

Module on Uses Of Cereals

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Text

Cereals represent a major component of the human diet worldwide, either directly as food or baked goods derived from flour or indirectly as components of animal feed (grains, brans, straws and other residues as appropriate for monogastrics, fowl and ruminants). Cereal components are used in a vast range of food and industrial applications which are discussed below:

Food

Cereals supply the bulk of the food consumed by the human race. They are the cheapest source of food energy and constitute a high percentage of the caloric and protein intake of man, particularly in the developing countries. The food uses of cereals are discussed briefly as under.

Wheat products

Wheat flour

The maximum amount of today's consumption is of wheat flour. Wheat flour is either white (if the bran and germ have been removed, leaving only the endosperm) or brown (which is either whole meal flour containing bran, germ, and endosperm or whole meal flour mixed with white flour in various proportions). The flour is known as "strong" if it has high gluten content and "soft" if the gluten content is low. Strong flour is used for bread making while soft flour is used for cake or biscuit making.

Pasta

It is a type of food made from the flour of various grains, water and some times eggs, which is mixed, kneaded and formed into various shapes and boiled prior to consumption. The English word pasta generally refers to noodles and other food products made from a flour and water paste, often including egg and salt. Pasta is made either by extrusion, where the ingredients are forced through holes in a plate known as a die, or by lamination, in which dough is kneaded, folded, rolled to thickness then cut by slitters.

Macaroni

It is typically machine-made dry commercial pasta, used in contrast to fresh

pasta made at home or in small local business. Macaroni technically must not contain eggs. Although usually commercially made, some more advanced home machines do allow for the fresh creation of macaroni pasta.

Wheat bread

Bread is a popular food in Western and most other societies except for the Asian societies that typically prefer rice. It is often made from wheat flour dough that is cultured with yeast, allowed to rise and finally baked in an oven. Owing to its high level of gluten, common wheat (also known as bread wheat) is the most common grain used for the preparation of bread, but bread is also made from the flour of other wheat species (including durum, spelt and emmer), rye, barley, maize and oats. Although common wheat is best suited for making highly risen white bread, other wheat species are capable of giving a good crumb.

Semolina

Semolina is coarsely grain, usually wheat, with particles mostly between 0.25 and 0.75 mm in diameter. The same milling grade is sometimes called Farina, or grits if made from maize.

Wheat beer

It is a beer that is brewed with a significant proportion of malted wheat. It is common for wheat beers to also contain malted barley. Wheat beers are brewed using both ale and larger brewing techniques. The two most common varieties of wheat beer are Belgian *Witbier* and German *Weizenbier*.

Wheat gluten

It is also called seitan, wheat meat, gluten meat or simple gluten, is a foodstuff made from the gluten of wheat. It is made by washing dough made from wheat flour in water until the starch is rinsed away, leaving only the gluten, which can then be cooked and processed in various ways. Wheat gluten, although not as well known, is an alternative to soy based meat substitutes such as tofu.

Wheat bran flakes

It is a breakfast cereal made from whole wheat. It comes in two sizes, bite sized

and normal sized, which may be crumbled up with hands before adding milk. Both sizes are available in a frosted variety, which has one side coated with sugar. The wheat is first cooked in water until its moisture content reaches about 50%. It is then tempered, allowing moisture to diffuse evenly into the grain. The grain then passes through a set of rollers with grooves in one side, yielding a web of shredded wheat strands. Many webs are stacked together and this moist stack strands is crimped at regular intervals to produce individual pieces of cereal with the strands attached at each end. These then go into an oven, where they are baked until their moisture content is reduced to 5%.

Rice products

Rice flour

This is made from second heads in pulverizing machines. Rice flour of 9-13% moisture content contains 5-9% of protein, 0.4-1.0% of fat and yields 0.4-0.7% ash. It is used in refrigerated biscuit manufacture to prevent sticking, in baby foods as a thickener and in waffle and pancake mixes as water absorbent. In India, rice flour is also used in the preparation of vermicelli, papad, sandige and in a number of other preparations.

Parched rice

About 4-5% of the total supplies of rice in India is converted into the rice productsparched rice, parched paddy and rice flakes. Parched rice is prepared by throwing rice into sand heated to a high temperature in an iron or earthen pan. On stirring, rice begins to crackle and swell. Then the contents of the pan are removed and sieved to separate the parched rice from sand. Parboiled rice is preferred in making parched rice.

Parched paddy (Puffed rice)

Sun dried paddy is filled in earthen jars and is moistened with hot water. After 2-3 min., the water is decanted and the jars are then kept in an inverted position for 8-10 hours. Next the paddy is exposed to the sun for a short time and then parched in hot sand as in the preparation of parched rice. During parching the grains swell and burst into a soft white product. The parched grains are sieved to remove sand and

winnowed to separate the husk.

Flaked rice

Flaked rice is made from parboiled rice. Paddy is soaked in water for 2-3 days to soften the kernel, followed by boiling in water for a few minutes. After cooking, the water is drained off and the paddy is heated in a shallow earthen vessel or iron pan, till the husks break open, after which it is pounded by a wooden pestle, which flattens the rice kernel and removes the husk. The husk is separated by winnowing. Flaked rice is thin and papery and of white colour. It can be stored without deterioration.

Rice starch

Rice starch granules are quite small and are embedded in a protein matrix. To separate them from proteins, broken rice is steeped for 24 hours in 5 times its weight of 0.3% caustic soda. The caustic soda treated granules are washed, dried and grounded into flour. The flour is then mixed with about ten times its weight of caustic soda solution. This removes the gluten. After 24 hours, the starch that settles down is removed, washed and cooled. Rice starch is used as food, especially in puddings, ice creams, pies and custard powder. Its principal use is in laundry as a stiffening agent. Rice starch also finds use in cosmetics, in face and dusting powders, as a thickener, in calico printing, in finishing textiles and for making dextrins, glucose and adhesives.

Maize products

Maize is ground for whole meal *atta* in power-driven or hand operated *chakkis*. The meal is sifted to remove fibre. In large scale milling, maida and suji are produced. Grits are used in the preparation of porridge to make corn flakes, as a brewing adjunct and to manufacture glucose by hydrolysis. Oil is extracted from germ, while bran and germ meal are utilized as animal feed. Maize oil rich in essential fatty acids, finds use as a salad oil. Its high smoke point makes it suitable for use as cooking oil. The protein concentrates, a by-product in wet milling, maize bran and oil cakes are used as animal feeds.

Barley products

Barley is used in India mainly as human food. Barley flour is generally mixed with wheat or gram (legume) flour for preparing *chapaties*. Wheat flour mixed with

barley or barley and rye or oats flour is used in making bread. In Western countries, one of the principal uses of barley is feed for animals either alone or mixed with other grains. Another important use of barley is in malting, for brewing in the manufacture of beer and distilling in the manufacture of whisky.

Oats and rye

Oat flakes or rolled oats are manufacture from pinhead meal by cooking the pinhead meal in a steamer, rolling the cooked product while hot, moist and plastic between heavy rollers and drying the flakes so formed. Rye bread is a widely eaten food in Northern Europe.

Millets

The name "millet" is applied to numerous small seeded grasses which oriented in Asia or Africa. The major millet crops of India are pearl millet (*Pennisetum typhoideum*), called "bajra" and finger millet (*Eleusine coracana*) known as "ragi". A number of other minor millets are grown and they are the common millet or proso millet (*Panicum miliaceum*), foxtail millet (*Setaria italica*) and kodo millet (*Paspalum scorbiculatum*). These millets along with maize and sorghum are considered "coarse grains" and constitute the food of the economically weaker sections of the population in India. In China, foxtail millet is the most common millet and one of the main food crops, especially among the poor in the dry northern part of that country.

After pearling bajra, the flour from pearled grain is used for preparation of traditional dishes having better look and taste. Ragi is the principal food grain of the rural population in India, especially in the Southern region. It is usually converted into flour and a variety of preparations like *mudde, chapatti, dosa*, porridge, etc. The grain is also malted and the flour of the malted grain is used as a nourshing food for infants and invalids. Malting releases the amylases which dextrinize the grain starch. Malted ragi flour is called "ragi malt" and is used in the preparation of milk beverages. A fermented drink or beer is also prepared from the grain in some parts of the country. Proso millet is sold as health food and due to its lack of gluten it can be included in the diets of people who cannot tolerate wheat.

Cereals as feed

Consortium for Educational Communication

Over 500 Mt of feed are used worldwide, split fairly evenly between poultry, pigs and cattle. In the past, compound feed has been determined by the price of ingredients on the world market, their nutritional value and the needs of the animals in question (monogastrics, fowl or ruminants), with feed prices moving with the cost of primary ingredients, followed by by-product from corn milling, soya processing, brewing, etc. Composition depends on the age of the animal and purpose for which it is raised (layers or broilers, beef or milk cattle, etc.). However on a local basis, changes reflecting a move from hay to silages and chemical preservation, the use of inoculants, enzymes, chemical preservation and modification as well as a move away from bought-in feed containing animal protein has extended the range of cereals and cereal fractions used, with an accelerating move towards organic and conservation grades.

Cereals as cleaners

Include simple or modified APGs and aminosorbital derivatives, dicarboxylic starch, glucose, sorbitol and methylglucoside peracetates as surface active agents, builders or bleaching agents and indirectly through production of enzymes (alkaline proteases, cellulases) for use in biological washing powders.

Chemical production

A range of solvents (e.g., ethanol, butanol, acetone) and acids (e.g., acetic, propionic, butyric, lactic, etc.) can be produced from cereals by fermentation and aromatics can be produced by hydrolysis or chemical means fairly directly (ferulic acid, vanillin, furfural) or through complex catalytic chemistry starting with ethanol or synthesis gas. Excluding food and pharmaceuticals, some products such as itaconic acid are produced in large volumes by fermentation. However, the main high volume products are modified starches, whilst other chemicals fall into food, pharmaceutical and fuel markets.

Medical and pharmaceuticals application

Starches are used as carriers or binders as well as raw material for production of ascorbic acid and fermentation products in medical and pharmaceuticals application. Carriers include cyclodextrins, where their structure enables them to entrap the active ingredient. Polyols are also finding increasing use since some are distinguished by

their chirality, one of the most rapidly growing areas of medicine.

Personal care products

Compounds such as APGs and other natural products are increasingly being used in cosmetics, whilst modified starches with high water holding capacity are used for their absorbent properties.

Liquid fuels and oxygenates

Conventional yeast based fermentation of starch hydrolysates followed by azeotropic distillation yields absolute ethanol, which can be added to petroleum based fuels as an extender, anti-knock (octane enhancer) or oxygenate.

Biodegradable plastics

These include conventional plastics using up to 85% starch fillers-with materials such as polycaprolactone co-polymers with modified starch (polyethylene co-acrylic or co-vinyl alcohol) at one end of the market and polyhydroxyalcanoate, polyhydroxy butyrate and other fermentation based products such as polylactic acid at the other. Other products include those with a small percentage of starch (Biofragmentable products). Gluten is also being used again, having in the past served for electrical components such as the rotor cap for Model T Fords. Currently such products account for around 1% of the market.

Loose fill packaging

Literally, pop corn is now being used as a substitute for polystyrene beads.

Biopesticides

Whole grain, brans and other fractions may be used as substrates for bacterial or fungal products and also as carriers and fillers in formulation. Hydrocolloids derived by fermentation or chemical modification may also be used for encapsulation.

Pulp and paper

This market includes products derived from straw and other cereal residues as well as starches used as fillers.

Composites and board

In theory straw can be used for board manufacture. Straws can be used in lower density boards.

Textiles

Starch is widely used as a size or stiffener in fabric especially printed cottons where it can be used to hold materials and prevent diffusion. The choice of starches both origin and amount of processing or derivatisation, is complex with cereal starches competing with potato or tapioca on price and performance. In general historical use and knowledge is greater than present practice, reflecting changes in the fibres used towards synthetics and geographical location towards Asia.

Adhesives

These consist of many ingredients including solvents, fillers, antifoams, stabilizers and plasticizers, as well as the resin or glue itself. Replacements for organic solvents, which ensure glue remains liquid and evaporates during drying, by water is increasingly occurring to reduce solvent abuse and release of volatile organic carbons.

Heat and power

Straw and other crop residues can be used as a fuel for conventional boiler/ steam turbine power generation plant in the 0.5 to 10 MW range, or as a component of the total fuel input in large waste to energy plant. Effluents and solid wastes can be dried and burnt, but this may give little net energy gain. An alternative for wet residues is the use of anaerobic digestion to produce biogas, the methane content of which it makes it a suitable boiler fuel or for use in internal combustion engines or gas turbines for power generation.