UNIT 9: CEREALS AND CEREAL PRODUCTS

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1.0 Introduction

Units 3 to 7 treated the nutrients in foods. Unit 8 treated the digestion absorption and utilization of the products derivable from the complex organic substances of carbohydrate, fats and oil and proteins. This unit and some other subsequent units will treat the major classes of food commodities, their characteristics, functions and products that are made or manufactured from them. This unit therefore treats cereals and cereal products.

2.0 Objectives

At the end of this unit, you should be able to

List the various kinds of cereals
Describe the structure of wheat grain
Discuss the milling of wheat
Describe the composition of wheat flour
Describe the process of bread making
List sonic other products from wheat

3.0 Main Content

3.1 Types of Cereals

Cereals are members of the family Grammineae or cultivated grasses and they *are* one of the *chief* supplier of human food.

In many rural areas of the world cereal has been found to provide more than 70% of the energy in the diet of the people.

The major principal cereals are wheat, rice, maize, millet, oats and rye. We can make flours from all cereals and from the flours we can make cakes and porridge. However, only wheat and ryes are suitable for bread making.

Wheat is grown in most dry climate of the world; rice in most damp tropical climate, maize in southern state of the United States, Italy Yugoslavia, Egypt and many parts of Africa, millet in all climate and on poor soil with limited water supply. We use barley mainly for brewing and it can also be eaten by man and cattle. Grains of cereal of different types have similar chemical composition and nutritive value. They supply energy and some protein of good quality. The supply appreciable amount of calcium and iron, the presence of phytic acid and interferes with the absorption of theses minerals.

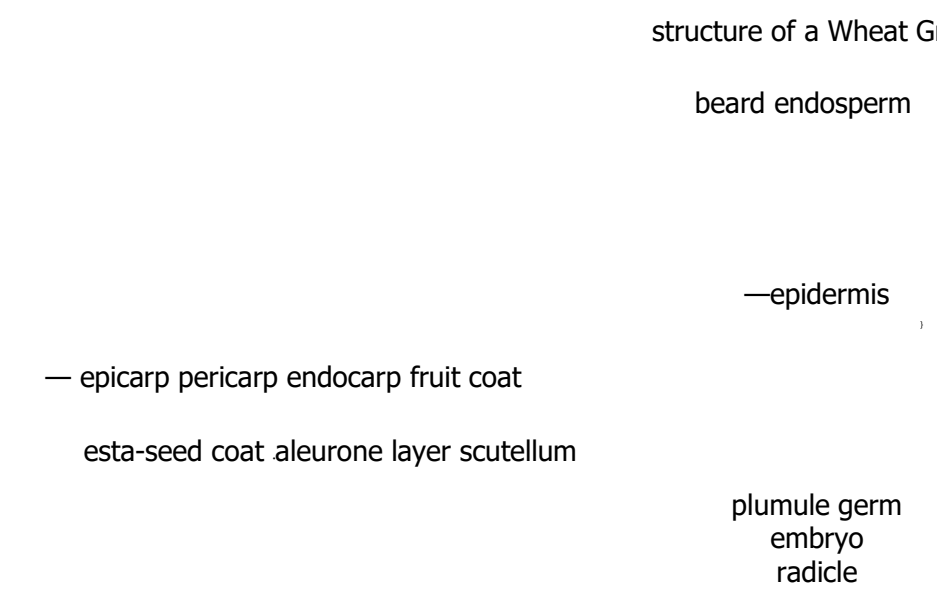
All cereals lack both ascorbic acids and vitamin A except yellow maize that contains some significant amount of the carotene the precursor of vitamin A. All cereal contains appreciable amount of water soluble vitamin B group. From this discussion, it can be realized that in order to prepare a balanced diet from cereals, the cereals must be enriched by animal proteins, minerals, vitamins A and E from meat, milk and fresh green vegetable.

To have a proper understanding of the nutritive value of cereals and the changes the cereals undergo during processing, we need to consider the structure of the cereal grain and the composition of the grain.

3.2 Wheat Flour

3.2.1 Structure of Wheat Grain Fig. 9.2

Structure of a Wheat Grain



Source:Lake B. and Waterworth M. (1980) Foods and Nutrition, 13th Edition, Mills and Boons Ltd. Brooks Mews, London. Pg. 192

Fig. 9.2 shows the structure of a wheat grain. The outer coverings are pericarp and testa. These are hard and indigestible fibres.

Under the pericarp and testa we have the aleurone layer which contains cells that are rich in protein, these outer layers constitute about 12% of the weight of the grain. The endosperm about 85% of the weight of the grain is composed of both the inner and outer portions.

The germ or the embryo found at the lower end of the grain consists of three pits; the plumule. ridicule and scutellum. While the plumule is the undeveloped shoot, the ridicule is root centre and contains the root bulb, the scutellum or cotyledon grows up to the leaf and consists of several distinct tissues most especially the epithelial layer. The cotyledon secretes the

various enzymes that are required to bring the food stores in the endosperms into soluble and useful state for the developing embryo.

It should be noted that the endosperm stores the food in the wheat and it must make provisions for the developing embryo. In doing this the starch is broken down by diastase to maltose and maltase converts maltose to glucose. The soluble gluten (wheat protein) and other proteins are converted to peptones and amino acids by appropriate proteolytic enzymes.

The nutrients in the grains are distributed as follows:

a. Germ: relatively rich in protein, fat and several of the B vitamins, the cotyledon in the germ contains about fifty times more thiamin than the whole grain.

b. Endorsperm and Aleurone layer: the outer layer of endosperm and the aleurone layer contains higher concentration of protein vitamins and the phatic acids than the inner endosperm. The inner endosperm supplies most of the starch and the protein in the grain.

3.2.2 Milling of Wheat

The milling of wheat grains started with the use of two stones. One resting on the floor and the other one held in the hand. The one resting on the floor is artificial hallowed and the one in the hand shaped to fit it.

The wheat grains are put on the resting stone and the stone in the hand is used to grind the grain.

Advancement in technology has brought about the roller milling process which will be learned in this unit.

Roller Milling Process

This is the process by which the endosperm is separated from the pericarp, testa, aleurone layers and embryo to produce flour. This process consists of the following stages:
Cleaning, conditioning, breakrolling. reduction and bleaching.

a. Cleaning: the cleaning is done to remove sticks, stones, dirt and soils from the ‘theat and this is done by passing the grain through the rubble separator where fans blow off the foreign matters. The grain is then allowed to pass through a disc separator which allows the retention of the wheat grains and the passage of seeds of oats. barley, rye and other foreign seeds.

The wheat grain is then passed over a magnetic separator that removes pieces of iron such as nails which may cause fire outbreak in subsequent processing of wheat. The wheat grain is treated in the "scourer" to remove surface impurities and the fine hairs (bearded) at the pointed end of the grain. The wheat then reaches the washer and the whizzer in which is carried into the machine in a stream of water and removed rapidly at high speed. Here, the

wheat grains float and the remaining impurities sink. The wheat is then taken out of the water. Under this condition the wheat is able to take up the correct amount of water for conditioning.

Conditioning: the wetting of the wheat conditions the wheat for break rolling. The conditioning makes the bran tough without affecting the bristle property of the endosperm. Some care should be taken in this process since hard wheat requires longer soaking time than medium and soft wheat. Before breakrolling is done, dry brushing to remove loose particles and slight steaming must be done. Conditioning also improves the baking property of flours.

c. Breakrolling: the milling of the wheat is done by passing the grain through a series of three or more break rolls consisting of a pair of steel rollers with finely fluted surfaces which rotate at different speeds. In the first break roll, the grain splits and the contents are set free. The complete separation of the starchy endosperm from the bran is done by passage through several break rolls; some of the endosperm is unavoidably converted to flour inch is removed by sieving through open wire sieve. This type of flour contains some dirt.

After each break, the endosperm becomes more and more separated from the bran and the starchy endosperm is made to move in opposite direction to a current of air in the purifier or separator. This current of air blows away fine Iluggy particles of hursk which are collected and removed.

d. Reduction: the starchy endosperm known as semulinas and midlings are ground to flour by passage through reduction and grinding rollers. This is then passed through fine sieve. Particles that could not pass through the sieve

are then passed through the rollers to grind and the process continues as

before.

Flour produced at many different points in the milling system is called

"steams" and these streams are blended together to form "straight run" floor.

3.2.3 Composition of Wheat Flour

From our discussion, you learned that wheat is ground to flour before it is used to prepare food. The germ and some varying proportion of the outer layers of the grains are separated from the endosperm and they are regarded as "bran". The proportion of the whole grain that is used to make flour is regarded as the "Extraction Rate". 80% extraction rate flour contains 80% by weight of the whole grain and 20% is discarded as bran. From this discussion we can have low extraction rate and high extraction rate.

The flour with high extraction rate loses little of the aleurone layer and outer endosperm.

The low extraction flours are

a. Whiter than the high extraction flour
h. Bread made from them is more attractive
c. They contain less fat, less phatic acid and they have better baking properties.

However, low extraction flour has less of a group vitamins, less calcium and iron, less protein and less of other trace minerals.

In general, wheat flour consists of about 70% starch from amylase and amylopeptin. Wheat starch is hygroscopic and has high moisture absorbing quality.

Gluten is the characteristic wheat flour protein that gives it its baking properties. It consists of gliadin and glutenin. The presence of gluten in
wheat makes wheat flour more suitable for bread making than all other flours.

Wheat flour contains some soluble protein such as albumins, globulins and proteoses.

The water content of lour varies form 11% to 14%, water level above 14% cause bacterial and mould growth and can also result in the development of acidity in flour.

Sucrose, maltose, glucose and fructose are present in the endosperm up to cir . This helps to feed the yeast during bread making.

The sugar of the Hour influencing the bloom of the crust of the bread since it undergoes caranelisation during baking.

The vitamin of the B group namely: Thiamin, nicotinic acid, riboflavin, pantothenic acid, pyridixin are distributed in varying proportion throughout
the grains.

The mineral content of flour are mainly phosphates of calcium, magnesium and potassium with traces of iron and magnesium phosphate.

This soluble mineral salt act as yeast food and buffers during fermentation of the dough and they help to stabilize the gluten.

3.2.4 Bleaching and Improving of Flour

Bleaching of the pigment of the wheat endosperm, xantophyll occurs rapidly when flour is exposed to air. Storage also improves the baking qualities of flour.

There are some chemical improves and bleaching agents that are permitted by law. Some permitted improves are ascorbic acid, potassium, bromate and monocalcium phosphate.

Chlorine dioxide acts as a bleaching as well as an improving agent. Benzoyl peroxide is also a permitted bleaching agent.

Cannoned heat treatment has been found to improve the quality of flour. The imi *ro*\ ing of the flour is generally believed to be due to the oxidation of cysteine sulphydryn which is present in wheat gluten.

3.2.5 Fortification of Wheat Flour

Iron, thiamin, nicotinic acid are all used to fortify wheat flour.

0.24mg of thiamin, 1.65mg of iron per 100g of flour have been recommended for fortification of flour.

Students Assessment Exercise 9.1

Discuss the composition of wheat flour

3.3 Bread Making

We make bread from four essential ingredients: flour, water, yeast, salt, sugar, milk and fact though optional are added to improve the quality of bread. Strong flour with gluten content of 14-16g is desirable for bread making. Correct amount of water must he added to the Hour when preparing

the dough. The salt added is used to improve the flavour of the bread, strengthen the gluten and control fermentation. It should be noted that excess salt reduces the activities of the yeast (Denaturation of protein). The fermentation of the dough must be controlled as over-fermentation leads to excessive production of carbon dioxide that destroys the structure of the gluten and causes the collapse of the structure. Inadequate fermentation leads to low volume of bread and production of sticky bread. Baking also must be controlled. We should avoid the dangers of overbaking and underbaking. Overbaking leads to burning of the brown crust and underbaking prevents heating of the starch and formation of brown crust of the bread.

After baking, adequate cooling of the loaves should be done before wrapping to prevent condensation that can facilitate early mould growth.

3.4 Wheat Products

Other wheat products are semolina and pastas, breakfast cereals, macaroni, spaghetti and chapattis.

4.0 Conclusion

In this unit, you learned the various types of cereals. You also learned the structure and composition of wheat grains, the milling of wheat grain, the composition of wheat flour, bleaching and improving of flour, fortification of flour and bread making,. The unit mentioned some other products from wheat.

5.0 Summary

Cereals are defined as members of family of Graminnaea and they provide foods for greater number of people in rural populations of the world. The cereals are wheat, maize, barley, oats, millets, rye, rice. The wheat grain consists of pericarp, testa, aleurone layer, outer and inner endosperm and the germ. The endosperm is the food store of wheat grain. The wheat grain is rich in protein, fat and several of the B Vitamins but devoid of ascorbic acid and Vitamins A and E. The milling process of the wheat involves cleaning, conditioning, breakrolling, reduction and bleaching.

The wheat flour contains 70% starch from ainylose and amylopeptin, gluten the characteristic wheat flour protein that gives the wheat flour its baking quality, soluble protein, albumins, glohins and proteoscs.

Bleaching and improving of the flour can be done by exposure and storage of the flour. Chemical improvers and bleaching agents can also *he* used

Bread is produced from flour, water, yeast and salt though sugar, milk and fat may be added to improve its quality. For bread making, glutin content of 14- 16% is desirable. • For good quality of the bread, the ingredients must. be added in correct proportions. Under fermentation and over fermentation should be avoided. Over baking and underbaking should be avoided and adequate cooling of the loaf after baking must be done before wrapping to prevent condensation that can lead to early growth of mould.

6.0 Tutor Marked Assignment

Discuss the roller milling process of wheat and the precautions taken during bread making to enhance the quality of bread.

Answer to Student Assessment Exercise 9.1

See answer in 3.2.1 of this unit

7.0 References and Other Sources

Davidson S. et al (1975) Human Nutrition and Dietetics. Sixth editionLongman Group Ltd.

Fleck H. (1976) Introduction To Nutrition. Third edition, Macmillan Pub. Co., Inc., New York

Gultrie H. A. (1979) Introductory Nutrition. Forth edition, The C.V. Mosby Company.St. Louis, London, Toronto.

Lake B and Inlaternurte M. (1980) Food and Nutrition 13th edition, Mills and Boon Ltd., London