Lecture 2
Food composition and chemistry
Carbohydrates

Reducing Disaccharides

• Maltose – present in malt, typically found in cereal grains (barley, jowar, ragi). Formed by two glucose residues are joined by glycosidic linkage between C1 of one glucose residue and C4 of the other residue. It is hydrolyzed by maltase.

• Lactose (milk sugar) – occurs in milk of all mammals but not found in food grains.

Lactose= Glucose + Galactose Presence of enzyme lactase

. • Sucrose (cane sugar, beet sugar) - occurs in sugarcane (10-12%).

Glucose + Fructose= Sucrose (by elimination of water).

Sucrose + H20 ---Sucrase/dilute Hcl-----> glucose + fructose

Polysaccharides

• Most of the carbohydrates in nature occur as polysaccharides

• Composed of large number of monosaccharide units combined to form one large molecule (polymer) • Consist of a primary chain of one or two types of monosaccharide units and side chains/branches with different types of glycosidic linkages

• Polysaccharides serve plants and animals: – Provide structural material – cellulose, hemicellulose and pectic (cell walls, fibers, seed coat). – Provide food reserves in animals (glycogen in animals, starch in plants) Polysaccharide – starch

• Sources of starch are cereals and millets (65 – 85%), roots and tubers (19-35%)

• Occurs in the form of granules (quasicrystalline) macromolecular aggregates

• Starch is a polysaccharide formed by the condensation of large number (4000 – 15000) glucose molecules

• Consists of a mixture of two components amylose and amylopectin – One molecule of amylose consists of 500 to 5000 glucose units and gives blue colour with iodine – One molecule of amylopectin contains 50000 to 500000 units and produces a purple to red colour with iodine Properties of Starch

• Primary food reserve polysaccharide in the plant kingdom

• Starch is a white, tasteless powder insoluble in cold water

• Occurs as granules in the cytoplasm of the cells that usually remain intact during processing

• On boiling in water forms a paste that sets to a jelly (gelatinization) on cooling

Other Polysaccharides

• Dextrin – products of the partial breakdown of starches – Intermediate in size and properties between starches and sugars (toasting of bread converts part of starch to dextrin)

• Glycogen – storage polysaccharide in animals – Primarily present in the liver and skeletal muscle – Branched -chain polysaccharide resembling amylopectin

• Cellulose – Makes up more than 25% of cell walls in higher plants and is found embedded in an amorphous gel composed of hemicellulose and pectic substances ctin Cellulose–Make s u p more than – Composed of long chains of glucose residues – Fibrous polysaccharide that does not dissolve in water – Acts as a roughage and broken down by microbial enzymes to glucose.

• Hemicelluloses – dietary fiber that is insoluble in water but soluble in alkali – Predominantly composed of pentoses (xylose) – Helps bind together closely packed cellulose microfilaments.

Pectin substances – occur as constituents of plant cell walls and in the middle lamella (serve as cementing material to hold cells together) Mixture of polysaccharides formed from galactose, arabinose, and galacturonic acid – Insoluble pectic substance that occurs in plants is protopectin – This decreases during ripening in fruits and soluble pectin increases • Gums – hydrophilic substances that give a viscous solution when treated with hot or cold water – Added to improve the texture, water retention, and rehydration of many dehydrated foods – Function as thickeners for gravies, sauces, emulsion stabilizers in salad dressings.

Functions of Carbohydrates

• Energy fuel for body activities

• Essential for the oxidation of fats

• Provide the carbon skeleton for the synthesis of some non-essential aminoacids and some are present in some tissue constituents

• Add flavor to the diet • Breakdown of carbohydrates are glucose, fructose, and galactose (absorbed in the intestines)

• Non-digestible carbohydrates (celluloses, hemicellulose, pentosans) add bulk to the contents of large intestine and some are fermented by bacteria in large intestines Regulation of Blood Sugar

• In the fasting state, blood of normal person contains about 80-100 mg of glucose/100 ml

• After a meal, the glucose level steadily increases and may a reach a level of 130-150 mg/100ml • If blood sugar level reaches above 180 mg/100 ml, glucose is excreted in urine – this condition is known as Diabetes Mellitus – Chronic disease which is primarily caused by the insufficient production of the hormone insulin by the pancreas – Other factors such as diet rich in carbohydrates, high thyroxine, lowered insulin, and muscular exercise also contribute to the increase in sugar levels.