

**PROCESSING
TECHNOLOGY OF CEREALS
ASFE 2201**

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WHEAT PROCESSING

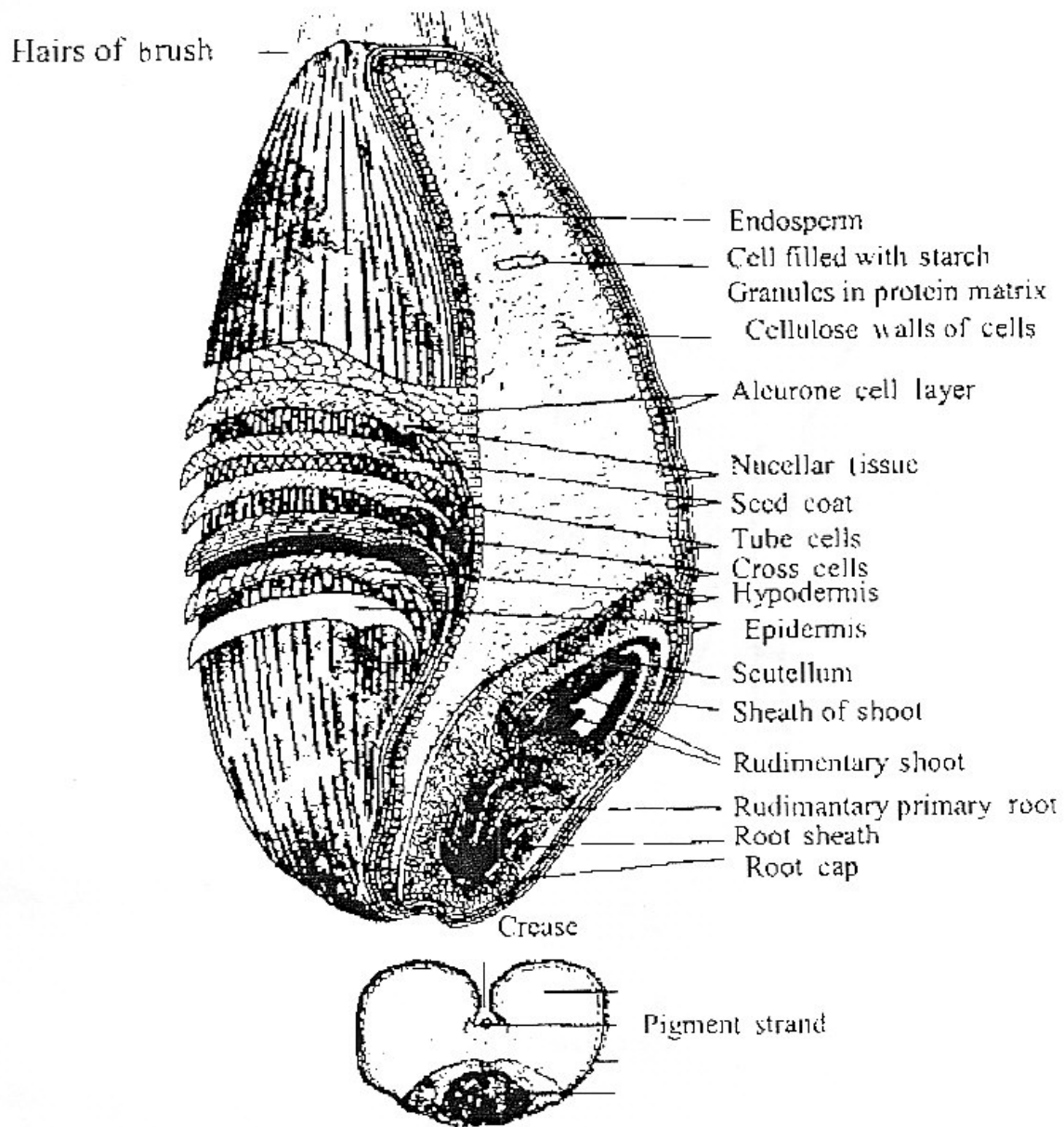


Fig. 1 Diagrammatic illustrations of wheat structure. (From Laszltly, 1999.)

□Wheat is a single-seeded fruit, 4- to 10-mm long, consisting of a germ and endosperm enclosed by an epidermis and a seed coat.

□The fruit coat or pericarp (45- to 50 μm thick) surrounds the seed and adheres closely to the seed coat.

□The wheat color, depending on the species and other factors, is red to white, and is due to material present in the seed coat.

□Wheat also is classified based on physical characteristics such as red, white, soft, hard, spring, or winter.

Table 2.1: Nutritive value of cereals (per 100 g)

<i>Food</i>	<i>Energy</i> <i>K.cal.</i>	<i>Protein</i> <i>g.</i>	<i>Fat</i> <i>g.</i>	<i>Carbo-</i> <i>hydrates</i> <i>g.</i>	<i>Calcium</i> <i>mg.</i>	<i>Iron</i> <i>mg.</i>	<i>Caro-</i> <i>tene</i> <i>mcg.</i>	<i>Thiamine</i> <i>mg.</i>	<i>Ribo-</i> <i>flavin</i> <i>mg.</i>	<i>Niacin</i> <i>mg.</i>
Bajra	361	11.6	5.0	67.5	42	8.0	132	0.33	0.25	2.3
Jowar	349	10.4	1.9	72.6	25	4.1	47	0.37	0.13	3.1
Maize, dry	342	11.1	3.6	66.2	10	2.3	90	0.42	0.10	1.8
Maize, tender	125	4.7	0.9	24.6	9	1.1	32	0.11	0.17	0.6
Ragi	328	7.3	1.3	72.0	344	3.9	42	0.42	0.19	1.1
Rice, parboiled, handpounded	349	8.5	0.6	77.4	10	2.8	9	0.27	0.12	4.0
Rice, parboiled, milled	346	6.4	0.4	79.0	9	1.0	—	0.21	0.05	3.8
Rice, raw, handpounded	346	7.5	1.0	76.7	10	3.2	2	0.21	0.16	3.9
Rice, raw, milled	345	6.8	0.5	78.2	10	0.7	0	0.06	0.06	1.9
Wheat flour (whole)	341	12.1	1.7	69.4	48	4.9	29	0.49	0.17	4.3
Wheat flour (refined)	348	11.0	0.9	73.9	23	2.7	25	0.12	0.07	2.4
Wheat bread (white)	245	7.8	0.7	51.9	11	1.1	—	0.07	—	0.7

Source: Gopalan C., B. V. Rama Sastri and S. C. Balasubramanian, 1991, Nutritive value of Indian foods, National Institute of Nutrition, ICMR, Hyderabad.

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 from 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 wheat are classified into :-

i). Extra hard ex: durum, some algerium varieties

ii). Hard varieties- Manitoba, American hard red spring wheat, Australian prime hard

iii). Medium hard – Russian varieties, American Hard seed winter wheat & some European varieties

iv). Soft: American soft red winter wheat, American soft white variety.

Strong and weak wheat:

□Wheat yielding flour which has the ability to produce the bread of large loaf volume, good crumb texture and good keeping qualities generally has high protein content and these types are called as strong wheat.

□Whereas the wheat yielding flour from which only a small loaf volume 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 (Canadian western Red spring wheat) called as Manitoba. American HR's, Russian spring type and some Australian varieties.
- 2) Medium types: American Hard red winter wheat, some European varieties and some Australian varieties.
- 3) Weak wheat: American soft red winter wheat, American soft white varieties.

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 agro-climate conditions.

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 palatability 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 attack 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 varieties.

iv) Fit for storage: The moisture content should not exceed 16% for immediate milling and 15% for storage.

Grading: There is no official grading system for the wheat. Generally wheat is described as “millable’ or ‘non millable’.

Marketing guide specifies 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.

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.

MILLING OF WHEAT

- Wheat is consumed mostly in the form of flour obtained by milling the grain while a small quantity is converted into breakfast foods such as wheat flakes and puffed wheat. Indian wheats are hard and the moisture content is usually 8-10%.
- The objective of modern flour milling is to obtain the maximum amount of white flour from the wheat endosperm without any bran or germ content.
- The yields of white flour and byproducts are generally 70 % and 30 % by weight.
- The mill feed (wheat) is composed of 12 % bran, 3% germ and 85 % endosperm.

- Modern flour milling consists of 6 steps:-
 - 1.Receiving , drying and storage of wheat
 - 2.Cleaning
 - 3.Conditioning
 - 4.Milling into flours and byproducts
 - 5.Packaging and storage of byproducts
 - 6.Blending

CLEANING

- It removes all the fine impurities and dirt sticking to the surface of the grain.
- Impurities like sticks, stones, sand etc. are removed by sieving and all the light impurities like chaff etc. are removed by aspiration.
- Powerful magnetic separators are used to remove all the ferromagnetic impurities.
- Disc separators are employed to remove other grains, defective grains and weeds.
- Scouring is done to remove dirt sticking on the surface. Usually, wheat is moved by paddles against stationary emery coated surface after which dirt and loose outer coating is aspirated off.
- The final step is washing by water which allows the dirt and metal bits to sink. The moisture content of wheat is increased by 1% during washing.

CONDITIONING/ HYDROTHERMAL TREATMENT

- It helps in separating bran and germ from endosperm.
- It is done in three steps of heating, moistening and cooling.
- The moisture content is elevated from 15-17 % to 16 – 19% at moistening.
- The tempering is done in a separate tempering bin for 18 to 72 hrs.
- The temperature of heating should not be more than 47°C as it can affect the quality of the flour as the gluten quality can deteriorate.

GRINDING/MILLING

- It is carried out in roller mills (break roll and reduction roll systems).
- The surface of reduction roll is smooth and break roll is rough.
- In break roll, the bran is cracked, the kernel is broken open and the endosperm adhering to the bran is milled successively in few steps. A series of four rolls are generally used.
- The reduction rolls are used for proper grinding of middling's into proper flour size. A series of 12 to 14 reduction mills are generally used.

STORAGE

- The flour and mill feed(bran, germ and shorts) are bagged in waterproof bags, stiched and stored in cold dry condition in flat godowns.

COMPONENTS OF A WHEAT MILL.

(1) *Break roll*

Break roll consists of twin pairs of corrugated steel rolls. One roll of a pair revolves faster than the other, differential speed being in the proportion of 2.5 to 1.

(2) *Break sifting system*

This can be divided into two parts—plan sifters and purifiers.

(a) *Plan sifter.* Plan sifter is a scalping system removing large bran pieces adhering with endosperm at the top. The next series, which are finer, remove the bran and germ. The next layer of still finer sieve removes the endosperm middling and the bottom rough flow.

(b) *Purifier.* The middling containing finer bran particles are removed by purifier before they move to reduction roll.

(3) *Reduction roll.*

The reduction roll comprises of two smooth rolls. The rolls in the reduction system are further divided into coarse rolls and fine rolls depending on the clearance between the rollers.

It is possible to grind flour into very fine particles by gradual grinding. But under high grinding pressure the starch is ruptured and this should be avoided.

(4) *Reduction sifting system*

The same plan sifting system is used here.

After each reduction the product is separated by plan sifters where the finished flour is sifted by 120 mesh sieve (silk) and removed and oversized material is sent back to the reduction rolls for further processing.

(5) *Scratch system*

If the mill is functioning properly, i.e., good release of endosperm is obtained on the break rolls, the scratch system can be bypassed, if not, the scratch system is employed to maintain proper release of endosperm from bran. The scratch system is an extension of the break system and thus used as stand-by system only.

ASSIGNMENT

1. Draw the flowchart of wheat milling process.
2. Write the different steps in modern wheat milling briefly describing the **various equipment's** used.