

UNIT 2 (CEREALS)

Wheat is a grass widely cultivated for its seed, a cereal grain which is a worldwide staple food. The many species of wheat together make up the genus *Triticum*; the most widely grown is common wheat (*T. aestivum*). The wheat kernel is a type of fruit called a caryopsis.

Wheat is an important source of carbohydrates. Globally, it is the leading source of vegetable protein in human food, having a protein content of about 13%, which is relatively high compared to other major cereals but relatively low in protein quality for supplying essential amino acids. When eaten as the whole grain, wheat is a source of multiple nutrients and dietary fibre.

Origin of Wheat:

Cultivation of wheat started after 8000 BC. Jared Diamond traces the spread of cultivated emmer wheat starting in the Fertile Crescent about 8500 BC. Archaeological analysis of wild emmer indicates that it was first cultivated in the southern Levant with Iran as far back as 9600 BC. Genetic analysis of wild einkorn wheat suggests that it was first grown in the Karacadag Mountain in South eastern Turkey.

Remains of harvested emmer from several sites near the Karacadag Range have been dated between 8600 (at Cayonu) and 8400 BC (Abu Hureyra). That is in the Neolithic period. Iraq-ed-Dubb is the exception where the earliest Carbon dated remains of domesticated emmer wheat were found is the earliest levels of Tell Aswad, in the Damascus basin near Mount Hermon in Syria.

The cultivation of emmer reached Greece, Cyprus and India by 6500 BC, Egypt after 6000 BC and Germany and Spain by 5000 BC. The early Egyptians were developers of bread or the use of over and developed baking into one of the first large-scale food production industries. Wheat was cultivated in India even during the Mohenjodaro period. It was the simple Emmer Wheat. Later wheat was grown throughout the northern belt of India. It was cultivated extensively after the Green Revolution (1960), when new, hybrids of wheat were introduced to India.

By 3000 BC, wheat had reached England and Scandinavia. A millennium later it reached China. The first identifiable bread wheat (*Triticum aestivum*) with sufficient gluten for

yeasted breads has been identified using DNA analysis in samples from a grainary dating to approximately 1350 BC at Assiros in Greek Macedonia.

Wheat (*Triticum* sp.) is a cereal grain originally from the Levant region of the near East and Ethiopian Highlands. It is now cultivated worldwide. In 2010 the world production of wheat was 65 million tons. It is the third most produced cereal after maize (844 million tons) and rice (672 million tons).

Wheat is the leading source of vegetable protein in human food, having higher protein content than other major cereals, maize and rice. The wheat crops are easily cultivated on large scale. Wheat contributed to the emergence of city states in the Fertile Crescent including Babylonian and Assyrian empires. It is a staple food used to prepare many items like bread, biscuit, cookies, cakes, breakfast, cereal, pasta, couscous, noodles. Fermentation is done to make beer, alcoholic beverages and bio-fuels.

It is a forage crop for live stock. Straw of wheat can be used as a construction material for roofing thatch. After removing bran and grain from the whole grain endosperm is milled to form white flour. Whole grain is source of vitamins, minerals and proteins. The refined grain has starch only.

➤ **Nutritional value per 100 gm is**

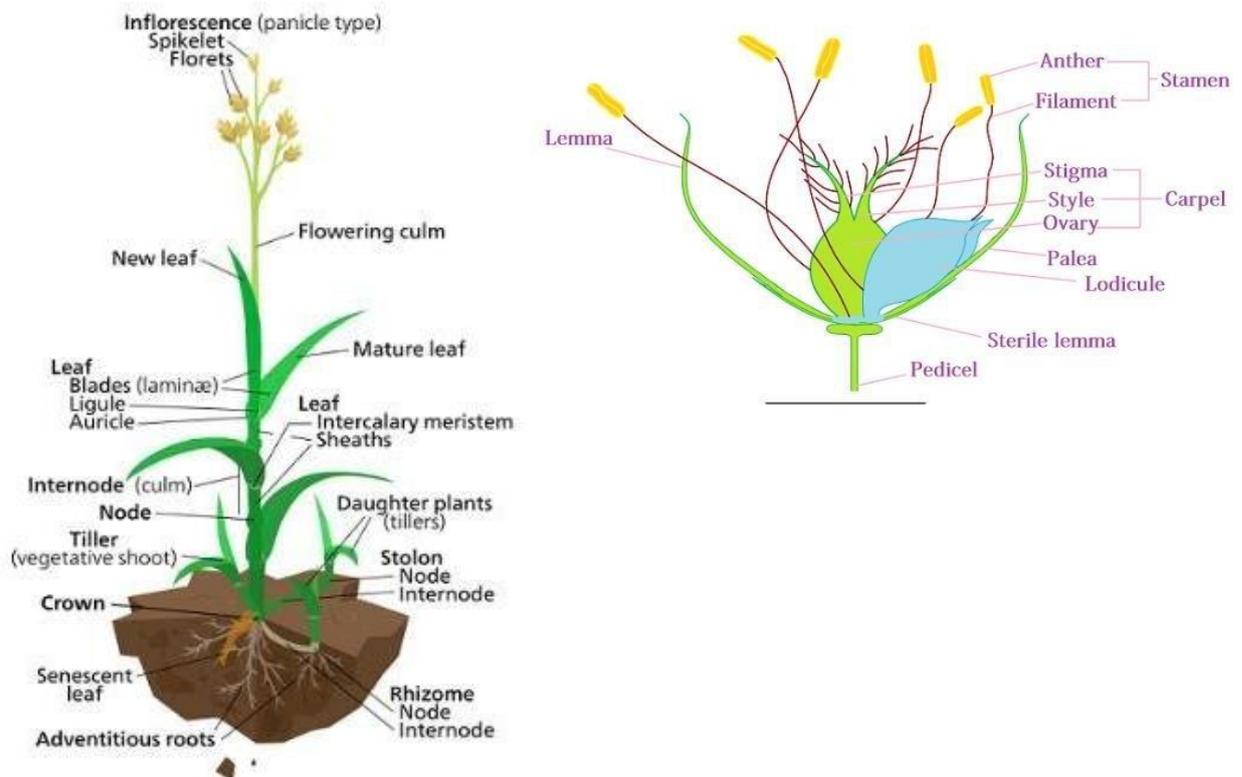
- **Energy** — 1,368 Kj (327 Kcal)
- **Carbohydrates** — 71.18 gm
- **Sugar** — 0.41
- **Dietary fibre** — 12.2 gm
- **Fat** — 1.54 gm
- **Proteins** — 12.61 gm

➤ **Vitamins and Minerals:**

- **Thiamine** (Vit B₁) — 0.383 mg (33%)
- **Riboflavin** (Vit B₂) — 0.115 mg (10%)
- **Niacin** (Vit B₃) — 5.464 mg (36%)
- **Pantothenic acid** (Vit B₅) — 0.954 mg (19%)
- **Vit. B₆** — 0.3 mg (23%)
- **Folate** (Vit B₉) — 38 mg (10%)

- **Vit. E** — 1.01 mg (7%)
- **Vit. K** — 1.9 mg (2%)
- **Calcium (Ca)** — 29 mg (3%)
- **Magnesium (Mg)** — 126 mg (35%)
- **Manganese (Mn)** — 3.985 mg (190%)
- **Phosphorus (P)** — 288 mg (41%)
- **Potassium (K)** — 363 mg (8%)
- **Sodium** — 2 mg (0%)
- **Zinc** — 2.65 mg (28%)

Morphology:



The botanical name for Wheat is *Triticum aestivum* from the family *Poaceae*. The wheat flower does not have petals or sepals. Each female flower consists of an ovary from which two styles emerge ending with two feathery stigmas each. The male flowers have three stamens that are generally gold or green in colour. Wheat generally self-pollinates. Each wheat flower is covered by an outer glume called lemma and an inner glume called palea. Lemma is larger than the palea. Three to five such flowers, attached alternately to opposite

sides of a central axis or rachilla and subtended by two empty scales, make up the spikelet. Each spikelet of wheat is also known as ear. The entire inflorescence, usually consisting of 15-25 spikelets is called a spike or a head of wheat. A grain of wheat is on average between 5-9mm in length and 30-50mg in weight.

The grain has a single cotyledon and when dissected can be divided into three main parts.

Bran:

The outer layer or the seed covering is called the wheat bran and protects the main part of the kernel. The bran comprises about 15 percent of the seed weight. Bran can be further divided into the pericarp which consists of epidermis, hypodermis, cross layer, tube cells, seed coats, and hyaline layer. The bran is a source of protein, large quantities of the three major B-vitamins, trace minerals, and dietary fibre.

Endosperm:

Endosperm is the main part of the seed and it accounts for 80 percent of the seed weight. It consists of starchy endosperm and endosperm cell. This layer contains the greatest share of protein, carbohydrates, and iron, as well as the major B-vitamins, such as riboflavin, niacin, and thiamine.

Germ (wheat germ):

The germ lies at one end of the seed and is a tiny part of the kernel. The germ is responsible for germination when planted in soil. It is a rich source of B-complex vitamins, oil, vitamin E and natural plant fat.

Ecology of Wheat

Variations in wheat strains have also enhanced the ability of wheat to grow globally in differing growing conditions. Modern wheat varieties are usually classified as winter wheat (fall-planted and unusually winter hardy for grain crops) and spring wheat, while ancient wheat such as spelt, emmer or farro are closely related to a wild grass species. Conditions necessary for a healthy yield of wheat include mild temperatures, nutritious soil, adequate water/ rainfall, and topography.

Temperature: Wheat requires cold, dry weather conditions. Temperatures around 15°C are the optimum levels for wheat growing season.

Water/rain: Wheat requires rainfall between 30-100 cm.

Soil: The soil quality suitable for wheat is either light clay or heavy loam.

Topography: Wheat is cultivated over plains and sometimes over rolling slopes.

Uses of Wheat

1. Wheat is used as food, feed, seed, and as a processed commodity for uses such as fuel.
2. Wheat contains a protein called gluten which is necessary for the basic structure in forming the dough system for bread, rolls and other baked goods.
3. Wheat is milled to produce flour which is used to make a variety of products around the world including bread across the world.
4. Many of the foods we consume on a daily basis such as bread, cookies, cakes, pies, pastries, cereals, crackers, pasta, flour tortillas and noodles are all made from wheat flour.
5. Wheat is used for cattle, poultry, and other livestock feed.
6. Wheat also forms the base for three extremely popular alcoholic drinks - whiskey, vodka, and beer.
7. Wheat has been substituted for corn and used to produce bioethanol in the UK and U.S.
8. Some strains of wheat are grown to produce starch in South Asia used in textile manufacturing.
9. Wheat straw is used to thatch houses as well as mattresses and pillows.
10. Wheat is also being used for plastics manufacturing and aquaculture feed purposes for both fish and shrimp.

LEGUMES

A legume is a plant in the family Fabaceae (or Leguminosae), or the fruit or seed of such a plant (also called a pulse, especially in the mature, dry condition). Legumes are grown agriculturally, primarily for human consumption, for livestock forage and silage, and as soil-enhancing green manure. Well known legumes include alfalfa, clover, beans, peas, chickpeas, lentils, lupins, mesquite, carob, soybeans, pea

uts, and tamarind. Legumes produce a botanically unique type of fruit – a simple dry fruit that develops from a simple carpel and usually dehisces (opens along a seam) on two sides.

Legumes are notable in that most of them have symbiotic nitrogen-fixing bacteria in structures called root nodules. For that reason, they play a key role in crop rotation.

Soya Beans

- Botanical name- Glycine max
- Classification-Kingdom: Plantae
 - Order: Fabales
 - Family: Fabaceae
 - Subfamily: Faboideae
 - Genus: Glycine
 - Species: G. max
- The soybean or soya bean is a species of legume native to East Asia, widely grown for its edible bean, which has numerous uses.
- Soybean is the largest oilseed crop, the main producers being the USA, Brazil, Argentina and China. The value of the crop is partly driven by the demand for soybean meal, which is the by-product of oil extraction, one of the major feed commodities and the main protein source in many animal diets.
- Optimal growth conditions are average day-temperatures around 30°C, 850 mm annual rainfall with not less than 500 mm water during the growing season, and soil pH ranging from 5.5 to 7.5 with good drainage. Soya is sensitive to soil acidity and aluminium toxicity. It can withstand short periods of both water logging and drought.
- Whole soybean seeds, usually called soybeans or full-fat soybeans to differentiate them from soybean meal, are also used for animal feeding.
- **Morphology-** Soybean pods generally contain one to three seeds each. There are large variations in seed shape, size and colour. Shape varies from almost spherical to flat and elongated. Seed size ranges from 5-11 mm and seed weight from 120-180 mg/seed. Soybean hulls may be yellow, green, brown or black, either all one colour or a pattern of two colours. Cotyledons are yellow or green, and the hilum may be black, brown, buff or light yellow.

- Soya beans grow in distinct morphological stages as they develop from seed into mature plant:
 1. **Germination** –The first stage of growth is germination, a method which first becomes apparent as a seed's radicle emerges. This is the first stage of root growth and occurs within the first 48 hours under ideal growing conditions. The first photosynthetic structures, the cotyledons, develop from the hypocotyls, the first plant structure to emerge from the soil. These cotyledons both act as leaves and as a source of nutrients for the immature plant, providing the seedling nutrition for its first 7 to 10 days.
 2. **Maturation-** The first true leaves develops as a pair of single blades. Subsequent to this first pair, mature nodes form compound leaves with three blades. Mature trifoliolate leaves, having three to four leaflets per leaf, are often between 6–15 cm (2.4–5.9 in) long and 2–7 cm (0.79–2.76 in) broad. Under ideal conditions, stem growth continues, producing new nodes every four days. Before flowering, roots can grow 1.9 cm (0.75 in) per day. If rhizobia are present, root nodulation begins by the time the third node appears. Nodulation typically continues for 8 weeks before the symbiotic infection process stabilizes. The final characteristics of a soybean plant are variable, with factors such as genetics, soil quality, and climate affecting its form; however, fully mature soybean plants are generally between 51–127 cm (20–50 in) in height and have rooting depths between 76–152 cm (30–60 in).
 3. **Flowering-** Flowering is triggered by day length. Soybeans form inconspicuous, self-fertile flowers which are borne in the axil of the leaf and are white, pink or purple. Depending of the soybean variety, node growth may cease once flowering begins. Strains that continue nodal development after flowering are termed "indeterminates" and are best suited to climates with longer growing seasons. Often soybeans drop their leaves before the seeds are fully mature. The fruit is a hairy pod that grows in clusters of three to five, each pod is 3–8 cm (1.2–3.1 in) long and usually contains two to four (rarely more) seeds 5–11 mm in diameter. Soybean seeds come in a wide variety of sizes and hull colours such as black, brown, yellow, and green. Variegated and bicoloured seed coats are also common

4. **Nitrogen fixation ability-** Like many legumes, soybeans can fix atmospheric nitrogen, due to the presence of symbiotic bacteria from the Rhizobia group.

- **Uses**

1. Soybeans are a globally important crop, providing oil and protein.
2. In the United States, the bulk of the harvest is solvent-extracted with hexane, and the "toasted" defatted soymeal (50% protein) then makes possible the raising of farm animals (e.g. chicken, hog, turkey) on a large industrial scale.
3. Soybean products are used in a large variety of processed foods. Such as make flour, milk, tofu and tofu-like products. They may be roasted and eaten as a snack, or fermented to make tempeh, miso, yuba and soy sauce. Soybeans are also used for animal feeding due to their high oil (20%) and protein content (40%).
4. They are the richest in protein of all the common seeds used for animal feeding.
5. Raw soybeans are usually processed in order to improve their nutritional value, either by removing anti-nutritional factors or by making the protein less degradable for ruminants.

Spices

- A **spice** is a seed, fruit, root, bark, or other plant substance primarily used for flavouring, colouring or preserving food.
- Spices are distinguished from herbs, which are the leaves, flowers, or stems of plants used for flavouring or as a garnish.
- Many spices have antimicrobial properties.
- Spices are sometimes used in medicine, religious, rituals, cosmetic and perfume production.
- Botanical basis- seeds such as fennel, mustard, black pepper; fruit such as cayenne pepper; Arils such as mace; Bark such as cinnamon, cassia; flower bud such as clove; stigma such as saffron; roots such as turmeric, ginger, galangal; resins such as asafoetida.

Black pepper (*Piper nigrum*)

Kingdom: Plantae

Order: Piperales

Family: Piperaceae

Genus: Piper

Species: *P. Nigrum*

- **Black pepper** (*Piper nigrum*) is a flowering vine in the family Piperaceae, cultivated for its fruit, known as a **peppercorn**, which is usually dried and used as a spice and seasoning.
- Peppercorns and the ground pepper derived from them may be described simply as *pepper*, or more precisely as *black pepper* (cooked and dried unripe fruit), *green pepper* (dried unripe fruit), or *white pepper* (ripe fruit seeds).
- Black pepper is cultivated in tropical region.
- Ground, dried and cooked peppercorns have been used since antiquity, both for flavour and as a traditional medicine.
- Black pepper is the world's most traded spice, and is one of the most common spices added to cuisines around the world.
- Its spiciness is due to the chemical compound piperine, which is a different kind of spicy from the capsaicin characteristic of chilli peppers.
- Morphology:
 - The pepper plant is a perennial woody vine growing up to 4 m (13 ft) in height on supporting trees, poles, or trellises.
 - It is a spreading vine, rooting readily where trailing stems touch the ground.
 - The leaves are alternate, entire, 5 to 10 cm long and 3 to 6 cm across.
 - The flowers are small, produced on pendulous spikes at the leaf nodes.
 - The plants bear fruit from the fourth or fifth year, and then typically for seven years.
 - A single stem bears 20 to 30 fruiting spikes.
 - The harvest begins as soon as one or two fruits at the base of the spikes begin to turn red, and before the fruit is fully mature, and still hard.

- The spikes are collected and spread out to dry in the sun, and then the peppercorns are stripped off the spikes.
- Processing: Black pepper is produced from the still-green, unripe drupe of the pepper plant. The drupes are cooked briefly in hot water, both to clean them and to prepare them for drying. The heat ruptures cell walls in the pepper, speeding the work of browning enzymes during drying. The drupes dry in the sun or by machine for several days, during which the pepper skin around the seed shrinks and darkens into a thin, wrinkled black layer. Once dry, the spice is called black peppercorn. On some estates, the berries are separated from the stem by hand and then sun-dried without the boiling process. Once the peppercorns are dried, pepper spirit and oil can be extracted from the berries by crushing them.
- Pepper spirit is used in many medicinal and beauty products. Pepper oil is also used as ayurvedic massage oil and in certain beauty and herbal treatments.

Clove (*Syzygium aromaticum*)

Kingdom: Plantae

Order: Myrtales

Family: Myrtaceae

Genus: *Syzygium*

Species: *S. aromaticum*

- Cloves are the aromatic flower buds of a tree in the family Myrtaceae.
- They are native to the Maluku Islands (or Moluccas) in Indonesia, and are commonly used as a spice.
- Cloves are available throughout the year due to different harvest seasons in different countries.
- The clove tree is an evergreen that grows up to 8–12 m tall, with large leaves and crimson flowers grouped in terminal clusters.
- The flower buds initially have a pale hue, gradually turn green, and then transition to a bright red when ready for harvest.

- Cloves are harvested at 1.5–2 cm long, and consist of a long calyx that terminates in four spreading sepals, and four unopened petals that form a small central ball.
- Chemical compound: Eugenol composes 72–90% of the essential oil extracted from cloves, and is the compound most responsible for clove aroma. Complete extraction occurs at 80 minutes in pressurized water at 125 °C (257 °F). Other important essential oil constituents of clove oil include acetyl eugenol, beta-caryophyllene, vanillin, crategolic acid, tannins such as bicornin, gallotannic acid, methyl salicylate (painkiller), the flavonoids eugenin, kaempferol, rhamnetin, and eugenitin, triterpenoids such as oleanolic acid, stigmasterol, and campesterol and several sesquiterpenes. Eugenol has not been classified for its potential toxicity.

USES:

- Cloves may be used to give aromatic and flavour qualities to hot beverages, often combined with other ingredients such as lemon and sugar.
- The spice may be used as an ant repellent because the bioactive chemicals of clove.
- The spice is used in a type of cigarette called *kretak* in Indonesia.
- Cloves can be used to make a fragrant pomander when combined with an orange.
- The spice used as tradition medicine, clove oil containing eugenol is effective for toothache pain and other types of pain.
- The clove oil is used in aromatherapy.