rate of crystallization in a seeded product is dependent on the temperature at the point of addition, the ratio of seed crystal to total syrup phase. High viscosity conditions inhibit the speed of crystallization. This is being revealed using x-ray diffraction analysis.

Polymorphism:

It is the ability of a material to exist in two or more crystal forms. Example cocoa butter can exist in atleast four forms in which only one is stable. This second major changeof state is particularly associated with the manufacture of high boiled sweet in which the water contents as low as 2%. Less water means in confections the greater should be the tendency for the syrup to crystallize. This is not the case, because in these low water content products sucrose no longer is held in crystallisable form it is as a glass or in an amorphous state a sugar boiling will stable provided sufficient water is removed during manufacture and the product has been protectively packed to prevent the ingress of water. The deposited water leaches sugar from the confection. Water in the syrup will evaporate as external temperature conditions change and the syrup crystallizes.

Starch:

Starch undergoes a change of state during the gelatinization process used to produce a starch jelly. In the process of starch gelatinization, heat must be applied to non modified, non cold water soluble to cause the starch to swell in water. The temperature at which this process takes place is usually reffered to as the gelatinisation of point, it is a single range point. Visible signs are the change from the opalescent solution to a relatively clear mix which, if sufficient concentration of starch of the right type has been used, sets or gels on cooling. The presence of sugars inhibits the process of gelatiniation.

Lecture-26
Boiled Sweets

Boiled sweets are, by legal definition, high cooked coloured and flavoured sugar masses which are formed into candies of desired shape and size. However this definition is too simplisite because it does not take into consideration the multiplicity of ingredients other than carbohydrates which are used to produce hard candies with particular organoleptical properties like butter scotch, milk, candy, peanut, brittle and boney-flavoured candy, further more this definition does not take into account the various special technological treatments which can be applied to modify the texture and the appearance of the cooked sugar mass with a view to producing a wide variety of specialities likes honey comb striped candies satin candies rocks mintoe.

Technically the term boiled sweet is applied to mixtures of sucrose and glucose syrup which are cooked to such a high temperature that the cooked mass becomes clearly marked by the following characteristics.

1) Non-crystalline clear and glassy in appearance when after the cooking process the cooked mass is not voluntarily opacified by pulling.

2) An extremely low amount of residual moistrure (1-3%) with an equilibrium relative humidity form the atmosphere.

3) After cooking the two main components sucrose and glucose syrup are accompanied by a variable amount of invert sugar the result of partial inversion of sucrose which takes place during the cooking process.

Classification:

The above description shows that the definition boiled sweet comprises a wide range of various products. A classification is not easy and can be made under different aspects, for instance.

1. Commercial definition
2. Applied forming process
3. Structure of finished products

Commercial definition

They also called high boiling sweets hard cadies drops and are represented by three general types.

Plain hard candy:

This is the generic name for an infinite number of a large variety of candy which as is produced in a wide range of shapes and sizes, flavours and colours as well as textures. They can be classified as follows in four main groups.

Acidified hard candies/fruit drops

1) Non-acdified hard candies like peppermint drops cough drops, etc.,
2) Hard milk caramels
3) Hard candies with added –value ingredients such as
4) Honey-honey drops/ honey comb
5) Malt extract- malted hard candy
6) Peanut-peanut brittle

Filled boiled sweets

These are composed of a clear, pulled striped or grained jacket enclosing a center which can be liquid. Semi liquid pasty or powdery. The main filling types are

1) Simple sugar- glucose syrup filling flavoured with natural, nature-identical or artificial flavour.
2) Fruit filling which besides sugar and glucose syrup contains fruit pulp or jam.
3) Alcohol filling.
4) Fat filling based on chocolate, hazelnut or almond paste, peanut butter etc.,
5) Powdery filling like sherbert filling, liquorice filling.

Sugarless boiled sweets:

Clear, pulled or grained sugarless boiled sweets, plain or filled, are characterized by the fact that they are composed of one or a combination of polyhydric alcohols. The following polyols are used one or a combination of polyhydric alcohols. The following polyols are used

1. Sorbitol mannitol, xylitol- the generation polyols.
2. Maltitol, lactitiol, isomaltitol- the second- generation plyols.

It is important to note that in most countries their use is subject to legal restriction. In compliance with legal status sugarless candies can be classified in three main categories.

a. Hard candies for diabetics
b. Tooth – friendly hard candies
c. Low calorie hard candies

Applied forming process:

In relation to the applied forming method, boiled sweets can be divided into six main groups:

1) Drops when using old-fashioned drop rollers.
2) Candy balls, slices, chips snippers, etc using a balling machine.
3) Plastic candies when using a rotary plastic moulder or a cutting and forming chain.
4) Deposited hard candies when using a depositing plant.

5) Rocks slices, candy sticks etc, when using a cutting machine.
6) Lollipops when using a drop roller or a mould depositing system (flat lollipop) or rotary plastic moulder (ball lollipop) with a stick push-in-device.

Drops:

These sweets are made by passing a sheet presized boiled sugar through two horizontally arranged rollers, with engraved cavities in the corresponds to the roller gap is compacted during the passage through the two rollers and adopts the shape of the cavities. The complete article is formed by placing the two halves accurately on the top of each other.

Balled sweets:

Balled sweets are round or spherical in shape and are made by passing a calibrated rope of sugar through three rollers, shaped according to the desired sweet profile which by progressively approaching each other cut and shape the rope of sugar into a sweet which also called rotary shape.

Plastic hard candy:

Die-formed sweets, also known by the technical term of plastic sweets, are produced by cutting and forming a rope of boiled sugar in continuous rotary forming die-heads or with a chain-forming machine.

Deposited hard candies:

These sweets are of one single colour, with a very smooth surface and practically without entrapped air inclusions. They are made in a continuous process in which a mass of boiled sugar of relatively low viscosity is deposited at high temperature (130-135^{0}C) into Tefllon-lined metal moulds, equipped at the bottom with ejector pins to eject the candies from the moulds once they have been solidified after passage through a cooling tunnel.

To prevent an uncontrolled inversion rate as well as discoloration, the following factors must be observed absolutely.

1. Only buffered acid can be used mainly buffered lactic acid.
2. Sugar mass level in the vaccum chamber where the acid solution is added must be maintained as low as possible.
3. Sugar mall level in the depositing hopper must maintained constantly at a level of 8-12 cm.
4. Deposited candies must be rapidly cooled down from 130/135 to a temperature below 90^{0}C.

Lollipops: Basically three types of lollipops can be distinguished:

1. Flat lollipops: The forming techniques can be applied

b) Depositing process by using special moulds.
c) Moulding stamping techniques including the following steps cutting of a well-tempered sugar rope free fall of the cut pieces into a mould and stamping the cut pieces in a rotating disc.
d) Moulding / stamping process.

2. Boll lollipop:

They are mainly produced by applying the Rostoplast forming technique with flap cutters. The filled or unfilled sugar rope is taken over by a set of sizing rollers and fed into the forming die. In the forming die the sugar rope is cut by flaps and then formed by pressing plungers. Flaps and plungers are moved by cams. The sugar pieces in the forming dies receive their sticks form an automatic stick-feeder.

3. Whistle lollipop:

They are produced with a specially designed Rosto-plast forming die-hard.

Ingredients used in Preparation:

It is quite erroneous to believe that boiled sweets result form simple basic formulations of sucrose and glucose syrup by applying the average ratios. It is important to emphasise at this point that the key to ensuring a satisfactory shelf life is an accurate mono-di-poly saccharides balance in conjunction with a low amount of residual water. Variation form following key composition values can lead quickly to graining or moisture pick-up.

Water:

Control of the quantity and quality of the water used in the production of boiled sweets is the first step to assure the quality of the finished product. Nevertheless its influence is often underestimated and only considered as the transient ingredient to dissolve the sugar. In many cases its quality can be the source of inexplicable troubles during the production for example uncontrolled inversion rate and discoloration during the cooking process (acidic water) or lack of setting by pectin jelly (hard water).

Further more, water is also an important technical medium. Reduced out put and efficiency of machines can find their source in a hard water. By dissolving under atmospheric pressure, the required water ratio varies in relation to the particle size of the sugar, from 33 to 40 parts sugar.

Sugar:

Sugar in crystallized form is mainly used in the production of boiled sweets. Based on the quality criteria of the European Community (EEC) sugar market

Regulations two main types of crystallized sugar are used.

1. Refined sugar category 1 with a purity of more than 99.9%
2. White sugar category 2 with a purity of more than 99.7%

Glucose syrup:

Glucose syrup is indispensable as a doctoring agent in boiled sweets to prevent their graining. Additionally its influence in the forming plasticity (stamped candies) or depositing viscosity as well as on the hygroscopicity of the finished products is another important factor which has to be taken into account. The amount of glucose syrup needed mainly depends on the following factors:

1. Less discolouration during the cooking process.

2. Cooked sugar mass with lower viscosity, fewer entrapped air bubbles and greater clarity as a result of a lower amount of ligosaccharides and higher molecular weight polysaccharides.
3. Candies with a decreased tendency to pick up moisture due to the extremely low amount of dextrose.

Lecture –27

Processing of Liquorice paste, Cream paste and Aerated confectionery products

Liquorice paste is manufactured for the production of pontefract cakes, count lines, pan centers and as sheets, tubes and rods for liquorice allsorts.

The manufacture of liquorice paste which depends on the gelatinization of starch has been developed in a continuing manufacturing process. The texture of the paste varies from the relative shortness and the shortness of pontefract cakes. The consistency of texture of liquorice pasties maintained constantly by achieving the same degree of starch geletinization, and this controlled by correct ratios of the ingredients used.

A liquorice paste which contains a fully gelatinized starch a good gloss and is most suited to the production of count lines, where as liquor paste which contains only partly gelatinized starch is short in texture and has a clean bite. Liquorice paste is manufactured by premixing suitable ingredients to a predetermined moisture content, cooking continuously, extruding, storing and or cooking and assembling.

Ingredients:

Liquorice paste is usually manufactured from treacle, wheat flour, liquorice extract, and caramel. But many other ingredients can be used such as sugars, invert sugar syrup, glucose syrup, basic molasses, modified starches, gelatin, colours, flavours such as aniseed oil.

	Allsort liquorice	Count line liquorice
Treacle	66	63
Wheat flour	30	35
Caramel	3	1
Liquorice extract	1	1

Manufacturing of liquorice paste

Over 25 years ago liquorice paste was manufactured by the batch cooking process. Many scraped surface heat exchangers are introduced like contlerm, votator gave an economical method of continuously producing liquorice paste.

Liquorice paste for allsort production is processed continuously using the unit operations like:

- Premixing
- Cooking
- Extruding
- Cooling
- Further processing

Liquorice paste for count line production would involve:

- Premixing
- Cooking
- Extruding
- Storing
- Cooling
- Further processing

Cream Paste:

Cream paste belongs to the family of sugar pastes. Cream paste is prepared by mixing icing sugar with a mucilage of glucose syrup, gelatin, fat.

The residual moisture contents of cream paste are used as a means of :

i) 5.5% moisture content, the product will be fresh, soft and short eating

ii) 3.5% moisture content, the product content becomes stale, dry and firm.

Thus is very important that the cream paste make up is consistent and the moisture content constant.

A cream paste consists of slid and liquid phases, in which the liquid phase is saturated with respect of sucrose. The equilibrium relative humidity of cream paste varies between 65 and 72, depending upon the recipe make up, under normal climatic conditions.

Cream paste ingredients:

The main ingredients used in the manufacture of cream paste are: Sucrose, glucose syrup, invert sugar syrup, hard fat, gelatin, corn flour, coconut flour. These are various ingredients which are used to improve the flavour and modifies texture.

Manufacture:

Cream paste is manufactured by mixing together icing sugar and a mucilage in a heavy-duty-Z-arm mixer,

In which a homogenous mix is obtained. There are two main processes by which a cream paste is made:

1. With boiled mucilage
2. Non boiled mucilage

The method adopted depends on the equipment available and the type of texture required. The most used method for production of cream paste is continuous process of non boiled system.

The non boiled method would use the following recipe:

Icing sugar	100
Glucose syrup	30
Invert sugar syrup	7
Hard palm kernel oil	7
Gelatin	1
Hot water	3

The glucose syrup, invert sugar syrup and the fat are heated together to 200^0F, and held until the fat get dissolved. The gelatin solution is then added and mixed in, forming the mucilage. The mucilage is then transferred to a Z-arm mixer and the appropriate colours and flavours added, the icing sugar is fed in continuously as the Z arm revolve to give a uniform mix of a cream paste. The moisture content of the paste can be controlled by varying the amount of water used in the preparation of the gelatin solution.

The boiled method would use the following recipe:

Icing sugar	100
Granulated sugar	15
Glucose syrup	25
Invert sugar syrup	7
Hard palm kernel oil	8
Gelatin	1
Hot water	3

The granulated sugar, glucose syrup, and invert sugar syrup are heated in a sweet pan and boiled to 230^0F. When the boiling has subsided, the fat and the gelatin solution are mixed in; the mucilage is transferred to a Z-mixer and the icing sugar added continuously, again to give a uniform mix of cram paste. The moisture content of the paste is controlled by the boiling temperature of the syrup during the preparation of the mucilage.

Mostly cream paste do not left alone, but is layered with others colours of cream paste, with pectin jelly or with liquorice paste.

Aerated confectionary

Aeration is extensively used in confectionary to produce a range of products that include chews, nougat, marshmallow, foam and pulled sugar in which the density ranges from 0.2-1.0 g/cm^3.

Marshmallow:

The most important ingredients in marshmallow are air and moisture. The air increases the volume and improves the texture, where as the high moisture content, can vary between 17 and 21%, controls the viscosity of the product and enables a large volume of air to be bitten into the mass, giving a density that can vary between 0.25 and 0.50 g/ml depending on the texture required.

The total process can be based on batch and continuous method. Thus this is named as :

- Batch marshmallow
- Continuous marshmallow.

Lecture-28
Tablets, Lozenges, Sugar Panning Tablets – Ingredients and Processing

Tablets

Tablets are formed by compressing powder in a dye. To form a tablet successfully, the powder must be free flowing and yet to be capable of bonding under pressure.

Certain powders already posses these characteristics and are termed "directly compressible" materials. Other powders may be formed into tablets, but must first undergo a granulation stage.

Granulation

The aim of granulation process is to produce a free flowing material, suitable for compression. There are several ways of achieving:

1. Wet Granulation:

Wet granulation is suitable for most materials but expensive in terms of manufacturing space, time and energy. The powder to be granulated is screened to a uniform particle size.

The granulating solution is a binder dissolved in water which will glue particle together to form granules.

Binders are materials such as gum Arabic, gelatin, starches and alginates. The correct level of binder addition is such that the material may be compressed in the hand to form a ball which will not crumble or sticky when broken apart.

The mixing may take up to one hour. The granules are dried on trays up to 24 hours at 50-60c.

2. Fluidised Bed Granulation:

With this method the bed of powder is fluidised in an air stream and sprayed with binder solution. The powder agglomerates into granules which are subsequently dried in the air stream. Once the granules are dry lubricant and flavour may be added and mixed by a further period of fluidization.

3. Sluggng

It is also termed as "double compression". This is particularly suitable for moisture sensitive materials such as effervescent tablets. The powder is fed into a large die in a heavy duty tablet press. The material is compressed using flat faced punches into a rough tablet. This is done slowly to allow air to escape. Since a binder is not added to hold the granules together the resultant tablets tend to be softer than those which have been wet granulated.

LOZENGES

Lozenges are made from icing sugar which is mixed with a binder solution, sheeted, cut to shape and allowed to dry common types of lozenge are extra strong mints and medicated lozenges. Compressed tablets have a smooth, shiny surface; lozenges tend to have a rather rough finish. The main ingredients of lozenges is icing sugar. The grade of sugar chosen will have a radical effect upon the final product. A fine particle size sugar must be used.

The next ingredients consider is the binder. This is usually gum Arabic, gelatin, gum tragacanth, or more often a blend. To overcome texture problems and to reduce the raw material cost a blend is more usually used as the binder. Gum Arabic, is made up as 50olo solution with water, gelatin is soaked in twice its weight of water.

Lozenge manufacture is a cold process. The icing sugar and binding sugar solution are mixed together. After mixing the lozenge mix should have a firm, doughy texture. The flavours used for lozenges are frequently volatile and can be lost during the mixing process, the flavours are best added at the last possible minute.

The lozenges are spread in a single layer on trace and allowed to form a slight crust, prior to dryng in an oven at approximately 35-40c. The sweets are dried until their moisture content is approx 1.5%. This is done slowly to reduce shrinkage and cracking. The drying time should not be more than 24h and more normally 12-15h. During extended dryrng, the flavour and color of the lozenges deteriorate and the binders also degrade.

Sugar Panning

Sugar panning is a process of building up a coating, layer by layer, on centers rotating in a pan the coating may be hard or soft, depending on the thickness, sugar composition and method of nanufacture, the resultant sweets are called dragees.

The exact recipe and process require to produce a particular sweet will depend upon the type of center used.

There are two main categories of sugar panned sweets

18. Hard panned
19. Soft panned

Hard panned confections have a hard crystalline coating and include products such as sugar almonds, mint imperials, non pareils and sugar coated chocolate lentils and eggs soft panning applies a thick, soft copies to centers such as moulded jelly beans or chews. Rather than using heat to dry out the crystallized a sugar coating, soft panning uses a non crystallizing syrup. This is a cold process the pan and syrup are unheated and no drying air is used. It is also a first process and thick coating can be built up in a very short time.

Hard panning:

Pretreatment of centers

Suitable centers for hard panning include nuts, liquorice, chewing gum, tableted sweets and chocolate lentils. Nut should be sieved and then sealed to prevent oil from the nut migrating through the sugar coating and causing mottling on the surface the nuts are dired over night at 30-36C. They are allowed to tumble in a degree pan and a solution of 40-50% gum Arabic is applied. A small quantity of wheat floor is added to dry the surface of the nuts and prevent them from sticky together.

Engrossing:

Engrossing is the process of building up the sugar layer. The engrossing sugar made from sucrose the concentration of the sugar syrup the faster the drying time will be. The larger the center and higher the sugar concentration may be used an average center may be coated with 70 Brix.

The syrups containing high % of sugar are croned to crystallization. The syrup should be subjected to minimal agitation. The syrups are not held at high temperature at longer period of time as inversion of sucrose is slow down the drying and soften the casing. A large pan is used for hard panning as its increases tumbling action but in case of delicate centers a small pan would be used. The larger the load the greater the frictional forces develop resulting in a better quality product. Higher temperatures will reduce the panning time and the resulting coating will be rough. In case of chocolate centers the pan and its contents must be heated. This also applies to chewing gum which will soften. The coating is allowed to dry until the first science of dust formation become apparent. The second wetting is immediately applied to drying. This process continues until the desired thickness of coating is applied. The last few applications of syrup should be diluted slightly to create a smooth surface, ready for polishing.

Lecture-29

Chewing gums, Fondants, Marzipan- Ingredients and Processing

Fondats

Fondant is the simplest of crystallized sugar confections, consisting of sugar crystals in a saturated solution of sugar and other carbohydrates. Normally there is approximately 50-60% sugar crystals present in its structure mixed into the 40-50% of syrup. When other things are added to this confection, such as egg whip, colour and flavour, another type of confection cream is produced. Creams are extensively used in boxed chocolates and their manufacture.

Recipes:

The recipe of fondants is made up of three main elements:

1) Sucrose which can come from sugar cane or sugar beet.
2) Other carbohydrates like corn syrup which is most often used together with invert sugar.
3) Water

The percentage of these ingredients used are 80% sugar, 7.6% corn syrup solids, 12.4% water, to a low sugar fondant of composition 57.5% sugar, 30% glucose solids and 12.5% water.

Other ingredients can also be added to alter the characteristics of the fondant, including:

Invert sugar solids
Glycerol
Sorbitol
Agar
Pectin
Gelatin
Carboxy methylcellulose

Basic steps in making the fondant
Fondant is made by:

1) Dissolving: The sugar is dissolved in water and then the other materials such as corn syrup or invert sugar are mixed in. This produces a syrup of approximately 25% water and 75% dissolved solids.
2) Boiling: The syrup is then boiled to a controlled temperature to give a material with a known moisture content. Under atmospheric boiling a normal fondant syrup will boil at 240^0F for a moisture content of 12.5%.
3) Cooling: The supersaturated syrup is then cooled to a controlled temperature before crystallization of the syrup is induced. For fine crystals the syrup is cooled to $110\text{-}115^0$F before mixing and for coarser crystals temperatures of $170\text{-}190^0$F can be used.

4) Mixing: The next basic step is crystallizing by mixing or beating. This induces the sugar to crystallize from the syrup, leaving the syrup saturated with sugar crystals dispersed through it.

Marzipan

Marzipan is a favourite European confection and similar in some respects to the previous confection in that sugar crystals are present in its structure, giving a texture similar to fudge. The characteristic flavour and texture of ground blanched almonds are also added to give unique confection so popular in France, Germany and Switzerland.

There are number of ways of producing marzipan centers to get the texture suitable for extrusion, sheeting or depositing. The common elements are:

1) Producing a paste of blanched almonds, sometimes with the addition of cheaper apricot kernels. This involves grinding the kernels to release the oil and break down the fibrous structure with minimum loss of flavour volatiles.
2) Making a sugar, corn syrup and probably invert sugar syrup, to a controlled moisture content.
3) Mixing the syrup and almond paste together and then cooling and crystallizing the mix to produce controlled sugar crystals. Often, as with fudge, fondant is added to help control sugar crystal size.

Chewing Gum

Actives such as nicotine or fluorides are usually added in a strictly defined sequence in the gum mixer at the appropriate phase, usually just before solid sweetener addition or during the same towards the end of the mixing operation before flavouring and colouring. The gum is formed into strips on typical Gimple machines, Togum or similar for rolling and scoring then packaging or pellet sugar coating by panning for chiclet type products.

Sugarless gums usually require much more careful handling and the proportioning of crystallizing and anticrystallising phase ingredients is critical. These gums usually require a greater quantity of gums base and have different textural and elasticity properties during forming. The addition of actives is performed in a similar way to that used in regular sugared gums.

Teeth whitening, gums protection and plaque claims are made with patented usage of urea and other compounds. The latest technology uses anhydrous gum formulation in which plasticity and softness are assured for much longer shelf life periods than was previously possible. However since humidity conditions is necessary to condition the gum prior to packaging. The packaging material does not require as many protective properties and the approved intense sweeteners, but patented encapsulation is required to protect these materials and give good sustained release which is related to perceived flavour longevity. Encapsulation of the actives within the gum base during mixing can be problematical when sustained release is required during the chew out.

Lecture-30
Crystallized Confectionery

This chapter discusses the formulation, manufacture, use and quality control of those sugar confections which contain sugar crystals dispersed through the syrup phase. These include fondants, crèmes, fudges and marzipan, particularly as used for the center of chocolate-coated confections.

The simplest and earliest confection used by man was honey, dating back over 3000 years ago. Honey is basically a syrup of dextrose, fructose and sugar dissolved in water, and has a 'straw'-like colour and characteristic flavor. Normally honey is a clear liquid, but sometimes, when it is kept for some time, crystals appear in it, producing an opaque, pasty material. The crystals are those of dextrose, which has a lower solubility than sugar and often separates from the syrup.

This pasty, crystallized honey, familiar to ancient man, was the first 'fondant' used by him to sweeten his life. It is a 'dextrose fondatnt', whereas most of the fondants we use today are based on sucrose (or sugar). Nevertheless it has similar textural and physical properties to the sugar fondants.

Fondant is the simplest of crystallized sugar confections, consisting of sugar crystals in a saturated solution of sugar and other carbohydrates. Normally there is approximately 50-60% sugar crystals present in its structure mixed into the 40-50% of syrup. When other things are added to this simple confection, such as egg whip, color and flavor, another type of confection, a crème is produced.

A further complication is to add milk solids to the confection. During cooking characteristic flavors are produced by the Maillard reaction, as the sugar and milk protein react together to give caramel flavours. When this material does not crystallize, the resulting confection is called a caramel or toffee, but when sugar crystals appear in the syrup phase, a fudge is the result.

The chemistry of these confections becomes increasingly complex as more materials are added to the syrup phase. However, the physical properties have several things in common and are dependent on similar parameters such as composition of the syrup phase, its moisture content and the size distribution of the sugar crystals dispersed through the syrup.

Recipes

Fondants

The recipe of fondants is made up of three main elements:

4. Sucrose which can come from sugar cane or sugar beet.
5. Other carbohydrates: corn syrup (or 'glucose') is most often used together with invert sugar.
6. water.

The percentage of these ingredients can be varied to give different taste and texture characteristics, depending on the use of the fondant. These can range from a high-sugar fondant of composition 80% sugar, 7.6% corn syrup solids, 12.4% water, to a low-sugar fondant of composition 57.5% sugar, 30% glucose solids, 12.5% water.

The list of possible variations is endless because the properties depend also on the type of glucose solids, and whether they are low-DE (dextrose equivalent), high-DE, high in maltose, or high in dextrose, etc.,

Other ingredients can also be added to alter the characteristics of the fondant, including:

Invert sugar solids Glycerol Sorbitol	All to lower the equilibrium relative humidity (ERH) of the fondant
Agar Pectin Gelatin Carboxy methyl cellulose	To control crystal size and texture

So the ‘simple’ confection, fondant, can be complex and give infinite variety.

Creams

One of the main uses of fondant is in the manufacture of confectionery crèmes, widely used for molding into centers for chocolate-coated boxed chocolates. Just as the ‘simple’ fondant can have an infinite number of recipes, so also can crèmes. However, there are some common elements, in that crèmes normally consist of three main ingredients:

1. Fondant 2. Frappe or egg whip 3. Thinning or ‘Bob’ syrup

together with color and flavor as desired.

The proportions of each of these elements can be varied to provide a spectrum of taste and texture sensations. This, coupled to the possible variations in the recipes and properties of each part, makes for a complex situation. Normally however th4e fondant recipe for molded crèmes consists of three parts sugar to one part glucose solids with 12.5% water.

The frappe part normally consists of 1-2% dried egg albumen dissolved in a sugar, corn syrup and probably invert sugar syrup, which is then whipped with air to reduce the density from 1.3 to 0.2-0.4. This egg whip or frappe is used to give a light texture to the crème and a good white, opaque color suitable for adding color. The resulting colored crème has a bright, fresh color, pleasing to the consumer.

The thinning syrup or ‘Bob’ syrup is normally added to adjust the viscosity of the crème prior to molding, to make sure it can be deposited well without ‘tailing’ or producing molding defects.

Fudge

Fondant is also used in the manufacture of fudge. Fudge is a ‘fondant’ containing milk protein and fat, often butter fat, and having the characteristic flavor of caramel or toffee. The recipe of fudge can cover a wide range of textures from the hard ‘snappy’ texture of traditional Scottish cut ‘tablet’ with its very high sugar content, to the soft tender texture of chocolate-coated starch-molded units. Often an egg whip is added to give a light ‘fluffy’ texture similar to a soft crème. The common elements in a fudge recipe are:

1. Sugar syrup
2. sugar crystals
3. Milk protein
4. fat- often dairy fat, but generally a hardened vegetable fat.

A typical hard fudge recipe of the ‘tablet’ type suitable for selling as an uncovered unit would be:

Sugar	45%
Corn syrup solids	7%
Full-cream, sweetened Condensed milk solids	40%
Water	8%
Salt and flavor as desired	

One for depositing and enrobing in chocolate would be as follows:

Sugar	35%
Corn syrup solids	12%
Full-cream, sweetened Condensed milk solids	30%
Hardened palm kernel oil	5%
Frappe solids	5%
Water	13%

Frappe recipe

63 DE glucose solids	60%
Invert sugar solids	18%
Egg albumen	2%
Water	20%

Marzipan

Marzipan is a favorite European confection and similar in some respects to the previous confections in that sugar crystals are present in its structure, giving a texture similar to a fudge. The characteristic flavor and texture of ground blanched almonds are added to give the unique confection so popular in France, Germany and Switzerland.

Variables affecting the properties of fondant

The key variables which affect the properties of fondant are described below.

Moisture content

The moisture content governs its firmness: the higher the moisture content, the softer the fondant. It ranges from 10 to 15% with a norm of 12.7% and must be controlled in manufacture and in the marketplace.

Crystal size of the sugar

The size of the sugar crystals is very important to both the texture and the rheological properties of fondant.

The human palate can detect particles above 12-15 μm in size, and anything below this tastes ‘smooth’. In making fondant, crystal sizes below 15 μm are usually desired to give a smooth texture in the confection. However, often much coarser particle sizes are used to give a rougher ‘sharper’ texture which can be appropriate, for instance, in ‘after-dinner’ mints to help ‘cleanse’ the palate.

Basic steps in making the confections

Fondant

Fondant is made by:

1) Dissolving. The sugar is dissolved in water and then the other materials such as corn syrup or invert sugar are mixed- in. This produces a syrup of approximately 25% water and 75% dissolved solids.

(2) Boiling: The syrup is then boiled to a controlled temperature to give a material with a known, moisture content. Under atmospheric boiling a normal fondant syrup will boil at 240^{0}F (115^{0}C), for a moisture content of 12.5%. However, this will depend on syrup composition to some extent and on atmospheric pressure. The higher the atmospheric pressure, the higher the boiling point for a given moisture content.

(3) Cooling: The supersaturated syrup is then cooled to a controlled temperature before crystallization of the syrup is induced. For fine (< 15 μm) crystals the syrup is cooled to 110-1l5^{0}F (43-4$6^{0}$C) before mixing, and for coarser crystals the temperature of 170 19$0^{0}$F (77-8$8^{0}$C) can be used.

Normally the syrup is not mixed when being cooled, particularly on older fondant -making plant. With modern plant control of mixing ‘speed or shear rate" and cooling rate is used efficiently to crystallize the syrup to the required particle size distribution.

(4) Mixing / crystallizing: The next basic step is crystallizing by mixing or ‘beating’. This induces the sugar to crystallize from the syrup, leaving the syrup saturated with sugar crystals dispersed through it.

The finished fondant is then ready for use in creme for subsequent processing. Often it is stored in lidded pans in a store at 10$0^{0}$F to allow it to ‘mature' before use. During storage small unstable crystals of sugar redissolve and then crystallize again on the large crystals, so that generally crystal sizes increase during this period. If no moisture, is lost during storage, the fondant becomes more fluid, as sugar crystal surface area becomes less. However, often moisture is lost and the stored fondant becomes thicker and more difficult to handle, as a dry "crust' is formed. On modern continuous equipment this is avoided, as the fondant passes from making straight through to use.

A diagram showing these operations is shown in Figure.

Sugar
Water
Corn syrup

Syrup making	cooking to control moisture	cooling	Beating to crystallize	store or use

Creme making :

Creme making involves bringing together the three basic materials which make up the finished product fondant, frappe and thinning (or 'Bob' syrup).

The fondant process is as outlines in section 14'4'1'

Frappi: The traditional method for making frappe involves:

(1) Dissolving powdered (spray-dried) egg albumen in water, normally using one part; albumen to two parts of water.

(2) Dissolving sugar in water and mixing in corn syrup and invert sugar and cooking. Often, sugar is not used in the recipe so it is only necessary to mix and cook the corn syrup and invert to the correct temperature to control moisture content (240^{0}F, 115^{0}C to 245^0 F, 118^{0}C). The syrup is then cooled to 170-180^{0}F (76-82^{0}C).

(3) The egg albumen solution and syrup are mixed together and should be held at 170^{0}F (76^{0}C) for l0min to pasteurize the solution, particularly to kill pathogens such as salmonella which can be present in albumen.

(4) The egg solution is then beaten, with air to reduce its density from 1.2-1.3 down to 0.3-0.4.

The resulting egg whip or frappe is then ready to be mixed with the fondant.

Thinning or 'Bob' syrup: The thinning or'Bob' syrup is made simply by dissolving sugar in water, adding corn syrup and invert sugar, and cooking the mix to a controlled temperature, to give a controlled moisture content. This may be as high as 20% but is generally13-14%. This material is then ready to mix with the other two bases.

Quality control in fondant crèmes, fudges and marzipan
The critical quality parameters in these confections are described below.

1. moisture content
2. drying
3. chemical analysis
4. near-infrared techniques
5. soluble solids of the syrup phase
6. sugar crystal size
7. optical polarizing microscope
8. laser scattering method
9. electron microscopy
10. fat content
11. density

Lecture-31
Quality and standards/ Regulations to be followed in the Bakery Industry and packaging requirements

The better the quality, the greater the cost. Under this policy insufficient attention is paid to the earlier parts of the process out of specification materials are used correct operating procedures are not followed, production operations are unaware of the standards they should be working to and therefore unaware of the process running ‘out of control’ at the end of the manufacturing line reject product is stored from that which by chance complies with the quality standards, and significant quantities of scrap are produced at appreciable cost to the company.

The answer to the problem is to adopt the correct approach to the quality control, that of prevention rather than cure, of controlling the whole manufacturing operation from raw materials through to dispatch of finished product, the policy of getting of it right first time.

The confectionery industry involves selling taste, texture and appearance, and quality efforts must be aimed at as ensuring that these three parameters up to standard. By these means scrap is reduced and manufacturing efficiency increased, thus improving profitability; the initial supposition is then seen to be fallacious and the opposite is, in fact, shown to be the case the better the quality, the lower the cost.

Quality management systems

Quality management systems are elaborate management systems that can be used by any organization to develop and achieve its quality objectives. Quality management systems include quality planning and improvement activities, in addition to quality control and assurance activities. These systems are intended to provide a company with the capability to meet all quality requirements. The best example of quality management system is the ISO 9001:2000 *Quality management system- requirements* standard (Sections 3.12 and 3.14). In the past, the terms *total quality control* and *company wide quality control* were occasionally used in the same context as quality management systems.

Total quality management

During the mid-1980s, the term total quality management (TQM) was introduced in North America. The term was associated with the management approach to quality improvement used in Japan for achieving long-term success. The TQM approach embodies both management principles and quality concepts, including customer focus, empowerment of people, leadership, strategic planning, improvement and process management. Of these contributions, the most widely recognized are the 14 points for quality management proposed by W.Edwards Deming. During the 1980s and 1990s many North American businesses adopted the TQM approach and developed the framework for its use in their Quality management systems, with the objective of achieving competitive advantage in the global marketplace.

Quality system standards

A quality system standard is a document that describes the requirements of a quality system. The *ISO 9001:2000* quality management system standard is the recognized international quality system standard. Many countries have formally adopted this international standard as their national quality system standard. Prior to the adoption of the international quality system standard, some countries had developed their own national quality system standards. In addition, some industry sectors have developed sector-specific quality system standards. In some instances, these sector-specific quality system standards are based on the *ISO 9000* quality standard; an example is the QS 9000 standard of the North American automotive industry.

The ISO 9000 quality system standards

The ISO 9000 quality system standards were developed by the International Organization for Standardization (ISO) for use by any organization that needs to develop, implement and operate with a quality management system. The ISO 9000 quality system standards have had considerable impact on the evolution of quality activities on a global scale since the first set of standards were issued in 1987. Estimates indicate that the ISO 9000 quality system standards are used by more than half a million organizations world wide.

ISO 9000:2000 quality management systems – fundamentals and vocabulary

The information in the ISO 9000-2000 standard is extremely important for an understanding of the basics of quality management systems. The standard introduces a set of eight quality management principles and describes a set of 12 fundamentals, which serve as the basis for the ISO quality management systems. The quality management principles are embodied in the quality management system fundamentals. The standard also provides definitions of technical terms.

Lecture-32
Quality Control and Chemical Analysis

Introduction

The better the quality, the greater the cost. For years, this supposition was thought to be valid, and indeed, where the quality control emphasis is on finished product inspection, then it will apply.

Designer quality

The basic principles of quality control apply to all manufacturers, regardless of ------------------ parameters critical to the quality of its products will differ from those of other companies, even within the same industry, depending on the products manufactured, the processes employed and the market sector within which the company operates.

Quality control procedures therefore need to be tailored to fit the requirements of each individual company, and indeed each manufacturing operation within the company. Hence the concept of 'designer' quality.

Control of raw materials and packaging

'Know your supplier' is a very important maxim in ensuring the consistent quality of materials supplied. A good working relationship needs to be built up with suppliers; visits should be made to suppliers' promises to gain knowledge of their process capabilities and assurance that they will be able to supply to the required specification.

1. Receipt of materials

On arrival at the factory, the first task is to ensure that the material is in a satisfactory condition to be unloaded from the delivery vehicle. In the case of bulk tanker deliveries, a sample should be taken and tested immediately before allowing the material to be pumped into the factory's bulk storage tanks. Sacks and cardboard cartons of dry goods should be free of staples and metal fastenings, and containers which are damaged, heavily soiled or leaking should not be accepted. Deliveries of fruit and nuts require careful inspection and rejection of the consignment at the slightest evidence of infestation. Materials carrying any microbilogical risk, such as skimmed-milk powder or cocoa powder, should be held in a separate isolation store, until shown to be uncontaminated.

No materials should be used in the factory until tested and released for use by the laboratory, and to facilitate adherence to this policy it is useful to operate a goods received note (GRN) system.

2. Sampling

Correct technique is crucial to obtaining a representative sample of a delivery, and to ensuring that samples for microbilogical testing are taken aseptically. Different lot numbers present in a delivery should be sampled and tested separately.

3. Testing

Responsibility for ensuring that a material complies with specification rests squarely with the supplier, and the customer’s laboratory should not find it necessary to perform a comprehensive range of quality control checks on a delivery. Critical parameters should, however, be tested routinely, together with checks which have commercial implications, e.g, solids content of glucose syrups or yield values on flexible packaging.

1. Flexible packaging- yield, dimensions and coefficient of friction, with seal strength where appropriate.
2. Foil laminates- yield and sealing temperature routinely, with a complete breakdown on a random basis.
3. Waxed paper- yield, surface wax and total wax.
4. Cartons, tins, etc., - fit of lid to base.
5. All items- weight of a unit of wrap or pack, for tare purposes and corrections of print and color, and odour and taint, where appropriate.

4. Process control

The primary requirements for adequate control of the manufacturing process are clearly defined recipes, manufacturing procedures and specifications. To control the process thoroughly, the principle of hazard analysis and critical control points (HACCP) should be utilized. In applying this, the process is analysed in detail, all operations which are critical to product quality identified, and appropriate controls introduced, e.g, weights, mixing times, temperatures, vacuum levels, steam pressures, etc.,

5. Finished packs

Important attributes are general appearance, closures, correct data or batch coding and pack weights: inefficiency in this last-mentioned area can be extremely costly to a company. When packing to a set weight with an indeterminate number of pieces per pack, adjustments can, of course be made during packing. This does not, however, detract from the importance of controlling individual piece weights during manufacture, since this has a bearing on the achievable pack weight. With a pack containing a fixed number of units, e.g, a presentation pack of pectin jellies, then weight control during manufacture becomes crucial.

6. Sensory evaluation

As the confectionery industry is selling taste, texture and appearance, great importance must be attached to the control of organoleptic quality. There are however, a number of constraints to placing a major effort behind product testing:

1. Finished product is being tested, rather than control being applied to the process.
2. The number of samples the human palate can taste in one session is very limited.
3. Palate sensitivity varies during the day.
4. Most products require 24h from manufacture for the flavour and texture to mature.

Having said this, it is generally very useful to have information on organoleptic quality from the following sources:

1. Routine daily evaluation by a panel of trained tasters
2. On-line tasting by operators-this gives a more rapid feedback of any problems arising.
3. Regular tasting by marketing management, to maintain their awareness of the standard quality levels of manufactured product, and provide an opportunity for comment against their perception of the product.

Sensory evaluation is very subjective, but becomes less so with correct training of the panel, a carefully considered questionnaire and the proper use of statistics.

7. Hygiene

The majority of sugar confectionery products are boiled to a temperature sufficient to kill any harmful bacteria present. However, surface contamination can always occur in the subsequent handling of products after they have cooled down, and thus products with lower solids levels, or which have not been boiled, can be subject to microbiological contamination. Good hygiene practices are therefore of paramount importance.

7.1. Microbiological testing

The number of incidents of microbiological contamination of foodstuff is increasing rapidly, foods which were previously thought to be safe are increasingly found to be not so, and today's consumer is far more aware of the problem. New, rapid testing methods, e.g, Bactometer, are being introduced, which are more reliable and sensitive than traditional methods. Some testing is therefore considered necessary, and the extent to which this is required will be identified by the HACCP analysis. The following are recommended:

1) The testing before use of any raw materials which may be considered a risk, or alternatively the receipt of microbiological certificate of analysis with the delivery.
2) Routine swabbing of the factory to confirm the effectiveness of cleaning.
3) Random swabbing of operators' hands, to ensure compliance with the hand-washing procedures.
4) Testing of any finished products identified as being susceptible to contamination.
5) Monitoring of cooling water systems for Legionella

If testing is performed on site, then the microbiology laboratory should be physically separated from the factory, to prevent any risk of cross-contamination.

7.2 Foreign matter

At the very least, it is extremely unpleasant for a consumer to find foreign matter in a foodstuff. At worst, it can cause injury and be very costly to the manufacturing company in terms of compensation, lost reputation and consequent lost sales. Every precaution must therefore be taken to prevent this sort of contamination, and the following action is recommended:

1) Sort fruit and nuts, and pass them through a metal detector, before use.
2) Pass materials and mixes through sieves or in-line filters at appropriate stages in the process.
3) Keep wooden pallets out of processing areas.
4) Debox raw materials before they enter processing areas.
5) Prevent glass from entering the factory: protect all lights and ensure all internal windows are of Perspex.
6) Keep paperclips, staples, drawing pins, etc, out of the factory.
7) Ban smoking on site, with the possible exception of designated areas within the canteen.
8) Provide maintenance engineers with containers in which to place nuts, bolts, washers, etc., when working on-line.
9) Do not permit 'tape engineering' i.e, repairs effected with adhesive tape, string etc.,
10) Regularly inspect conveyor belts for fraying edges and trim or replace as soon as necessary.
11) Pass product through metal detectors as late as possible in the process, ideally as finished packs.
12) Employ a reputable firm of specialists to provide a comprehensive pest control service.
13) Keep doors shut and screen any windows which need to be opened.

This list is not exhaustive, but covers the main points.

8. Legislation

Compliance with food legislation, with regard to composition and labeling, must be built in at the development stage, taking due account of any export requirements. With the increasing complexity of legislation relating to foodstuffs, it is frequently necessary to seek advice on the matter, either from a specialist consultant, or from a trade or research association; the authors have found local trading standards officers very willing to advice on the legality of labeling. Whilst legislation is continually changing, it is perhaps worth noting that the current list of acts with which the confectionery manufacturer has to comply is as follows:

Medicines act 1968 – for medicated confectionery only
Trade Descriptions Act 1968
European Communities Act 1972
Trade Descriptions Act 1972
Food Act 1984
Weights and Measure Act 1985
Food and Environment Protection Act 1985
Single European Act 1986

There are a host of statutory instruments associated with the above Acts, all of which are available from HMSO.

9. Chemical analysis

The main purposes of chemical analysis are to ensure that raw materials are to specification and finished product is of the correct composition and will have the required keeping qualities. Of the raw materials used, granulated sugar, glucose syrup, fats (including butter), condensed milk, nuts, acid and flavours need to be monitored (see Table). Finished product may require analysis for sugars present, moisture content, acid content, fat and protein levels and in the case of medicated products, levels of active ingredients.

Table: Tests applied to raw materials

Raw material	Parameter	Potential problem
Sugar	Particle size	Handling/ processing difficulties
	Dampness	Clumping in silo
	Clarity of solution	Foreign matter
	Protein content	Foaming when boiling
Glucose syrup	Clarity / colour	Foreign matter
	Per cent dextrose	Incorrect grade
	Foam index	Foaming when boiling
	Total solids	Buying excess water
Fats	Slip point	Incorrect grade
	Free fatty acid content	Rancidity in product
Condensed milk	Taste	Off-flavours
	Viscosity	Handling difficulties
	Total solids	Buying excess water
Nuts	Free fatty acids	Rancid flavour
	Aflatoxins	Carcinogenicity, noncompliance with legislation
Acids	Particle size	Poor distribution in product
Flavours	Taste	Wrong flavour to product

9.2 Sugar analysis

Various techniques are available for the analysis of sugars, the major components of sugar confectionery products. The traditional methods of reducing sugar analysis by Lane & Eynon and polarimetry, with subsequent inversion and reanalysis, enable sucrose, glucose and invert sugar systems to be analysed, and are widely used. These are, however, being superseded by the more modern methods of gas-liquid chromatography (GLC) and high-performance liquid chromatography (HPLC)

9.3 Moisture content

This has a major effect on the keeping qualities of sugar confectionery and although generally regulated by accurate temperature control (and vacuum control where appropriate), still needs to be checked occasionally.

9.4 Protein

The Kjeldahl method is the standard for protein determination.

9.5 Fat analysis

Confectionery fats are mainly triglycerides of long-chain saturated or unsaturated fatty acids.

9.6 Aflatoxins

The standard method is that of the Tropical Products Institute but is very time-consuming. HPLC, using a fluorescence detector, produces quantitative results.

9.7 Viscosity

9.8 Particle size

9.9 Acid content

9.10 Modern methods

Wheat quality: Quality in the general sense means suitability for some particular purpose as applied to wheat. The criteria of quality are :

i). Yield of end product (wheat – for the grower, flour- for the miller, bread or baked goods for the baker)
ii). Ease of processing
iii). Nature of the end product – uniformity, palatability, appearance and chemical composition.

These criteria of quality are dependent upon the variety of wheat grown & the agroclimate condtions.

Quality requirements: Wheat passes through many hands between the field and the table. All those who handle it are interested in the quality of cereal, but in different ways.

i). The grower requires good cropping and high yields. He is not concerned with quality whether it is fit for milling or not.
ii). The miller requires wheat of good milling quality which is fit for storage, capable of yielding the max amount of flour suitable for a particular purpose.
iii). The baker requires flour suitable for making bread biscuits and cakes. He wants his flour to yield maximum quantity of goods which meets rigid specifications.
iv). Consumer requires platability and good appearance in goods he purchases. They should have high nutritive value and be reasonably priced.

For the miller wheat in a good is

i). Is of good appearance,
The grains are normal in colour and bright, grains should be free from fungal and bacterial diseases.
ii). Undamaged: The grains are not mechanically damaged by the thresher, by insect infestation, by the rodent attach and have not been damaged by over heating during drying.
iii). Clean: The grain should be free from admixture with chaff, straw, stones, weed seeds and other types of varities.
iv). Fit for storage: The moisture content should not exceed 16% for immediate milling and 15% for storage.
Besides these four aspects of under consideration which are dependent mainly upon agril history of wheat wheat before the miller received is, the miller also wants the wheat to be of good milling quality i.e, to perform well on the mill, to give an adequate yield of flour, to process easily and to yield a product of satisfactory quality. The quality of wheat on the mill is measured by the yield and purity of the flour obtained from it.

Grading: There is no official grading system for the wheat. Generally wheat is described as “millable’ or ‘non millable’.

MK--- guy specified the following requirements for milling the wheat.

i). It should be free from objectionable small , pest infestation, discoloured grains and other injurious metals.
ii). It should not be over heated during drying or storage
iii). Moisture content should not exceed 15% or 16%

iv). Content of admixture should not exceed 2%

v). Pesticide residues should be with in limits prescribed by European countries legislation.

In addition marketing guide classified wheat varieties as

1. favoured from bread making (hard varieties)
2. others-favoured for biscuit and other purposes (soft varities)

The marketing guide recommends a minimum protein content of 10.5 – 11% for bread making with a falling no index of 250 or more is acceptable.

For biscuit making the marketing guide specifies a soft milling wheat with a low water absorption capacity having a protein content of 9-10% with falling no index of 140 or more is acceptable.

The price of wheat for domestic consumption is fixed according to its classes and grade. There are 4 classes for which the minimum requirements are shown as

Minimum quality requirements for wheat

Class	Protein	Beleny's sedimentation value
I	13	38
II	12	28
III	11	18
IV	10	13

With in each class the wheat is graded into one of the 3 grades.

Quality requirements for wheat grades

Grade	Min limits		Max limits		Total impurities
	Heto lt wt.	Falling value	M.C (%)	Broken kernels (%)	
1	76	200	15.5	4	2
2	75	150	16.0	5	3

Grains which does not confirm to these requirements are termed as "worse grade/ outside grade'.

Types of wheat:

Wheat types may be classified as hard or soft wheat and strong or weak. Hardness and softness are the milling characteristics relating to the way, the endosperm breaks down. In hard wheat, fragmentation of endosperm tends to occur along the lines of cell boundaries. Whereas the endosperm of soft wheat fractures in random way. This phenomena suggests a pattern of area of mechanical strength and weakness in hard wheat. But fairly uniform mechanical weakness in soft wheat. Hardness is related to the degree of adhesion between the starch granules and surrounding protein. Hard wheat yield coarse, gritty flour, free flowing and easily sifted consists of regular shape particles. Soft wheat gives very fine flour, consists of irregular shape fragments of endosperm cells with some flattened particles which becomes entangled and adhere together sift with difficulty and tend to clog the apertures of sieves. The degree of mechanical damage to starch granules produced during milling is greater for hard wheat than for soft wheat. Hardness effects the ease of detachment of endosperm form the bran. In hard wheat, the endosperm cells comes away more cleanly whereas in soft wheat the endosperm cells tend to fragment. Depending upon the degree of hardness, the principle wheats of the world are classified into :-

i). Extra hard ex: durum, some algerium varities

ii). Hard varieties- Manitoba, American hard red spring wheat, Austrialian prime hard

iii). Medium hard – Russian varities, American Hard seed winter wheat & some European varities

iv). Soft: American soft red winter wheat, American soft white varity.

Strong and weak wheats:

Wheats yielding flour which has the ability to produce the bread of large loaf vol, good crumb texture and good keeping qualities generally has high protein content and these types are called as strong wheats. Whereas the wheat yielding flour from which only a small loaf vol with coarse open crumb texture having low protein content are generally categorized as weak flour / weak wheat. The flour from the weak wheat is ideal for biscuits and cakes.

The main types of wheat are classified according to their baking strength are as follows:

1) Strong wheat Ex: CWRS (Canadial wester Red spring wheat) called as Manitoba. American HR's, Russian spring type and some Australian varities.

Medium types: American Hard red winter wheat, some European varities and some Australian varities.

Weak wheat: American soft red winter wheat, American soft white varities.