EXERCISES

FREQUENTLY ASKED QUESTIONS:

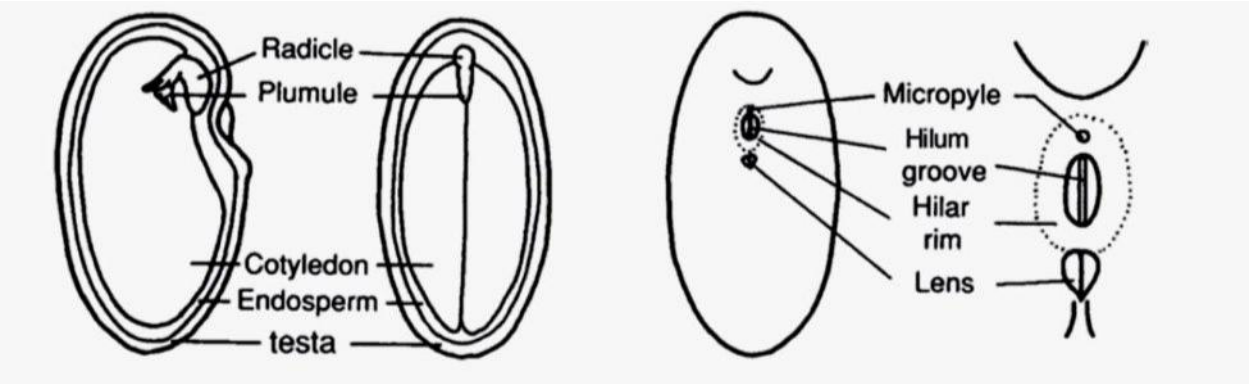
Q no.1. Define the term legume?

Ans 1. A legume is a plant that produces seeds in a pod (fruit). The physical shape of the seed helps distinguish beans from peas and lentils. Usually, beans are kidney-shaped or oval, peas are round, and lentils are flat disks. Most dry beans grown belong to the species Phaseolus vulgaris, or common bean.

Q no.2. Briefly describe the identifying characteristics of legumes.

Ans 2. Plants in the Leguminosae family have characteristic leaves and pods that help identify them as legumes. The leaves are usually alternate and compound. They may be pinnate or trifoliate. All legumes have similar fruits, called pods. Within the Leguminosae, particular subfamilies and species can only be distinguished reliably by an examination of their flowers.

Q no.3. Explain the structure of a legume seed with an aid of a labelled diagram.



Ans 3. The structure of a legume seed consists of three major parts: seed coat (testa or hull), the cotyledons, and hypocotyl (including plumule). The cotyledons constitute about 90% of the seed. However, most of the legume seeds have very little endosperm at maturity, as the cotyledons of the embryo make up a majority of the seed weight and contain the necessary stores for growth. The cotyledons are part of the embryo and are not therefore analogous to the endosperm of cereals. Although, legume seeds have an endosperm at an early stage of development, but in the mature seed it is vestigial, and the reserves for the early growth of the seedling are stored in the cotyledons. Cotyledons provide a majority of the nutritional components to food value, with the exception of fiber and calcium, of which a significant portion is found in seed coat. The seed coat is the next largest fraction, but because of high fiber content, it contains an insignificant part of the total food value of the whole seed. Outer layers of the seed coat are also known to contain tannins. The compositions of the hull and cotyledon are different, as would be expected. It has been therefore demonstrated that the cotyledons account for most of the food value of the whole seed. The seed coat contains very little nutrient material.

Q no.4. Write a short note on chemical composition of legume.

Ans 4. Legume seeds are characterized by the high nutritious and energy values. In contrast to many other vegetables they are rich in proteins that constitute approximately 20–35%, or even 42% of solid substance. Dry pulses are characterized by the high protein content of approximately 200-250g protein/kg raw material, which is decreased after cooking to approximately 70-100g/kg cooked seeds. The latter is comparable to the protein content in bread (80-90g/kg). For comparison, potatoes contain only 15-22g protein/kg. Proteins contained in pulses are characterized by low levels of tryptophan and sulfur amino acids that reduce their nutritious value. Whereas principal components of dry pulses are carbohydrates that account for approximately 60% solid substance. An exception are soybean grains that in contrast to the other legumes are rich in lipids (approximately 18% dry mass), containing high levels of unsaturated fatty acids and lecithin. Grains of leguminous plants are also rich in minerals, mainly phosphorus, potassium, calcium, magnesium, iron, zinc, copper and manganese, although their availability is reduced by the dietary fiber and phytates. These grains are also an important source of group B vitamins. Pulses are also a source of dietary fiber that encompasses these polymers of plant cell walls, which escape digestion in the gastrointestinal tract. The dietary fiber is necessary for function of the latter. It includes polysaccharides such as cellulose, hemicelluloses, pectins, plant gums, mucus substances, and resistant starch as well as lignin, which is not a polysaccharide.

Q no.5. What is the impact of moisture content on the storage stability of legume seeds?

Ans 5. The moisture content of the legume seed has a major impact on how long it remain in storage as nutritious and edible. Seeds with a moisture content as high as 13% can be safely stored, but there is a risk to keep it at that level. The problem lies in that some fungal species are able to grow and reproduce at moisture levels between 13.5% to 15%. Seeds with moisture content as high as 13% you are perilously close to having enough moisture to enable mold growth which could lead to the spoilage and loss of your product. For this reason, storing legumes to a moisture content of no more than 10% is suggested. An exception to this is raw peanuts which are particularly susceptible to an Aspergillus mold growth that produces aflatoxin (a type of mycotoxin) and should be stored with 8% moisture content or less.

Q no.6. Why are soybeans considered unique in comparison to other legumes?

Ans 6. Soyabeans are considered unique with respect to their high fat and protein content as compared to other legume seeds. Furthermore, they also contain isoflavones i.e. bioactive compounds. Such nutritional characteristics imaprts unique characteristics to them.

Q no.7. Explain nutritional significance of legumes.

Ans 7. Legume seeds (also called pulses or grain legumes) are second only to cereals as asource of human and animal food. When legumes and cereals are eaten

together, they provide complete protein nutrition. Nutritionally, legume seeds are two to three times richer in protein than cereal grains. Some legumes, such as soybeans and peanuts, are also rich in oil. Kidney beans and other legumes are a major source of food in Latin America, while lentils, pigeon peas, and chickpeas are important in South Asia. In the Middle East and North Africa, faba beans, lentils, and chickpeas are particularly important. Common food products made from legumes include tofu, peanut butter, and soymilk.

Q no.8. Expalin nutritional significance of legume lipids

Ans 8. Seeds of legumes contain relatively low amounts of fat with an exception of soybean. Legume lipids (mainly di- and triacylglycerols and free fatty acids) are rich in polyunsaturated fatty acids. The latter reduce levels of LDL-cholesterol and the risk of cardiovascular diseases including atherosclerosis. Neither n-3 nor n-6 polyunsaturated fatty acids are synthesized by human organism and must be contained in the diet. Most abundant unsaturated fatty acids of pulses is linoleic acids that is necessary for an organism to function, for growth and health.

Q no.9. What are the anti-nutritional substances found in legumes?

Ans 9. Apart from the nutrients present, pulses contain certain anti-nutritional substances that impair digestion processes. The anti-nutritional compounds of pulses fall into two categories such as proteins or other compounds. Some of them are relatively more harmlful such as inhibitors of proteases. The category of non-protein anti-nutritional substances includes: alkaloids, phytic acid, phenolics such as tannins and saponins, and oligosaccharides. The protein anti-nutritional compounds that are commonly encountered in pulses are represented by

lectins or agglutinins, trypsin inhibitor, chymotrypsin inhibitor, and anti-fungal peptides.

Q no.10. What are trypsin inhibitors?

Ans 10. Trypsin inhibitors are low molecular weight peptides (4,000-20,000 Da) that are soluble in water. Usually they are isomers of one peptide. Trypsin inhibitors contained in the diet irreversibly inactivate trypsin in the small intestine that reduces protein digestion. They also cause the hypertrophy of pancreas. Levels of trypsin inhibitor (expressed in trypsin inhibitor units - TIU) are species-dependent. They are the highest in soybean seeds (43-84 TIU/mg protein), lower in chickpea seeds (15-19 TIU/mg protein) and pea (6-15 TIU/mg protein), and the lowest in lentil and Faba bean (3-8 TIU/mg protein and 5-10 TIU/mg protein), respectively.

Q no. 11. What do you mean by seed storage proteins?

Ans 11. Legume seeds contain large amounts of proteins, mostly with a storage role, ranging from about 16 % (dry weight) in cowpea, pigeon pea and chickpea to as much as about 50 % in lupin and soybean. Storage proteins are synthesized during seed development, stored in specific subcellular compartments, the storage vacuoles or protein bodies and then hydrolyzed during germination to provide nitrogen and carbon skeletons for the developing seedling. The storage proteins of legume seeds are oligomeric globulins and albumins, which usually account for about 70 and 20 % of the total protein, respectively.

Q no.12. Explain the major seed storage protein from a structural view point?

Ans 12. The major storage proteins of legume seeds are oligomeric globulins which usually account for about 70% of the total protein. Globulins are classified as 7S and 11S proteins, according to their sedimentation coefficients (S), and are collectively named vicilins and legumins, respectively. Legumins are compact hexamers of about 350– 400 kDa, and each monomer is made up of two disulphide-bonded subunits derived from posttranslational proteolysis of a single precursor polypeptide. Vicilins are typically trimeric proteins of 150–190 kDa that lack cysteine residues and hence cannot form disulphide bonds. Their subunit compositions vary considerably, mainly because of differences in the extent of posttranslational processing (proteolysis and glycosylation). Vicilins can be divided into two groups: In the first one, the precursor polypeptides are extensively fragmented to give rise to mature subunits in the range of 12–34 kDa. Conversely, the precursor polypeptides belonging to the second group undergo little or no posttranslational cleavage, and mature polypeptides are about 40–76 kDa. Although legumins and vicilins are both present in most legumes, their relative abundance is highly variable, and some species are virtually devoid of either one or the other. Vicilins are usually less abundant then legumins.

Albumins account for 20% of the total storage proteins in legume seeds. They are the second most abundant class of legume storage proteins and are water-soluble proteins comprising mostly of the bioactive polypeptides, such as lectins, protease inhibitors and αAI. The abundance of these bioactive molecules is quite variable in different legumes. Lectins are widespread in many legume seeds, while αAI activity has been detected only in few legume species.

Q no. 13. Give a brief about the amino acid profile of legumes.

Ans 13. From a nutritional point of view, the amino acid profile of legume storage proteins reveals low amounts of the essential sulphur-containing amino acids (i.e. methionine and cysteine) and tryptophan, while lysine, another essential amino acid is quite abundant. Legume proteins complement very well those of cereals, which are normally rich in sulphur amino acids and poor in lysine and threonine.

Q no. 14. Explain legumes as a source of carbohydrates.

Ans 14. The major component of the legume seed is the carbohydrate fraction which usually comprises about 70% of the seed by weight. Starch is the principal carbohydrate, with minor amounts of the smaller molecular weight carbohydrates such as sucrose and sucrosyl oligosaccharides. The oligosaccharides include raffinose, stachyose and verbascose which are present in varying amounts in most legume seeds.

Q no. 15. Give the traditional method of detoxifiying legumes against anti nutritional factors.

Ans 15. Traditional methods for domestic preparation of legumes have largely overcome the problem of toxicity. Legumes when cooked until soft are safe to eat with moist heat at 100°C should have penetrated right through the grain.