FAQs

Qno. 1: What are the main sources of starch?

Ans 1: Starch is widely distributed in various plant organs as a storage carbohydrate. Starch is isolated mainly from the sources such as corn, potato, rice, wheat, sweet potato, lotus root etc. Recently, starches have also been obtained from legumes (peas, lentils).

Qno. 2: How is starch isolated?

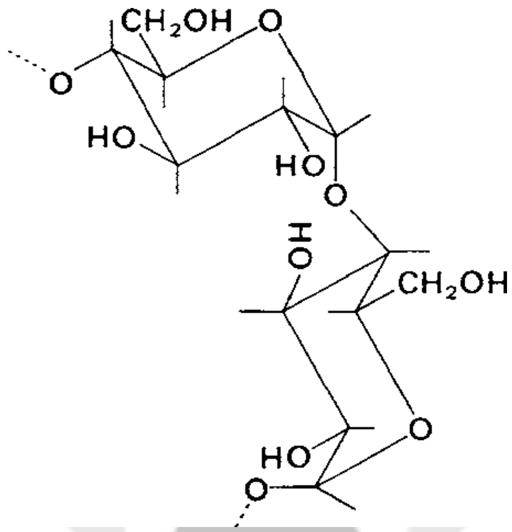
Ans 2: The process of starch isolation varies depending upon the source employed. In some cases, e.g., potato tubers, starch granules occur free, deposited in cell vacuoles; hence, their isolation is relatively simple. The plant material is disintegrated, the starch granules are washed out with water, and then sedimented from the “starch milk” suspension and dried. In other cases, such as cereals, the starch is embedded in the endosperm protein matrix; hence, granule isolation is a more demanding process. Thus, a counter-current process with water at 50 ◦C for 36–48 h is required to soften corn (steeping step of processing). The steeping water contains 0.2% SO_2 in order to loosen the protein matrix and, thereby, to accelerate the granule release and increase the starch yield. The corn grain is then disintegrated. The germ has a low density and is readily separated by flotation. The protein and starch are then separated in hydrocyclones. The separation is based on density difference (protein < starch). The recovered starch is washed and dried. In the case of wheat flour, dough is made first, from which a raw starch suspension is washed out. After separation of fiber particles from this suspension, the starch is fractionated by centrifugation. In addition to the relatively pure primary starch, a finer grained secondary starch is obtained which contains pentosans. The starch is then dried and further classified.

Qno. 3: Name the principal components of starch.

Ans 3: Starch is composed of two basic molecular components: amylose and amylopectin. These are identical in their constituent basic units (glucose), but differ in their structural organization (linkages). These variations in the linkages in turn affect their functionality in food applications.

Qno. 4: Briefly describe the structure and properties of amylose.

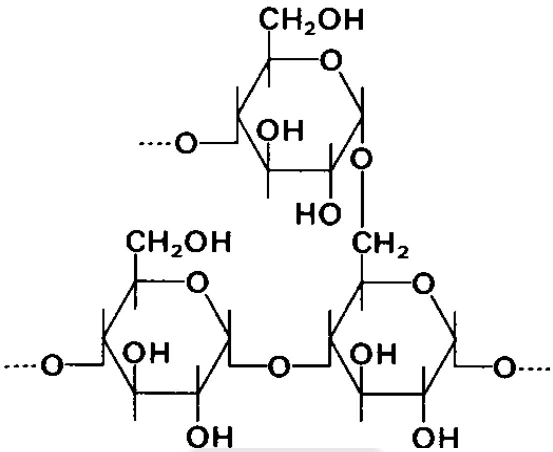
Ans 4: Amylose is a straight chain polymer of α-D-glucopyranosyl residues linked 1→4:



The molecular size of amylose is variable. The polymerization degree in wheat starch lies between 500 and 6000, while in potatoes it can rise up to 4500. This corresponds to a molecular weight of 150–750 kdal. Amylose is the key component involved in water absorption, swelling, and gelation of starch in food processing. High amylose starches are therefore most commonly applied in food products that require quick-setting gels such as candies and confectionery. Amylose is more susceptible to gelatinization and retrogradation, and hence is most commonly involved in resistant starch formation.

Qno. 5: Give a brief description of amylopectin and its properties.

Ans 5: Amylopectin is a branched glucan with side chains attached in the 6-position of the glucose residues of the principal chain (Fig). An average of 20–60 glucose residues are present in short chain branches and each of these branch chains is joined by linkage of C-1 to C-6 of the next chain. The main portion of a starch granule's crystalline structure is apparently derived from amylopectin. The degree of polymerization of amylopectin (wheat) lies in the range of 3×10^5–3×10^6 glucose units, which corresponds to a molecular mass of 5×10^7–5×10^8.



Amylopectin, when heated in water, forms a transparent, highly viscous solution, which is ropy, sticky, and coherent. Unlike with amylose, there is no tendency toward retrogradation. There are no staling or aging phenomena and no gelling, except at very high concentrations. High amylopectin starches (waxy starches) are therefore commonly used in noodle processing and in some baked products to extend shelf-life. However, there is a rapid viscosity drop in acidic media and on autoclaving or applying stronger mechanical shear force.

Qno. 6: What are the various uses of starch?

Ans 6: Starch is an important thickening and binding agent and is used extensively in the production of puddings, soups, sauces, salad dressings, diet food preparations for infants, pastry filling, mayonnaise, etc. Corn starch is the main food starch and an important raw material for the isolation of starch syrup and glucose. Amylose films can be used for food packaging, as edible wrapping or tubing, as exemplified by a variety of instant coffee or tea products. Amylopectin utilization is also diversified. It is used to a large extent as a thickener or stabilizer and as an adhesive or binding agent.

Qno. 7: Write a short note on the types of starches.

Ans 7: Two main types of starch are generally identified: Resistant starch and modified starches. Starch and its degradation products which are not absorbed in the small intestine are called resistant starch (RS). RS can, however, be metabolized by the bacteria of the colon. Starch properties and those of amylose and amylopectin can be improved or “tailored” by physical and chemical methods to fit or adjust the properties to a particular application or food product. The starch thus obtained is known as modified starch.

Qno. 8: What is mechanically damaged starch?

Ans 8: When starch granules are damaged by grinding or by application of pressure at various water contents, the amorphous portion is increased, resulting in improved dispersibility and swellability in cold water, a decrease in the gelatinization temperature by 5–10°C, and an increase in enzymatic

vulnerability. In bread dough made from flour containing damaged starch, for instance, the uptake of water is faster and higher and amylose degradation greater.

Qno. 9: What is oxidized starch?

Ans 9: Starch hydrolysis and oxidation occur when aqueous starch suspensions are treated with sodium hypochlorite at a temperature below the starch gelatinization temperature range. The products obtained have an average of one carboxyl group per 25–50 glucose residues. Oxidized starch is used as a lower-viscosity filler for salad dressings and mayonnaise. Unlike thin boiling starch, oxidized starch does not retrograde nor does it set to an opaque gel.

Qno. 10: What is gelatinization?

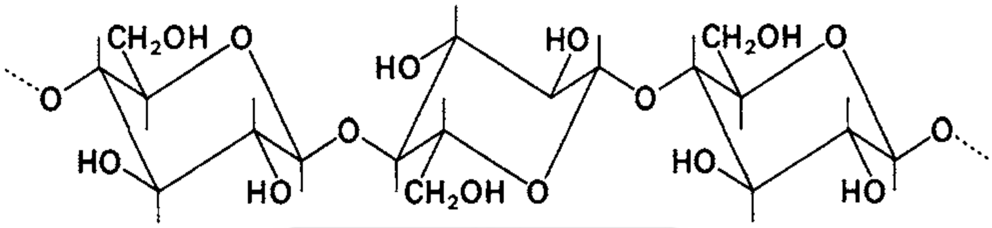
Ans 10: When starch is suspended in cold water, the starch granules swell and show an increase in the diameter. Further heating leads to certain irreversible changes in the starch suspension. The viscosity of the starch suspension increases steeply as the starch granules absorb 20-40 g of water/g of starch. This process is known as gelatinization. In gelatinization, water first diffuses into the granule, crystalline regions then melt with the help of hydration, and, finally, swelling gives rise to a solution through further diffusion of water. In this process, hydrogen bridges between glucose chains in the crystallites are primarily disrupted and perhaps some of those in the amorphous regions as well.

Qno. 11: Define cellulose.

Ans 11: Cellulose is the main constituent of plant cell walls, where it usually occurs together with hemicelluloses, pectin and lignin. Since cellulase enzymes are absent in the human digestive tract, cellulose, together with some other inert polysaccharides, constitute the indigestible carbohydrate of plant food (vegetables, fruits or cereals), referred to as dietary fiber.

Qno. 12: Describe the structure of cellulose.

Ans 12: Cellulose consists of β-glucopyranosyl residues joined by 1→4 linkages.



Cellulose crystallizes as monoclinic, rod-like crystals. The chains are oriented parallel to the fiber direction and form the long b-axis of the unit cell. The crystalline sections of cellulose comprise an average of 60% of native cellulose. These sections are interrupted by amorphous gel regions, which can become crystalline when moisture is removed. The acid- or alkali-labile bonds also apparently occur in these regions.

Qno. 13: What are the uses of cellulose?

Ans 13: Microcrystalline cellulose is used in low-calorie food products and in salad dressings, desserts and ice creams. Its hydration capacity and dispersibility are substantially enhanced by adding it in combination with small amounts of carboxymethyl cellulose.

Qno. 14: Name different derivatives of cellulose.

Ans 14: Cellulose can be alkylated into a number of derivatives with good swelling properties and improved solubility. Such derivatives include Alkyl cellulose, Hydroxyalkyl cellulose, and Carboxymethyl Cellulose.

Qno. 15. What is Carboxymethyl cellulose?

Ans 15: Carboxymethyl cellulose is obtained by treating alkaline cellulose with chloroacetic acid. Carboxymethyl cellulose is an inert binding and thickening agent used to adjust or improve the texture of many food products, such as jellies, paste fillings, spreadable process cheeses, salad dressings and cake fillings and icings. It retards ice crystal formation in ice

cream, stabilizing the smooth and soft texture.