COURSE CODE:	FSM 204
COURSE TITLE:	Spices, Pastries & Confectionaries
NUMBER OF UNITS:	2 Units
COURSE DURATION:	Two hours per week

COURSE DETAILS:

Course Coordinator: **Dr. (Mrs) M.O. Adegunwa** *B.Sc., M.Sc., MBA, PGDE, PhD*
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Office Location: **Room 202, COLFHEC**
Other Lecturers:

COURSE CONTENT:

Identification and classification of spices and condiments. Indigenous and non indigenous spices and condiments. Role of spices in food industry. Cooking starch, pasties, butter, cake mixtures and decoration.

COURSE REQUIREMENTS:

This is a compulsory course for students in the department of Foodservice and Tourism. In view of this, students are expected to participate in all the course activities and have minimum of 75% attendance to be able to write the final examination.

READING LIST:

1. SBrown, W. H.; Poon, T. (2005). *Introduction to organic chemistry* (3rd ed.). Wiley.
2. B.O Friberg. *Professional Pastry Chef*. John Wiley and Sons. ISBN 0471218251
3. McGee, Harold (2004). *On Food and Cooking (Revised Edition)*. Scribner. ISBN 0-684-80001-2. pp 33–39, "Butter and Margarine"
4. Dalby, Andrew (2003). Food in the Ancient World from A to Z, 65. Google Print. ISBN 0-415-23259-7 (accessed November 16, 2005). Also available in print from Routledge (UK).
5. Jaine, Tom, and Soun Vannithone. The Oxford Companion to Food. New York: Oxford UP, 1999.

LECTURE NOTES

WHAT IS A SPICE?

- A spice is a dried seed, fruit, root, bark or vegetative substance used in nutritionally insignificant quantities as a food additive for the purpose of flavoring, and sometimes as a preservative by killing or preventing the growth of harmful bacteria.
  Many of these substances are also used for other purposes, such as medicine, religious rituals, cosmetics, perfumery or eating as vegetables.
- In the kitchen, spices are distinguished from herbs, which are leafy, green plant parts used for flavoring purposes. Herbs, such as basil or oregano, may be used fresh, and are commonly chopped into smaller pieces. Spices, however, are dried and often ground or grated into a powder. India produces a wide range of spices.
- The fruits are opened by hand and the scarlet aril (mace) surrounding the nut is removed. This is removed by cutting with a small pointed knife the attachment of the mace to the base of the nut (nutmeg).
- Care needs to be taken to avoid damage to the nut, alternatively, the nuts can be shelled by tipping them onto a sloping cement floor from a height of three to four metres.
- The technology of extracting citronella oil can be classified as agro-based and generally as clean technology. Aside from being a port-substitute, the citronella oil or essential oils, in general, has export potential and its production can utilize rural sector participation.
- Essential oils can be isolated by several means, including solvent extraction and pressing. The method used for this is a steam distillation to extract to oil from the seed, followed by a solvent extraction to separate the oil from the water.
- The essential oils can be isolated from Cloves, Caraway and Anise seeds, and using IR spectroscopy to determine the compounds contained in each spice.
- Many fresh herbs in the UK are cultivated for industrial uses as ingredients in food preparations (vinegar, mustards etc.). Salt, vinegar, jaggery, honey, asafoetida and tamarind were used for preserving and lending taste to foods as the accent was always on the preservation of good health through a well adjusted diet.
- Oleoresins are the preferred spice extract used for flavouring purposes. The oleoresins is produced by extraction of the dry spices with an organic solvent / solvent mixture.
- MSG may be the most widely used flavor enhancing ingredient after salt and pepper. MSG helps bring out the best natural flavors in a variety of foods such as meat,

poultry, seafood and vegetables. Soups, casseroles, gravies and sauces are examples of dishes that can benefit from the proper use of MSG Market.

Condiment

A **condiment** is sauce or seasoning added to food to impart a particular flavor or to complement the dish. Often pungent in flavour and therefore added in fairly small quantities, popular condiments include salt, pepper, ketchup, mustard, olive oil, vinegar and sugar.

Usually applied by the diner, condiments generally have the consistency of a thick liquid or paste and are served from a bottle, jar, or bowl. They may also be dry, such as a mixture of herbs and seasonings. Many condiments are available packaged in single-serving packets (sachets), like mustard or ketchup, particularly when supplied with take-out or fast food meals.

Condiments are sometimes added prior to serving, for example a sandwich made with ketchup or mustard. Some condiments are used during cooking to add flavor or texture to the food; for example, barbecue sauce, teriyaki sauce, and soy sauce all have flavors that can enhance the tastes of a variety of different meats and vegetables.

Condiments List

Whether you are just starting out on your own or just updating your pantry a condiments list can help. A condiment is simply a category of food made up most of sauce type items. Everyone is familiar with catsup, one of the most popular condiments, but there are many others to choose from. A large selection of condiments will add flavor and color to any menu and complete many simple dishes. Imagine a hamburger without catsup or mustard or mayonnaise.

Once you move past the basic condiments list there are sauces, pastes, liquids, and jellies for every taste, cuisine and menu. Many can be made at home if you have the time and the inclination. Most can be obtained at your local grocer, although you may have to look in the imported foods for some of these, depending on where you live.

This condiments list is not complete. There are many more condiments to explore. Make it a habit to try new things regularly. It will improve your cooking and your appreciation of food.

Basic Condiment List

These are condiments that nearly everyone needs in their pantry.

Barbecue Sauce – Barbecue sauce is a spicy tomato based sauce that you brush on chicken and other meats before grilling or baking.

Catsup (ketchup) – Catsup is made from tomatoes, sugar, and spices cooked into a thick paste. It is excellent with hamburgers, French fries, meatloaf, and hotdogs. It has many uses.

Honey – Honey is the sweet product that bees make.

Hot Sauce – Hot sauce is made from spicy peppers, often cayenne. A few drops can add spice to almost any dish.

Jam and Jelly – What is a peanut butter and jelly sandwich without the jelly? Sweet condiments usually made from fruit that are used on toast and other bread items.

Mayonnaise – Mayonnaise is a combination of eggs, vinegar and oil. It is the basis for many other condiments as well as used on sandwiches and in salads.

Mustard – a piquant yellow or brown condiment that can be used with most meats, as an ingredients in many salad dressings, or in a variety of recipes.

Vinegar – Vinegar is an acidic liquid that is comes from a variety of sources.

- Balsamic - a fruity, mild vinegar
- Cider – made from apples
- Distilled – made from other vinegars, usually malt
- Malt – made from barley
- Wine – made from wine that is allowed to age and sour

Relish – Relish is made from a variety of finely chopped vegetables, often cucumbers, which have been pickled in a vinegar based sauce. It is excellent on hamburgers, hot dogs, and is an important part of both Thousand Island dressing and tartar sauce.

Soy Sauce – Soy sauce is made from fermented soy beans and is good as part of a marinade for many meats. It can be used as a flavoring for rice and oriental sauces as well.

Tartar Sauce – Tartar sauce is a combination of mayonnaise and relish used on fish dishes.

Teriyaki – Teriyaki is a mixture of soy sauce in sweet rice wine. It is good in many oriental dishes.

Worcestershire Sauce – Worcestershire is a savory sauce that is good on beef, game, and in a variety of recipes.

Difference between spices and condiments?

Spices are ingredients used to enhance or add flavor to a dish. They are mostly added during the cooking process. Salt, pepper, oregano, basil, garlic powder, and other like herbs are spices.

Condiments are usually added after the dish is finished. Condiments are normally sauces. Ketchup, mustard, relish, and tobacco are all examples of condiments. Condiments are usually there to enhance a dish based on a person's preference of taste (I may like chili on my hot dog while you may not).

Usually spices are an ingredient used to season a dish in the meal during its preparation, condiments are for using at the table as individual tastes prefer to enhance the dish. You like ketchup on your hamburger, I like mustard, for example. A condiment is most often something involving some preparation on its own before using, like ketchup and mustard. A spice is usually a single ingredient, e.g., nutmeg, cinnamon, clove but can also be made ahead as a mixture like curry powder. Spices differ from herbs in that the herbs are typically the green leafy parts of the plant being used while spices are the dried seed, bark or other plant part. For example dill weed is an herb and dill seeds are a spice. There is some cross over when it comes to spices and condiments, for example prepared mustard you use on your hamburger is a condiment (it is ground mustard seed combined with vinegar and other ingredients to make the spread) but mustard powder made from the ground seeds or whole mustard seeds would be considered spice.

Spices are the condiments generally used to enhance cooked food material especially for aroma and taste whereas herbs include all such kind of aromatic and medicinal plants and their produce i.e. root, shoot, flower, leaves, seeds etc.

Medicinal Importance of Spices

Spices play an important role in the nutrition of our daily diet. Scientists have done a lot of research on this and have found out that spices contain more antioxidants than fruits and vegetables. The spices contain more antioxidants when they are dried than when they are raw. Half teaspoon of spices will contribute more amounts of antioxidants than half a cup of fruits. Spices play an active role by acting as medicines. Cloves, oregano, allspice, cinnamon, sage, peppermint, thyme and lemon balm are some of the spices. These spices may be of a significant dietary source.

Dried herbs and spices with high amount of antioxidants are:

Cloves, Allspice, Cinnamon, Rosemary, Thyme, Marjoram, Saffron, Oregano, Tarragon and Basil

The fresh herbs with antioxidants are:

Oregano, Sage, Peppermint, Thyme, Lemon balm, Marjoram

The addition of spices in our daily life not only keeps us healthier but it also adds tasty to our food. There are different flavors we can make with different spices.

The function of antioxidants is that:

i. They fight against cancer causing cells.

ii. Some spices reduce the cholesterol level in the blood.

iii. They prevents us from several skin diseases.

Now we will see about different spices and their medical properties.

Turmeric:

Turmeric belongs to ginger family. It is yellow in colour and is a traditional crop of India. Turmeric is used as medicines for centuries. It enhances immune functions, improves digestion and it also reduces the risk of heart attack.

People use turmeric as a lotion to their faces as it keeps your face shinning and prevents from pimples.

Ginger:

Ginger has several medical properties. It helps in preventing the symptoms of motion sickness, especially seasickness. Apart from this, it can also be used in reducing nausea and vomiting brought on by pregnancy. If your stomach is upset drink two teaspoons of ginger juice, it will clean your stomach. Ginger contains an inflammation-fighting substance called "gingerol", which may help reduce pain and improve function in people who have arthritis.

Coriander:

Coriander is rich in protective photochemical and it is a very good source of iron, magnesium and manganese.

Cinnamon:

One of the oldest spices known is cinnamon. The benefit of cinnamon is that it reduces inflammation, and recently scientists have found out that consumption of cinnamon reduces cholesterol and is good for heart.

Researchers have found that oregano, dill, thyme and rosemary have some of the highest levels of cancer-fighting antioxidants. Many of the spices contains anti cancerous Enzymes, so it is advisable for cancer patients to consume spices.

THE ESSENTIAL ROLE OF SPICES

Since time immemorial, spices have played a vital role in world trade, due to their varied properties and applications. We primarily depend on spices for flavour and fragrance as well as colour, preservative and inherent medicinal qualities.

India, with its favourable climatic and soil conditions for growing spices and other semi – tropical herbs, is in the fore-front among the spice-producing countries. The spices that India can offer in abundant quantities are Pepper, Ginger, Turmeric, Chilli, Cardamom, Celery, Fenugreek, Fennel, Cumin, Dill, Coriander, Cinnamon, Ajowan, Cassia, Cloves, Nutmeg and Mace.

Spice extracts were developed to meet the new demands of the Food Processing Industry. They have the following advantages:

- Consistency in flavour.
- Not affected by Bacterial contamination.
- Much longer shelf life.
- Easier storage and handling.
- Full release of flavour during cooking.
- Can easily be blended to achieve the desired characteristics.
- The Food Industry across the globe is turning more and more to spice oils and oleoresins to create newer varieties of food. New flavour systems are being developed to introduce new products in the market and create competitive advantages. The Indian spice oils and oleoresin industry is engaged in continuous innovation and up gradation of process and products to meet the new global demand.

SPICE PRODUCTS

Spice Oils

- On steam distillation, the spices yield their volatile constituents. The essential oils thus obtained are endowed with the major part of the spice flavour and fragrance properties.
- Spice oils, although characterised on the basis of their physicochemical properties, including glc and spectrophotometric characteristics, are ultimately judged by sensory and olefactory evaluation. Depending on the final environment of use for the spice oil, the standards of quality required will differ and this would demand of the manufacturer to tailor oils to the customer's exact requirements.

Spice Oleoresins

- The oleoresins, containing all the volatile as well as non-volatile constituents of the spices, most closely represent the total flavour of the fresh spice in a highly concentrated form.
- For this reason oleoresins are the preferred spice extract used for flavouring purposes. The oleoresins is produced by extraction of the dry spices with an organic solvent / solvent mixture. Whilst the choice of organic solvent is wide, it is usually restricted to the proven solvents such as ethylene dichloride, acetone, hexane, or alcohol. Special attention is always paid to the final stage of preparation, to strip off residual solvent to ensure that any residue in the oleoresin is minimal (always less than 30 ppm).
- The choice of solvent is very important as it governs the ratio of the spice constituents that are extracted. Spice can be seen to yield a range of oleoresins specified by their ratio of constituents. In the case of turmeric, a highly coloured oleoresin with little characteristic odour of the spice in solid form can be obtained. Alternatively a very low-coloured product having the highly aromatic smell of the ground Turmeric in a liquid state may also be produced. Similarly different products can be obtained by selection of solvents for chilli and black pepper. Decolourised oleoresins are also available.
- Thus tailored oleoresins can be made to meet most users requirements.The oleoresins containing all the flavour elements of the spice, in highly concentrated form provide a very economic method of flavouring products.

Supercritical fluid extraction technology

SCFE system is the modern technology of making oils and oleoresins through Carbon-dioxide processing. This system provides a modern cost effective technology for value addition in the processing of various agricultural commodities like spices.

SCFE is a tow-step process which uses Carbon- dioxide as the solvent above its critical pressure and temperature for extraction of various natural materials. This technology is preferred worldwide for commercial-scale extraction because it offers: **Superior Product**

- Delicacy and freshness close to natural.
- High potency of active components.
- Excellent blending characteristics.
- Longer shelf life.
- Free of biological contaminants Superior Technology
- Simultaneous Fractionation of extract.
- Pollution free process.
- Provides solution to international concerns.
- No residual solvent
- No residual pesticide

APPLICATIONS

Spice oils and oleoresins can be used to advantage wherever spices are used, except in those applications where the appearance or filler aspect of the spice is of importance. The above details provides guide levels of replacement for spices, and suggested dispersion rate on to food carriers. In addition to the benefit of standardisation, consistency, and hygiene afforded by spice oils and oleoresins, there is a big potential in their use of new product development. New flavours and fragrances are constantly being sought to entice the consumer. This applies equally to food products, medications, as well as other nonfood products. It also illustrates the range of applications for spice oils and oleoresins, specifying the areas, and the particular spice that is known to have a contribution potential.

FOOD

PROCESSED MEATS

The use of spices, particularly pepper, in the manufacture of meat products, is traditional to impart flavour and keeping quality to the products. Typical seasoning mix for fresh sausages, for example, consists of pepper, capsicum, ginger, nutmeg, plus herbs. For dry sausages and pickled meats cardamom and coriander are also used.The move to use oleoresins has been accelerated by the increasing size of the manufacturing plants, where the use of spice extracts benefits production quality, as well as easy handling and cost savings.The above spices are used in the dispersed form of their oleoresin, with cardamom and coriander in the form of their oils.

FISH AND VEGETABLES

Seasoning mixes for both fish and vegetables, and particularly pickled or brined products such as herrings, contain a wide range of spices and herbs. The use of oleoresins, particularly dispersed oleoresins on a soluble base, will provide a means of easier preparation, reduced handling and costs.

SOUPS, SAUCES, CHUTENYS, AND DRESSINGS

The increasing demand for convenience products available in the form of a dry mix for ready reconstitution, has caused a rapid move from conventional seasoning towards dispersed or encapsulated oleoresins and oils. Oleoresins of celery, pepper, capsicum, are used in conjunction with the oils of onion and garlic. Coriander and ginger extracts are used in barbeque sauces. The use of the lesser – known but highly useful spices such as fenugreek broaden the new product opportunities.

CHEESES AND DAIRY PRODUCTS

The use of spices in cheeses is established in Germany, including "Quark". Spice extracts are unlikely to be uses in these products as the spices provide the flavouring plus visual impact.However, spice oils and oleoresins will have significance in processed cheeses and savoury spreads.

BAKED GOODS

The use of cardamom in baked goods in Scandinavia and Germany is traditional. The baking industry generally uses ginger, cinnamon, and nutmeg. The move from the spice to their oleoresin has been effectively taking place for many years for ease of handling and simplicity in manufacture. The use of spice extracts in cake fillings, biscuits, and snack products is also increasing steadily.

CONFECTIONERY

The use of spices and spices extracts in the confectionery area is rather rare, but demonstration of the use of such material as cardamom oil and other extracts in toffees, chocolates, and others, has shown that they provide a very novel and pleasing confectionery ingredient new to the market.

SNACKS

The flavouring is an essential component of the appeal of snack products, and unusual because the flavour is often applied on the surface, either by spray coating or dusting. For this purpose the seasoning mix has to be capable of being applied in spray form, or powder. Oleoresins of pepper, chilli, and celery, are widely used. Turmeric and chilli extracts are used to provide colour.

BEVERAGES

Spice oils are used for the preparation of soft beverages, as for example ginger oil in the preparation of ginger beer, etc. Some of the less well-known spice extracts can be used to produce very pleasing soft drink products as yet not widely known outside of local production in countries where they originate.

COSMETICS

The use of spice oils in the preparation of creams, soaps, shampoos, lacquers, lipsticks, etc., is well known. However, some of the materials available from India are as yet not widely used, not recognised as providing means for a new dimension to cosmetic products.

The growing preference for herbal, spicy, and spicy coniferous products like shampoos and hair tonics are noted, yet such extracts as those of cardamom and fenugreek are little heard of. The use of lesser known spice extracts can provide new product appeal.

PERFUMES

Perfumery uses a wide range of essential oils and oleoresins from sources far and wide, and yet some of the lesser – known oils and oleoresins are hardly used at all. Examination of the wide range of those available from India could well provide a new basis of products of appeal.

HYGIENE PRODUCTS

Products like toothpastes, mouthwashes etc., depend on essential oils to provide their pleasing flavour, making them not only acceptable, but pleasant to use.

In cleansing materials, detergents etc., spice oils provide the aromatic appeal in otherwise uninteresting and sometimes offensive notes associated with some of the base products.

AEROSOLS

The use of aerosols worldwide is increasing at a significant rate in products such as air freshners, polishes, lacquers and many cleansing agents, as well as waxes etc., All of these are perfumed with essential oils to provide their pleasant and fresh aroma.

The range of spice oils from India can make their contribution to new product development.

PHARMACEUTICALS

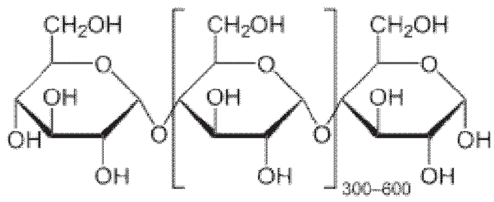
Both oils and oleoresins are widely used in pharmaceutical products, to provide either pleasant taste or aroma to render the medicinal products, which would otherwise be difficult to accept, pleasing and easy to use. These include medications, skin creams, cold remedies, etc.,

Starch

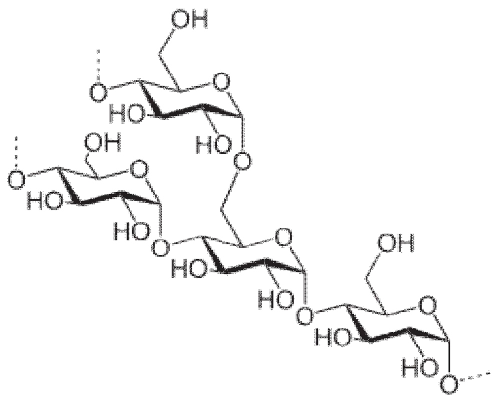
Starch or **amylum** is a carbohydrate consisting of a large number of glucose units joined together by glycosidic bonds. This polysaccharide is produced by all green plants as an energy store. It is the most important carbohydrate in the human diet and is contained in such staple foods as potatoes, wheat, maize (corn), rice, and cassava.

Pure starch is a white, tasteless and odorless powder that is insoluble in cold water or alcohol. It consists of two types of molecules: the linear and helical amylose and the branched amylopectin. Depending on the plant, starch generally contains 20 to 25% amylose and 75 to 80% amylopectin.[1] Glycogen, the glucose store of animals, is a more branched version of amylopectin.

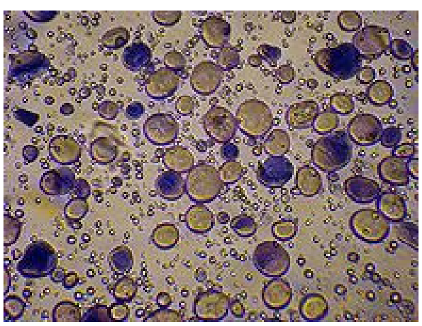
Starch is processed to produce many of the sugars in processed foods. When dissolved in warm water, it can be used as a thickening, stiffening or gluing agent, giving wheatpaste.



Structure of the amylose molecule.



Structure of the amylopectin molecule.



Granules of wheat starch, stained with iodine, photographed through a light microscope.

Name

The word "starch" is derived from Middle English *sterchen*, meaning to stiffen. "Amylum" is Latin for starch, from the Greek "amulon" which means "not ground at a mill". The root amyl is used in biochemistry for several compounds related to starch.

History

Wheat starch paste was used by Egyptians to stiffen cloth and during weaving linen and possibly to glue papyrus.[2] Romans used it also in cosmetic creams, to powder the hair and to thicken sauces. Persians and Indians used it to make dishes similar to gothumai wheat halva. In China, with the invention of paper, rice starch was used as a surface treatment of the paper.

Energy store of plants

In photosynthesis, plants use light energy to produce glucose from carbon dioxide. The glucose is stored mainly in the form of starch granules, in plastids such as chloroplasts and especially amyloplasts. Toward the end of the growing season, starch accumulates in twigs of trees near the buds. Fruit, seeds, rhizomes, and tubers store starch to prepare for the next growing season.

Glucose is soluble in water, hydrophilic, binds much water and then takes up much space; glucose in the form of starch, on the other hand, is not soluble and can be stored much more compactly.

Glucose molecules are bound in starch by the easily hydrolyzed alpha bonds. The same type of bond can also be seen in the animal reserve polysaccharide glycogen. This is in contrast to many structural polysaccharides such as chitin, cellulose and peptidoglycan, which are bound by beta-bonds and are much more resistant to hydrolysis.

Biosynthesis

Plants produce starch by first converting glucose 1-phosphate to ADP-glucose using the enzyme glucose-1-phosphate adenylyltransferase. This step requires energy in the form of ATP. The enzyme starch synthase then adds the ADP-glucose via a 1,4-alpha glycosidic bond to a growing chain of glucose residues, liberating ADP and creating amylose. Starch branching enzyme introduces 1,6-alpha glycosidic bonds between these chains, creating the branched amylopectin. The starch debranching enzyme isoamylase removes some of these branches. Several isoforms of these enzymes exist, leading to a highly complex synthesis process.[3]

While amylose was traditionally thought to be completely unbranched, it is now known that some of its molecules contain a few branch points.[4]

Glycogen and amylopectin have the same structure, but the former has about one branch point per ten 1,4-alpha bonds, compared to about one branch point per thirty 1,4-alpha bonds in amylopectin.[5] Another difference is that glycogen is synthesised from UDP-glucose while starch is synthesised from ADP-glucose.

Properties

Structure

Starch molecules arrange themselves in the plant in semi-crystalline granules. Each plant species has a unique starch granular size: rice starch is relatively small (about 2μm) while potato starches have larger granules (up to 100μm). Although in absolute mass only about one quarter of the starch granules in plants consist of amylose, there are about 150 times more amylose molecules than amylopectin molecules. Amylose is a much smaller molecule than amylopectin.

Starch becomes soluble in water when heated. The granules swell and burst, the semi-crystalline structure is lost and the smaller amylose molecules start leaching out of the granule, forming a network that holds water and increasing the mixture's viscosity. This process is called starch gelatinization. During cooking the starch becomes a paste and increases further in viscosity. During cooling or prolonged storage of the paste, the semi-crystalline structure partially recovers and the starch paste thickens, expelling water. This is mainly caused by the retrogradation of the amylose. This process is responsible for the hardening of bread or staling, and for the water layer on top of a starch gel (syneresis).

Some cultivated plant varieties have pure amylopectin starch without amylose, known as *waxy starches*. The most used is waxy maize, others are glutinous rice and waxy potato starch. Waxy starches have less retrogradation, resulting in a more stable paste. High amylose starch, amylomaize, is cultivated for the use of its gel strength.

Hydrolysis

The enzymes that break down or hydrolyze starch into the constituent sugars are known as amylases.

Alpha-amylases are found in plants and in animals. Human saliva is rich in amylase, and the pancreas also secretes the enzyme. Individuals from populations with a high-starch diet tend to have more amylase genes than those with low-starch diets[6]; chimpanzees have very few amylase genes[6]. It is possible that turning to a high-starch diet was a significant event in human evolution.[7]

Beta-amylase cuts starch into maltose units. This process is important in the digestion of starch and is also used in brewing, where the amylase from the skin of the seed grains is responsible for converting starch to maltose (Malting, Mashing).

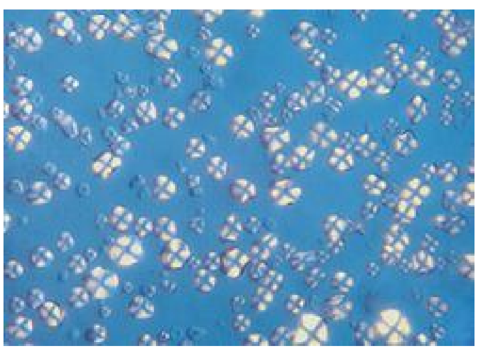
Dextrinization

If starch is subjected to dry heat, it breaks down to form pyrodextrins, in a process known as dextrinization. Pyrodextrins are brown in color. This process is partially responsible for the browning of toasted bread.

Chemical tests

Main article: Iodine test

Iodine solution is used to test for starch; a dark blue color indicates the presence of starch. The details of this reaction are not yet fully known, but it is thought that the iodine (I_3^- and I_5^- ions) fit inside the coils of amylose, the charge transfers between the iodine and the starch, and the energy level spacings in the resulting complex correspond to the absorption spectrum in the visible light region. The strength of the resulting blue color depends on the amount of amylose present. Waxy starches with little or no amylose present will color red.



Starch, 800x magnified, under polarized light.

Starch indicator solution consisting of water, starch and iodine is often used in redox titrations: in the presence of an oxidizing agent the solution turns blue, in the presence of reducing agent the blue color disappears because triiodide (I_3^-) ions break up into three iodide ions, disassembling the starch-iodine complex. A 0.3% w/w solution is the standard concentration for a starch indicator. It is made by adding 3 grams of soluble starch to 1 litre of heated water; the solution is cooled before use (starch-iodine complex becomes unstable at temperatures above 35 °C).

Microscopy of starch granules - Each species of plant has a unique shape of starch granules in granular size, shape and crystallisation pattern. Under the microscope, starch grains stained with iodine illuminated from behind with polarized light show a distinctive Maltese cross effect (also known as extinction cross and birefringence).

Starch as food

Starch is the most important carbohydrate in the human diet and is contained in many staple foods. The major sources of starch intake worldwide are rice, wheat, maize (corn), potatoes and cassava. Widely used prepared foods containing starch are bread, pancakes, cereals, noodles, pasta, porridge and tortilla.[8]

Depending on the local climate other starch sources are used for food, such as acorn, arrowroot, arracacha, banana, barley, breadfruit, buckwheat, canna, colacasia, katakuri, kudzu, malanga, millet, oat, oca, polynesian arrowroot, sago, sorghum, sweet potato, rye, taro, water chestnut and yams. Chestnuts and edible beans, such as favas, lentils, mung bean and peas, are also rich in starch.

Digestive enzymes have problems digesting crystalline structures. Raw starch will digest poorly in the duodenum and small intestine, while bacterial degradation will take place mainly in the colon. Resistant starch is starch that escapes digestion in the small intestine of healthy individuals. In order to increase the digestibility, starch is cooked. Hence, before humans started using fire, eating grains was not a very useful way to get energy.

Starch industry

The starch industry extracts and refines starches from seeds, roots and tubers, by wet grinding, washing, sieving and drying. Today, the main commercial refined starches are cornstarch, tapioca, wheat and potato starch. To a lesser extent, sources include rice, sweet potato, sago and mung bean. Historically, Florida arrowroot was also commercialized. Starch is still extracted from more than 50 types of plants.

Untreated starch requires heat to thicken or gelatinize. When a starch is pre-cooked, it can then be used to thicken instantly in cold water. This is referred to as a pregelatinized starch.

Starch sugars

Starch can be hydrolyzed into simpler carbohydrates by acids, various enzymes, or a combination of the two. The resulting fragments are known as dextrins. The extent of conversion is typically quantified by *dextrose equivalent* (DE), which is roughly the fraction of the glycosidic bonds in starch that have been broken.

These starch sugars are by far the most common starch based food ingredient and are used as sweetener in many drinks and foods. They include:

- Maltodextrin, a lightly hydrolyzed (DE 10–20) starch product used as a bland-tasting filler and thickener.
- Various glucose syrup / corn syrups (DE 30–70), viscous solutions used as sweeteners and thickeners in many kinds of processed foods.
- Dextrose (DE 100), commercial glucose, prepared by the complete hydrolysis of starch.
- High fructose syrup, made by first treating dextrose solutions with sulfuric acid and followed by the enzyme glucose isomerase, until a substantial fraction of the glucose has been converted to fructose. In the United States, high fructose corn syrup is the principal sweetener used in sweetened beverages because fructose has better handling characteristics, such as microbiological stability, and more consistent sweetness/flavor. High fructose corn syrup is typically more sweet than regular sucrose because more HFCS-55 is made (which is sweeter) than HFC-42 (on par with sugar).[9][10]
- Sugar alcohols, such as maltitol, erythritol, sorbitol, mannitol and hydrogenated starch hydrolysate, are sweeteners made by reducing sugars.

Modified starches

A modified food starch is a starch that has been chemically modified to allow the starch to function properly under conditions frequently encountered during processing or storage, such as high heat, high shear, low pH, freeze/thaw and cooling.

The modified starches are E coded according to the International Numbering System for Food Additives (INS):[11]

- 1401 Acid-treated starch
- 1402 Alkaline-treated starch
- 1403 Bleached starch
- 1404 Oxidized starch
- 1405 Starches, enzyme-treated

- 1410 Monostarch phosphate
- 1412 Distarch phosphate
- 1413 Phosphated distarch phosphate
- 1414 Acetylated distarch phosphate
- 1420 Starch acetate
- 1422 Acetylated distarch adipate
- 1440 Hydroxypropyl starch
- 1442 Hydroxypropyl distarch phosphate
- 1443 Hydroxypropyl distarch glycerol
- 1450 Starch sodium octenyl succinate
- 1451 Acetylated oxidized starch

INS 1401, 1402, 1403 and 1405 are in the EU food ingredients without an E-number. Typical modified starches for technical applications are cationic starches, hydroxyethyl starch and carboxymethylated starches.

Use as food additive

As an additive for food processing, food starches are typically used as thickeners and stabilizers in foods such as puddings, custards, soups, sauces, gravies, pie fillings, and salad dressings, and to make noodles and pastas.

Gummed sweets such as jelly beans and wine gums are not manufactured using a mold in the conventional sense. A tray is filled with native starch and leveled. A positive mold is then pressed into the starch leaving an impression of 1000 or so jelly beans. The jelly mix is then poured into the impressions and put into a stove to set. This method greatly reduces the number of molds that must be manufactured.

In the pharmaceutical industry, starch is also used as an excipient, as tablet disintegrant or as binder.Industrial applications

Starch adhesive.

Papermaking is the largest non-food application for starches globally, consuming millions of metric tons annually. In a typical sheet of copy paper for instance, the starch content may be as high as 8%. Both chemically modified and unmodified starches are used in papermaking. In the wet part of the papermaking process, generally called the “wet-end”, the starches used are cationic and have a positive charge bound to the starch polymer. These starch derivatives associate with the anionic or negatively charged paper fibers / cellulose and inorganic fillers. Cationic starches together with other retention and internal sizing agent help to give the necessary strength properties to the paper web to be formed in the papermaking process (wet strength), and to provide strength to the final paper sheet (dry strength).

In the dry end of the papermaking process the paper web is rewetted with a starch based solution. The process is called surface sizing. Starches used have been chemically, or enzymatically depolymerized at the paper mill or by the starch industry (oxidized starch). The size - starch solutions are applied to the paper web by means of various mechanical presses (size press). Together with surface sizing agent the surface starches impart additional strength to the paper web and additionally provide water hold out or “size” for superior printing properties. Starch is also used in paper coating as one of the binders for the coating formulation a mixture of pigments, binders and thickeners. Coated paper has improved smoothness, hardness, whiteness and gloss and thus improves printing characteristics.

Corrugated board adhesives are the next largest application of non-food starches globally. Starch glues are mostly based on unmodified native starches, plus some additive such as borax and caustic soda. Part of the starch is gelatinized to carry the slurry of uncooked starches and prevent sedimentation. This opaque glue is called a SteinHall adhesive. The glue is applied on tips of the fluting. The fluted paper is pressed to paper called liner. This is then dried under high heat, which causes the rest of the uncooked starch in glue to swell/gelatinize. This gelatinizing makes the glue a fast and strong adhesive for corrugated board production.

Another large non-food starch application is in the construction industry, where starch is used in the gypsum wall board manufacturing process. Chemically modified or unmodified starches are added to the stucco containing primarily gypsum. Top and bottom heavyweight sheets of paper are applied to the formulation, and the process is allowed to heat and cure to form the eventual rigid wall board. The starches act as a glue for the cured gypsum rock with the paper covering, and also provide rigidity to the board.

Starch is used in the manufacture of various **adhesives** or glues[12] for book-binding, wallpaper adhesives, paper sack production, tube winding, gummed paper, envelop adhesives, school glues and bottle labeling.

Starch derivatives, such as yellow dextrins, can be modified by addition of some chemicals to form a hard glue for paper work; some of those forms use borax or soda ash, which are mixed with the starch solution at 50-70 °C to create a very good adhesive. Sodium silicate can be added to reinforce these formulae.

Clothing starch or **laundry starch** is a liquid that is prepared by mixing a vegetable starch in water (earlier preparations also had to be boiled), and is used in the laundering of clothes. Starch was widely used in Europe in the 16th and 17th centuries to stiffen the wide collars and ruffs of fine linen which surrounded the necks of the well-to-do. During the 19th century and early 20th century, it was stylish to stiffen the collars and sleeves of men's shirts and the ruffles of girls' petticoats by applying starch to them as the clean clothes were being ironed. Aside from the smooth, crisp edges it gave to clothing, it served practical purposes as well. Dirt and sweat from a person's neck and wrists would stick to the starch rather than to the fibers of the clothing, and would easily wash away along with the starch. After each laundering, the starch would be reapplied. Today, the product is sold in aerosol cans for home use.

Starch is also used to make some packing peanuts, and some drop ceiling tiles.

Textile chemicals from starch are used to reduce breaking of yarns during weaving; the warp yarns are sized, especially for cotton. Starch is also used as textile printing thickener.

In the printing **industry**, food grade starch[13] is used in the manufacture of anti-set-off spray powder used to separate printed sheets of paper to avoid wet ink being set off.

Starch is used to produce various bioplastics, synthetic polymers that are biodegradable. An example is polylactic acid.

For **body powder**, powdered corn starch is used as a substitute for talcum powder, and similarly in other health and beauty products.

In **oil exploration**, starch is used to adjust the viscosity of drilling fluid, which is used to lubricate the drill head and suspend the grinding residue in petroleum extraction.

Glucose from starch can be further fermented to biofuel ethanol.

Hydrogen production can use starch as the raw material, using enzymes.[14]

[edit] See also

- Modified starch
- Yeast extract
- Flour
- Distilled beverage, brewing from starch alcohol
- Baking, making starches digestible
- Cooking
- Acrylamide, present in fried potatoes
- Non-Newtonian fluid

PASTRIES

Pastry is the name given to various kinds of baked goods made from ingredients such as flour, butter, shortening, baking powder or eggs. Small cakes, tarts and other sweet baked goods are called "pastries".

Pastry may also refer to the dough from which such baked goods are made. Pastry dough is rolled out thinly and used as a base for baked goods. Common pastry dishes include pies, tarts and quiches.[1][2]

Pastry is distinguished from bread by having a higher fat content, which contributes to a flaky or crumbly texture. A good pastry is light and airy and fatty, but firm enough to support the weight of the filling. When making a shortcrust pastry, care must be taken to blend the fat and flour thoroughly before adding any liquid. This ensures that the flour granules are adequately coated with fat and less likely to develop gluten. On the other hand, over mixing results in long gluten strands that toughen the pastry. In other types of pastry, such as Danish pastry and croissants, the characteristic flaky texture is achieved by repeatedly rolling out a dough similar to that for yeast bread, spreading it with butter, and folding it to produce many thin layers of folds.

Many pie recipes involve blind-baking the pastry before the filling is added. Pastry dough may be sweetened or perhaps unsweetened.

MAIN TYPES OF PASTRY

Shortcrust pastry

Shortcrust, or short, pastry is the simplest and most common pastry. It is made with flour, fat, salt, and water. The process of making pastry includes mixing of the fat and flour, adding water, and rolling out the paste. It is cooked at 180 °C and the result is a soft, tender pastry. A related type is the sweetened sweetcrust pastry.

Flaky (or rough puff) pastry

Flaky pastry is a simple pastry that expands when cooked due to the number of layers. This is perfect if you are looking for a crisp, buttery pastry. The "puff" is obtained by beginning the baking process with a high temperature and lowering the temperature to finish.

Puff pastry

Puff pastry has many layers that cause it to expand or “puff” when baked. Pastries are made using flour, butter, salt, and water. Pastry rises up due to the combination and reaction of the four ingredients and also from the air that gets between the layers. Puff pastries come out of the oven light, flaky, and tender.

Choux pastry

Choux pastry is a very light pastry that is filled with cream. The pastry is filled with various flavors of cream and is often topped with chocolate. Choux pastries can also be filled with things like cheese, tuna, or chicken to be used as appetizers.

Phyllo (filo) pastry

Phyllo pastries are usually paper-thin and greatly stretched. They involve several stretched out layers and are wrapped around a filling and brushed with butter. These pastries are very delicate and can break easily.[4]

Background

Pastries go back to the ancient Mediterranean almost paper-thin multi-layered baklava and filo. Medieval Europe took on pastry making after the Crusaders brought it back. French and Italian Renaissance chefs eventually perfected the Puff and Choux pastries, while 17th and 18th century chefs brought new recipes to the table.[5] These new pastries included brioche, Napoleons, cream puffs, and éclairs. French chef Antonin Careme reportedly was the first to incorporate art in pastry making.[6]

[edit] Definitions

Red Velvet Cake with pastry cream

Pastry chef with croquembouche

Pastry

A mixture of flour, fat, possibly egg and sugar, the fat usually dispersed as small solid globules coated with flour and the whole brought together with liquid prior to shaping and baking. There are many types of pastry.

Pastry bag or Piping bag

An often cone shaped bag that is used to make an even stream of dough, frosting, or flavored substance, to form a structure, decorate a baked good, or fill a pastry with a custard, cream, jelly, or other filling.

Pastry board

A square or oblong board preferably marble but usually wood on which pastry is rolled out.

Pastry brake

Opposed and contra-rotating rollers with a variable gap through which pastry can be worked and reduced in thickness for commercial production. A very small version is used domestically for pasta production.

Pastry case

An uncooked or blind baked pastry container used to hold savory or sweet mixtures.

Pastry cream

Confectioner's custard. An egg and flour thickened custard made with sweetened milk flavored with vanilla. Used as a filling for flans, cakes, pastries, tarts, etc. The flour prevents the egg from curdling.

Pastry cutters

Various metal or plastic outlines of shapes, e.g. circles fluted circles, diamonds, ginger bread men, etc. Sharpened on one edge and used to cut out corresponding shapes from biscuit, scone, pastry, or cakes mixtures.[7]

Pastry blender

A kitchen implement used to properly combine the fat and flour. Usually constructed of wire or plastic, with multiple wires or small blades connected to a handle.

Chemistry of a pastry

Different kinds of pastries are made by the nature of wheat flour and also due to certain types of fats. When wheat flour is kneaded into plain dough and made with water it develops strands of gluten, which are what make the bread tough and elastic. In a typical pastry, however, this toughness is unwanted so fat or oil is put in to slow down the development of gluten. It is common to use lard or suet here because they have a coarse, crystalline structure that is very effective. Using only unclarified butter does not always work well because of its water content; clarified butter is virtually water free. Shortcrust pastry using only butter may develop an inferior texture. If the fat is melted with hot water, or if liquid oil is used, the thin oily layer between the grains offers less obstacle to gluten formation and the resulting pastry is tougher. In hot water pastry, liquid oil or melted fat is used, the layer or oil between the grains makes it easier for gluten to form, making the pastry tougher.

BUTTER

Butter is a dairy product made by churning fresh or fermented cream or milk. It is generally used as a spread and a condiment, as well as in cooking applications, such as baking, sauce making, and pan frying. Butter consists of butterfat, water and milk proteins.

Most frequently made from cows' milk, butter can also be manufactured from the milk of other mammals, including sheep, goats, buffalo, and yaks. Salt, flavorings and preservatives are sometimes added to butter. Rendering butter produces clarified butter or *ghee*, which is almost entirely butterfat.

Butter is a water-in-oil emulsion resulting from an inversion of the cream, an oil-in-water emulsion; the milk proteins are the emulsifiers. Butter remains a solid when refrigerated, but softens to a spreadable consistency at room temperature, and melts to a thin liquid consistency at 32–35 °C (90–95 °F). The density of butter is 911 kg/m^3 (56.9 lb/ft^3).[1]

It generally has a pale yellow color, but varies from deep yellow to nearly white. Its unmodified color is dependent on the animals' feed and is commonly manipulated with food colorings in the commercial manufacturing process, most commonly annatto or carotene.

Production

Main article: Churning (butter)

Commercial butter-making is a carefully controlled operation.

Unhomogenized milk and cream contain butterfat in microscopic globules. These globules are surrounded by membranes made of phospholipids (fatty acid emulsifiers) and proteins, which prevent the fat in milk from pooling together into a single mass. Butter is produced by agitating cream, which damages these membranes and allows the milk fats to conjoin, separating from the other parts of the cream. Variations in the production method will create butters with different consistencies, mostly due to the butterfat composition in the finished product. Butter contains fat in three separate forms: free butterfat, butterfat crystals, and undamaged fat globules. In the finished product, different proportions of these forms result in different consistencies within the butter; butters with many crystals are harder than butters dominated by free fats.

Churning cream into butter using a hand held mixer

Churning produces small butter grains floating in the water-based portion of the cream. This watery liquid is called buttermilk—although the buttermilk most common today is instead a directly fermented skimmed milk. The buttermilk is drained off; sometimes more buttermilk is removed by rinsing the grains with water. Then the grains are "worked": pressed and kneaded together. When prepared manually, this is done using wooden boards called scotch hands. This consolidates the butter into a solid mass and breaks up embedded pockets of buttermilk or water into tiny droplets.

Commercial butter is about 80% butterfat and 15% water; traditionally made butter may have as little as 65% fat and 30% water. Butterfat consists of many moderate-sized, saturated hydrocarbon chain fatty acids. It is a triglyceride, an ester derived from glycerol and three fatty acid groups. Butter becomes rancid when these chains break down into smaller components, like butyric acid and diacetyl. The density of butter is 0.911 g/cm^3 (527 oz/in^3), about the same as ice.

Types

Hand-made butter

Before modern factory butter making, cream was usually collected from several milkings and was therefore several days old and somewhat fermented by the time it was made into butter. Butter made from a fermented cream is known as **cultured butter**. During fermentation, the cream naturally sours as bacteria convert milk sugars into lactic acid. The fermentation process produces additional aroma compounds, including diacetyl, which makes for a fuller-flavored and more "buttery" tasting product.[9] Today, cultured butter is usually made from pasteurized cream whose fermentation is produced by the introduction of *Lactococcus* and *Leuconostoc* bacteria.

Another method for producing cultured butter, developed in the early 1970s, is to produce butter from fresh cream and then incorporate bacterial cultures and lactic acid. Using this method, the cultured butter flavor grows as the butter is aged in cold storage. For manufacturers, this method is more efficient since aging the cream used to make butter takes significantly more space than simply storing the finished butter product. A method to make an artificial simulation of cultured butter is to add lactic acid and flavor compounds directly to the fresh-cream butter; while this more efficient process is claimed to simulate the taste of cultured butter, the product produced is not cultured but is instead flavored.

When heated, butter quickly melts into a thin liquid.

Dairy products are often pasteurized during production to kill pathogenic bacteria and other microbes. Butter made from pasteurized fresh cream is called **sweet cream butter**. Production of sweet cream butter first became common in the 19th century, with the development of refrigeration and the mechanical cream separator.[10] Butter made from fresh or cultured unpasteurized cream is called **raw cream butter**. Raw cream butter has a "cleaner" cream flavor, without the cooked-milk notes that pasteurization introduces.

Throughout Continental Europe, cultured butter is preferred, while sweet cream butter dominates in the United States and the United Kingdom. Therefore, cultured butter is sometimes labeled *European-style butter* in the United States. Commercial raw cream butter is virtually unheard-of in the United States. Raw cream butter is generally only found made at home by consumers who have purchased raw whole milk directly from dairy farmers, skimmed the cream themselves, and made butter with it. It is rare in Europe as well.[11]

Several **spreadable butters** have been developed; these remain softer at colder temperatures and are therefore easier to use directly out of refrigeration. Some modify the makeup of the butter's fat through chemical manipulation of the finished product, some through manipulation of the cattle's feed, and some by incorporating vegetable oils into the butter. **Whipped butter**, another product designed to be more spreadable, is aerated via the incorporation of nitrogen gas—normal air is not used, because doing so would encourage oxidation and rancidity.

Butter sold in a London market, salted (right) and unsalted (left)

All categories of butter are sold either in salted and unsalted forms. Either granular salt or a strong brine are added to salted butter during processing. In addition to enhanced flavor, the addition of salt acts as a preservative.

The amount of butterfat in the finished product is a vital aspect of production. In the United States, products sold as "butter" are required to contain a minimum of 80% butterfat; in practice most American butters contain only slightly more than that, averaging around 81% butterfat. European butters generally have a higher ratio, which may extend up to 85%.

Clarified butter is butter with almost all of its water and milk solids removed, leaving almost-pure butterfat. Clarified butter is made by heating butter to its melting point and then allowing it to cool off; after settling, the remaining components separate by density. At the top, whey proteins form a skin which is removed, and the resulting butterfat is then poured off from the mixture of water and casein proteins that settle to the bottom.[12]

Ghee is clarified butter which is brought to higher temperatures of around 120 °C (250 °F) once the water has cooked off, allowing the milk solids to brown. This process flavors the ghee, and also produces antioxidants which help protect it longer from rancidity. Because of this, ghee can keep for six to eight months under normal conditions.[12]

Cream may be skimmed from whey instead of milk, as a by-product of cheese-making. Whey butter may be made from whey cream. Whey cream and butter have a lower fat content and taste more salty, tangy and "cheesy".[13] They are also cheaper than "sweet" cream and butter.