

**PROCESSING TECHNOLOGY
OF CEREALS
ASFE 2201**

**SUDIPTA BEHERA
ASSISTANT PROFESSOR, SoABE**

INTRODUCTION

- A grain is a living biological product which germinates and respire also.
- The respiration process is externally manifested by decrease in dry weight, utilization of oxygen, evolution of carbon dioxide and release of heat.
- Food grains include cereals like rice, wheat, maize, sorghum and millets; pulses like pigeon pea, chick pea, black gram and oilseeds like groundnut, mustard, coconut, sesame.
- Cereal grains are hygroscopic and would gain or lose moisture initially until they are in equilibrium with air.

- Cereals are the edible seeds or grains of the grass family.
- Cereals have been a part of the human diet since pre historic times.
- Wheat and rice are the most important crops world-wide as they account for over 50% of the world's cereal production.
- Wheat is the cereal most commonly used for the manufacture of food products.
- Each cereal has unique properties which make it suitable for a variety of food products.
- Cereals are also known as 'staple foods' as they often make up the bulk of the diet since they are relatively cheap to produce.

- In general processing of products is done in three ways i.e., primary processing, secondary processing and tertiary processing.
- By products are processed for economic utilization. At every stage of processing, value is added to the product.
- Primary processing refers to those operations which convert raw food materials into a form fit for eating or to be used in subsequent processing. Some examples are: milling of paddy into rice, that of wheat into flour.
- Secondary processing converts primary processed food materials into form fit for use at home or canteen or hotels. Some examples are milling of chick pea, splits into Besan.

MORPHOLOGY OF CEREAL, MAJOR & MINOR MILLETS

- The cereal crops that are grown for their edible fruit are generally called grain, but botanically referred to as caryopsis.
- The cereal seed consists of two major components, the endosperm and embryo or germ.
- The endosperm encompasses the bulk of the seed and is the energy source of stored food.
- An outer wall called the pericarp that develops from the ovary wall encases the endosperm.
- A semi permeable layer under the pericarp, which is called testa, surrounds the embryo and is derived from the inner ovary wall.
- The testa is permeable to water, but not to dissolved salts, and is important for germination.
- The third layer, which is called aleurone, contains thick-walled cells that are free of starch. The pericarp, testa, and aleurone layer are collectively called the bran.

TABLE 7. Average composition of cereals and legumes

	Raw brown rice	Whole wheat	Whole Maize	Sorghum	Millet	Legume Lentils	Broad beans (ker- nels)
Moisture (per cent)	12.0	12.5	13.8	11.0	11.8	12.2	10.6
Calories/ 100 gm	360	330	348	332	327	351	354
Protein, (per cent)	7.5	12.3	8.9	11.0	9.9	23.7	25.0
Fat, (per cent)	1.9	1.8	3.9	3.3	2.9	1.3	1.8
N-free extract, (per cent)	77.4	71.7	72.2	73.0	72.9	57.4	53.7
Fibre, (per cent)	0.9	2.3	2.0	1.7	3.2	3.2	5.9
Ash, (per cent)	1.2	1.7	1.2	1.7	2.5	2.2	3.0
Thiamine, mg/100 gm	0.34	0.52	0.37	0.38	0.73	—	—
Riboflavin, mg/100 gm	0.05	0.12	0.12	0.15	0.38	—	—
Niacin, mg/100 gm	4.7	4.3	2.2	3.9	2.3	—	—

FOOD PRODUCTS FROM CEREAL, MAJOR & MINOR MILLETS

➤ **Traditional Food Products:**

Various types of flours, Roti/Bhakari, Annum, Boiled grains, Grits, Rava, Semolina, Malted grains/flours, Fermented flours, pops, flakes, etc.

➤ **Ethnic Food Products:**

Papad, Kurdai, Chiwada, Chakali, Idli, Dosa, Upma, Shira, Khakara, Pakoda, Wada, etc.

➤ **Bakery Food Products:**

Bread, Toasts, Buns, Butters, Sweet rolls, Biscuits, Cookies, Cakes, Kharies, etc.

➤ **Nutraceutical/Industrial Food Products:**

Diabetic flour, High fiber food products, Starch, Beer, Weaning foods, Fortified food products, Syrups, Alcohol/Ethanol, etc.

AVERAGE COMPOSITION OF CEREALS

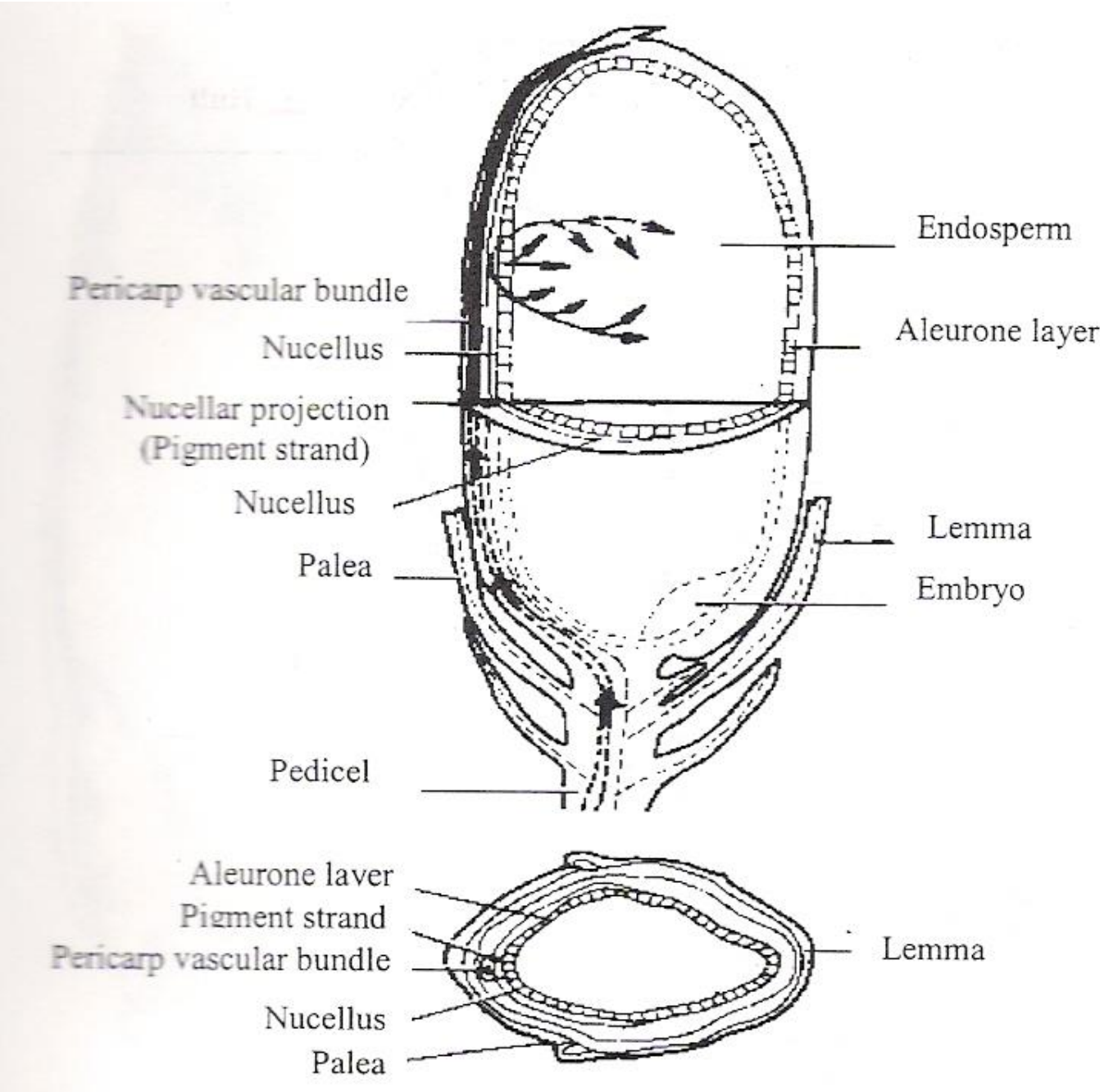
Food grains	Rice	Wheat	Maize	Sorghum	Millets
Moisture, %	12.0	12.5	13.8	11.0	11.8
Protein, %	7.5	12.3	8.9	11.0	9.9
Fat, %	1.9	1.8	3.9	3.3	2.9
NFE, %	77.4	71.7	72.2	73.0	72.9
Fiber, %	0.9	2.3	2.0	1.7	3.2
Ash, %	1.2	1.7	1.2	1.7	2.5
Thiamine, mg/100g	0.34	0.52	0.37	0.38	0.73
Riboflavin, mg/100g	0.05	0.12	0.12	0.15	0.38
Niacin, mg/100g	4.7	4.3	2.2	3.9	2.3
Calories	360	330	348	332	327

COMPOSITION OF SOME OAT, RYE AND BARLEY PRODUCTS

Millet	Moisture	Protein	Fat	CHO	Dietary fiber	NSPS
1. Oat						
Oat Meal	8.8	11.8	6.8	68.4	6.3	6.8
Rolled	10.1	12.0	6.8	67.2	-	-
Quick cook	8.2	11.2	9.2	66.0	6.8	7.1
2. Rye						
Whole flour	15.0	8.2	2.0	66.0	-	11.7
Bread	37.4	8.3	1.7	45.8	5.8	4.4
Crisp bread	6.4	9.4	2.1	70.6	11.7	-
3. Barley						
Whole grains	11.7	10.6	2.1	64.0	-	14.8
Pearled	10.6	7.9	1.7	83.6	5.9	-

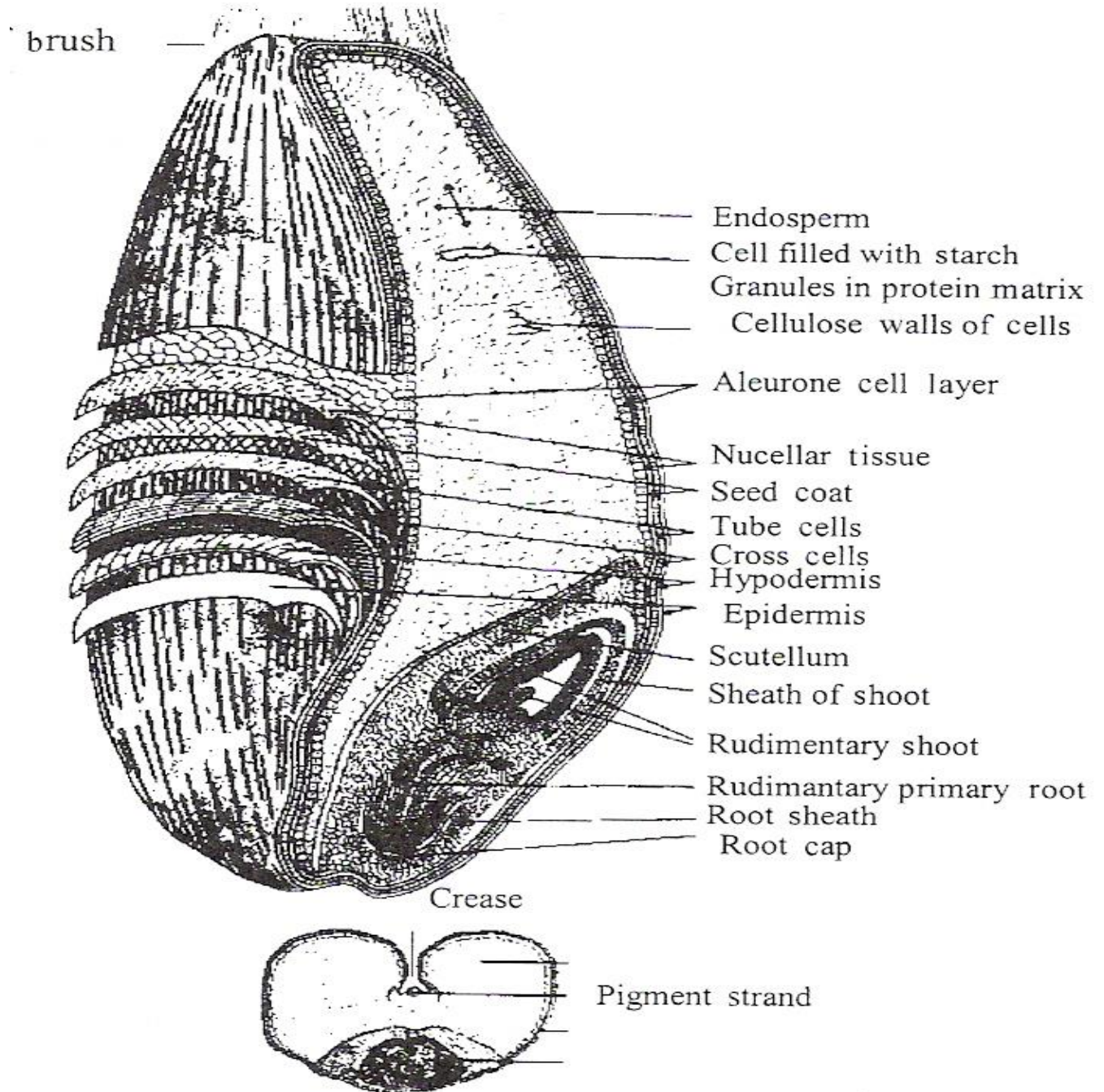
CHO: Carbohydrates, NSPS: Non starch polysaccharides

RICE GRAIN



WHEAT GRAIN

(4- to 10-mm)



CORN GRAIN

2 to 3.5 m tall

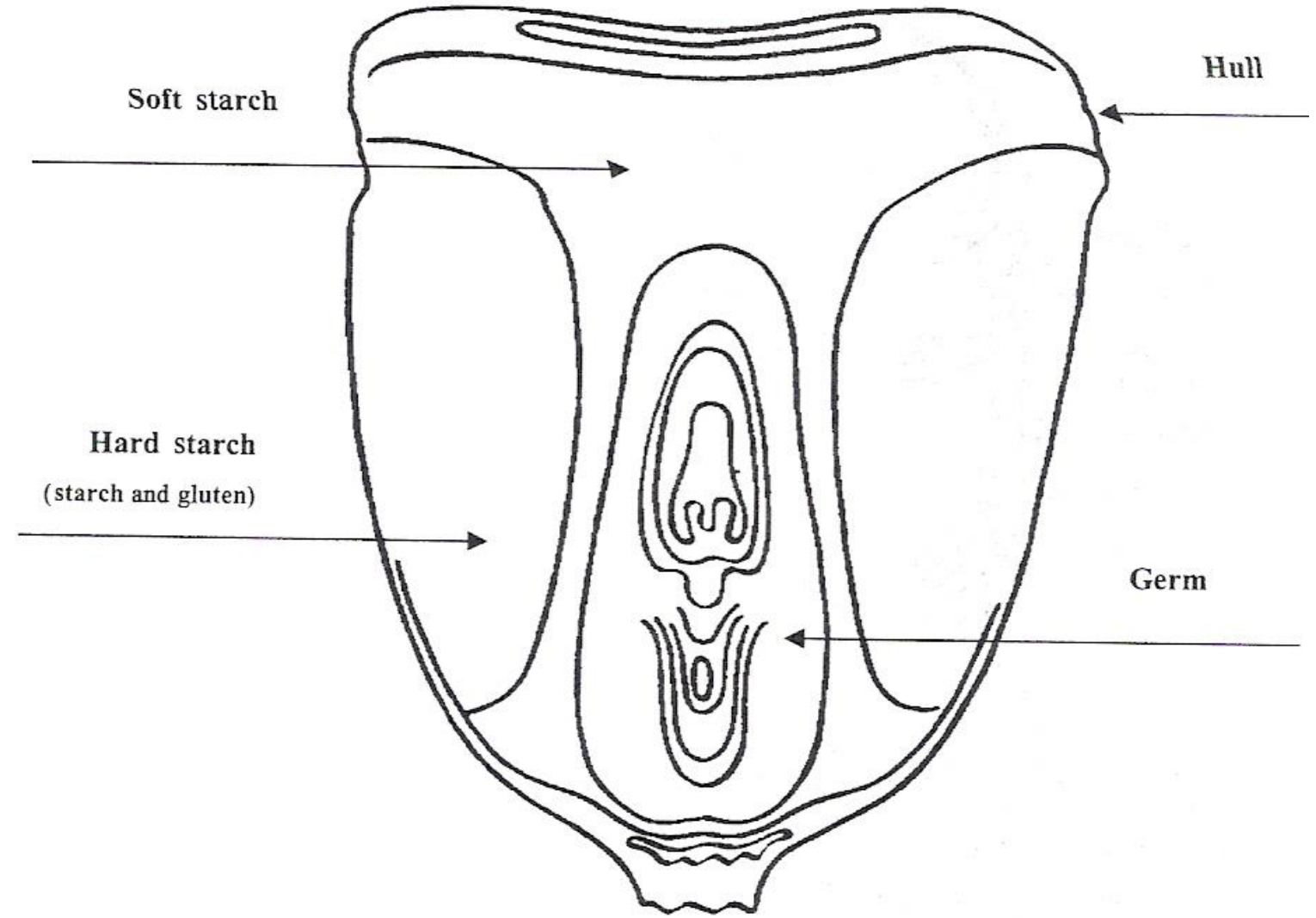
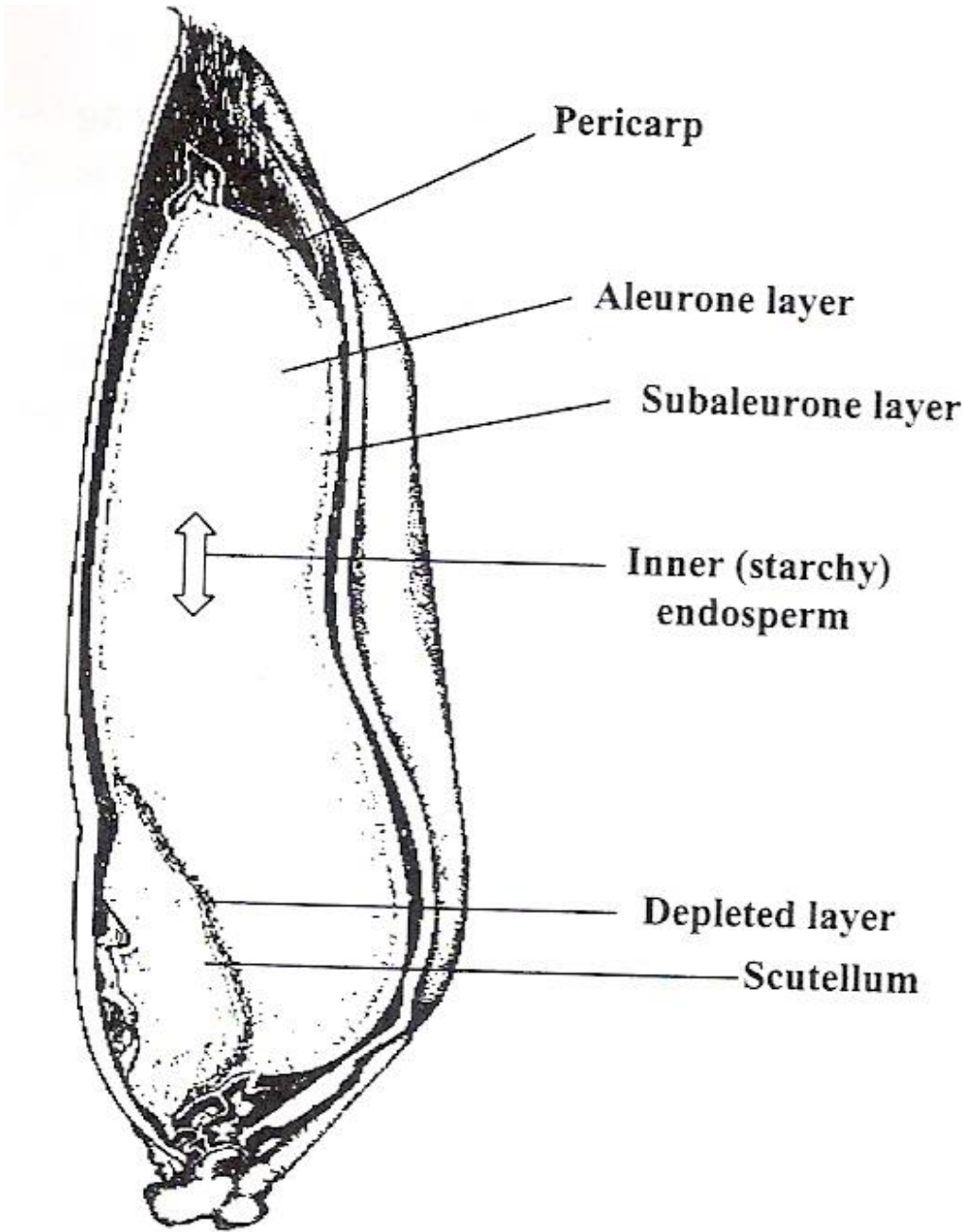
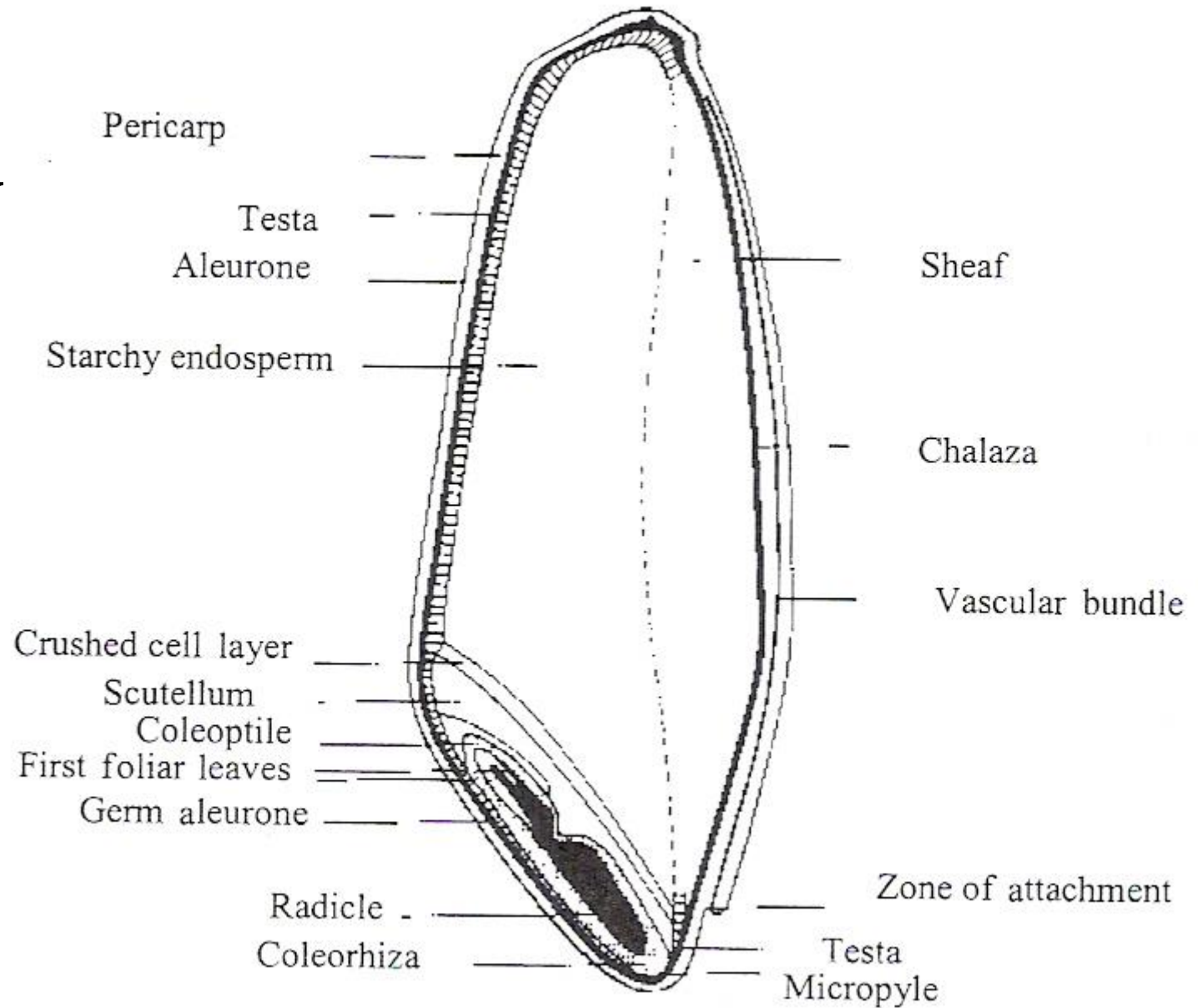


Fig. 2 Diagram of a corn kernel. (From Potter, 1986.)

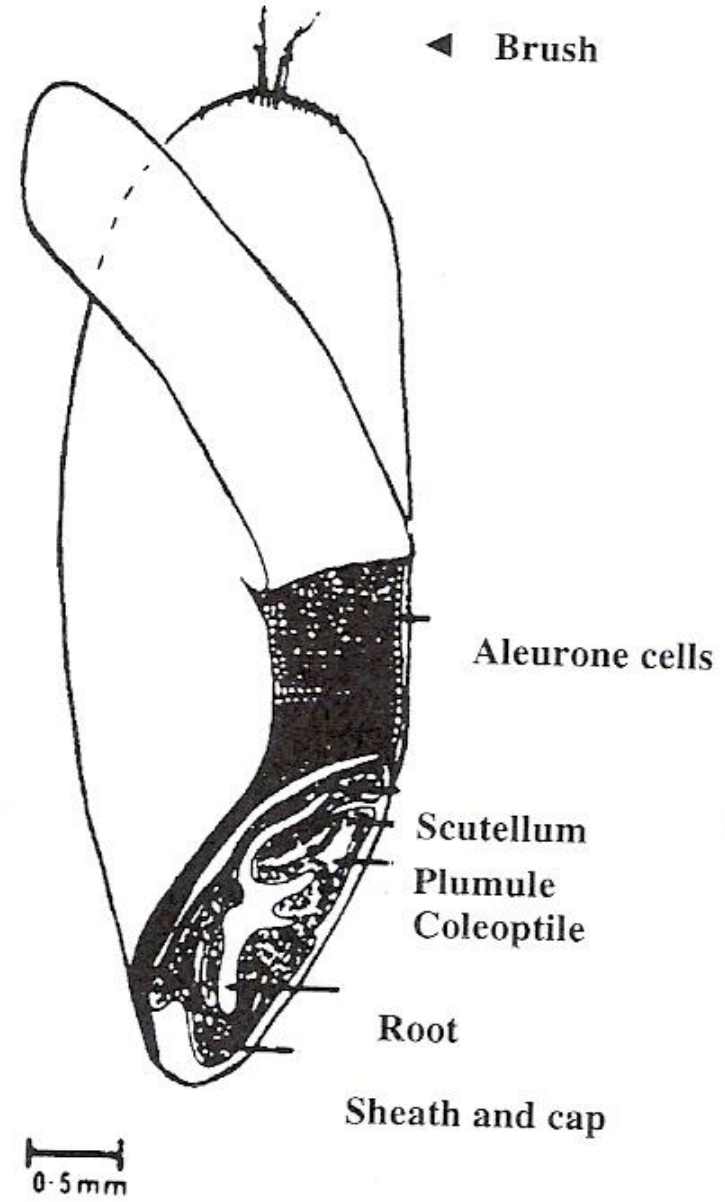
OAT GRAIN



BARLEY GRAIN



RYE GRAIN



SORGHUM GRAIN

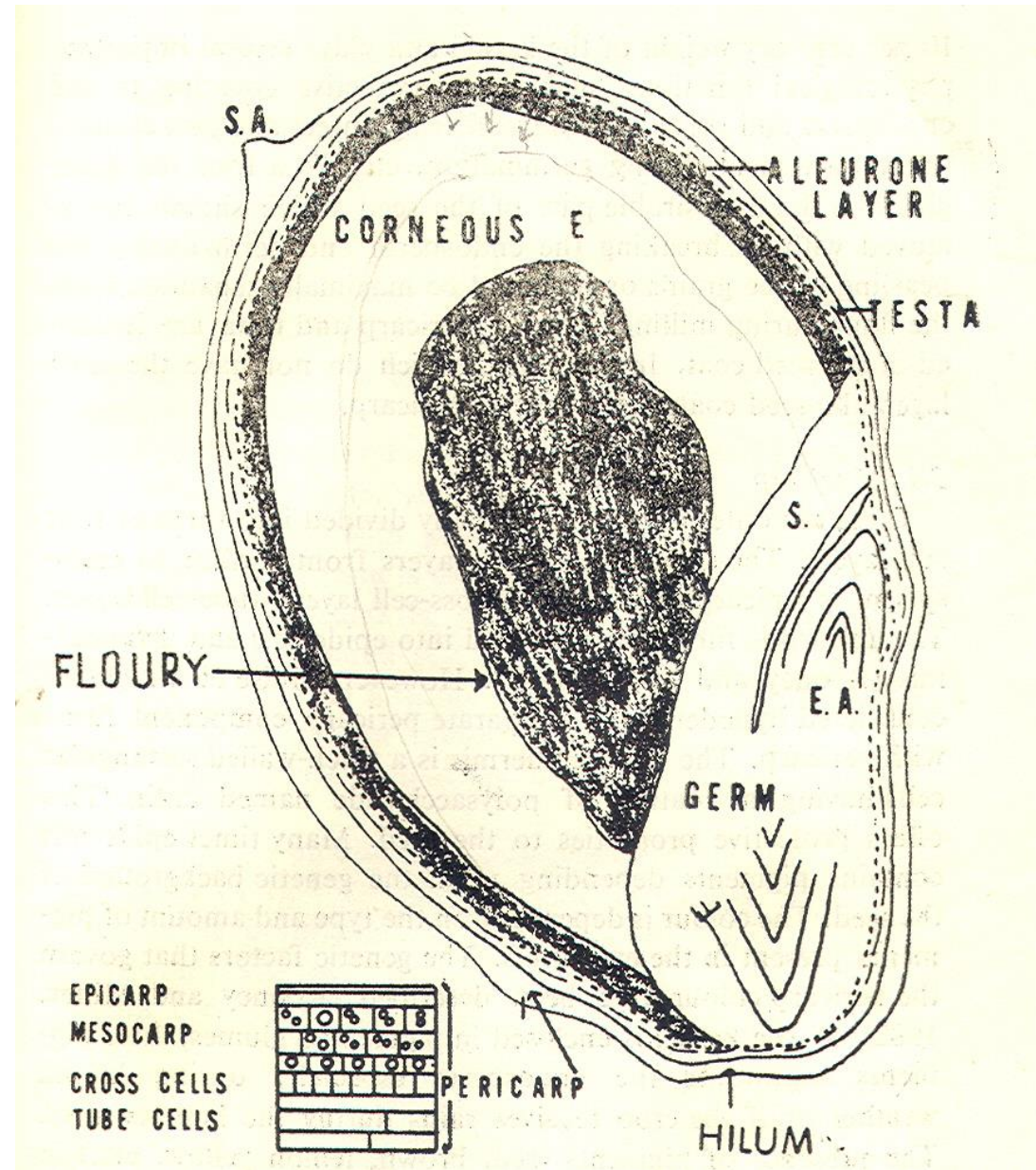


Table 2.1: Nutritive value of cereals (per 100 g)

<i>Food</i>	<i>Energy</i> <i>K.cal.</i>	<i>Protein</i> <i>g.</i>	<i>Fat</i> <i>g.</i>	<i>Carbo- hydrates</i> <i>g.</i>	<i>Calcium</i> <i>mg.</i>	<i>Iron</i> <i>mg.</i>	<i>Caro- tene</i> <i>mcg.</i>	<i>Thiamine</i> <i>mg.</i>	<i>Ribo- 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.

ASSIGNMENT

- Write the production scenario of major cereals and millets.
- Write the present status and future prospects of cereals and millets.
- Write the characteristics of wheat, corn, rice, barley, oat, rye, sorghum in tabular form.