Vegetables and fruits

Definitions of vegetables and fruits

- Vegetables :A **vegetable is** the edible portion of a plant. **Vegetables** are usually grouped according to the portion of the plant that is eaten such as leaves (lettuce), stem (celery), roots (carrot), tubers (potato), bulbs (onion) and flowers (broccoli).
- Fruits :the sweet and fleshy product of a tree or other plant that contains seed and can be eaten as food

Starches in vegetables and fruits

- Starch is an insoluble, non-structural carbohydrate composed of α-glucose polymers. It is synthesized by plants and algae to store energy in a dense, osmotically inert form. Starch has significant value for humans: it serves as the main carbohydrate source in an equilibrated diet and as a renewable raw material for industry.

Based on its biological functions, starch is often categorized into two types: transitory starch and storage starch.

- The starch which is synthesized in the leaves directly from photosynthates during the day is typically defined as transitory starch.
- The starch in non-photosynthetic tissues, such as seeds, stems, roots or tubers, is generally stored for longer periods and regarded as storage starch.

There are three different types of starches:

- Slowly digested starch
- Rapidly digested starch
- Resistant starch

Description of starches

- Slowly digested starches
- Amylose contains 500 to 20,000 molecules of glucose connected together in a straight chain. The chain twists into a helix and then two chains bond together, forming a structure that resists the digestive enzymes trying to break the glucose molecules apart. As a result, amylose is slowly digested and absorbed, which is why it's called a slowly digestible starch. Amylose can help keep your blood sugar balanced because it does not cause a large spike in blood sugar levels

- Rapidly digested starches
- Amylopectin is significantly larger than amylose, with a structure made up of millions of glucose molecules that branch out and form a crystalline structure. Its glucose units are easily cleaved during digestion, which makes it a rapidly digestible starch. Amylopectin can boost your blood sugar temporarily, but it is followed by a hunger-producing drop in blood sugar.

- Resistant starches
- The third type of starch -- resistant starch -- is not digested, but it is fermented by bacteria in your colon. The fermentation of starch produces short chain fatty acids that provide energy for cells in your large intestine. There are several types of resistant starches. The first type, which is found in beans, seeds, whole grains or partially milled grains, is protected from digestion because it is inside cell walls. The second type contains high amounts of amylose, which are naturally resistant. This type comes from potatoes, corn and starchy fruits such as bananas. The third type, found in bread, potatoes and rice, becomes more resistant after it's cooked and cooled.

- Starch sources
- The top sources of total starch are grains, beans and starchy vegetables such as potatoes, corn and peas. You'll also get a smaller amount from nuts, seeds, non-starchy vegetables and fruits. Some starches are extracted from corn or other plants and chemically modified to make them more resistant to digestion. They form a fourth group of resistant starches.

Protopectin

- Immature fruits contain the precursor substance protopectin, which is converted to pectin and becomes more water-soluble as ripening proceeds. At this stage the pectin helps ripening fruits to remain firm and retain their shape. As a fruit becomes overripe, the pectin in it is broken down to simple sugars that are completely water-soluble. As a result, the overripe fruit becomes soft and begins to lose its shape.

Pectinic acids

- **Pectic acid**, also known as **polygalacturonic acid**, is a water-insoluble, transparent gelatinous acid existing in over-ripe fruit and some vegetables. It is a product of pectin degradation in plants, and is produced via the interaction between pectinase and pectin (the latter being common in the wine-making industry.) In the early stage of development of fruits, the pectic substance is a water-insoluble protopectin which is converted into pectin by the enzyme protopectinase during ripening of fruit.

INTRODUCTION: WHAT ARE PIGMENTS ?

- Produced by living organisms.
- Have a colour resulting from selective colour absorption.
- Include “Plant pigments” and “Flower pigments.”
- Biological structures such as Skin, Eyes, Fur ,Hair contain “melanin” pigment in specialized cells called “chromatophores”.

PIGMENTS IN PLANTS

- The Principal pigments in plants are–
- Chlorophyll
- Carotenoids
- Xanthophylls
- Anthocyanins
- Betalins

PRIMARY FUNCTION OF PIGMENTS IN PLANTS

- Primary Function : Photosynthesis
- Uses green pigment chlorophyll along with several red and yellow pigments.
- Help to capture as much light as possible.
- Other functions include attracting insects to flowers to encourage pollination.

Chlorophyll

- Primary pigment in plant.
- Chlorin absorbs yellow and blue wavelengths.
- Reflecting green.
- Chlorophyll serve as fuel to photosynthesis.
- Synthesized from succinyl-CoA and Glycine.
- Immediate precursor to Chlorophyll A and B is protochlorophyllide.
- Contains hydrophobic phytol chain embedded in lipid membrane.
- Rest structure is tetrapyrrolic ring.

Carotenoids

- Red, orange or yellow pigments.
- Function as accessory pigments in plants.
- Absorb wavelength not readily absorbed by chlotophyll.
- Ex: Carotene (Found in Carrots)
- Lutein (Yellow pigment found in fruits and vegetables).
- Lycopene (Red pigment in tomatoes)

Anthocyanins

- · Literally "Flower blue"
- Water soluble flavanoid pigments
- Colour appear as red to blue, acc to pH.
- Occur in all tissues of higher plants but colour not noticeable.
- Have purple colour and are present in: vegetables (onions, cabbage, potatoes), red, blue & purple berries, black beans

BETALINS

- Red or yellow pigments.
- Water soluble.
- Synthesized from tyrosine.
- Never co-occur in plants having anthocyanins.
- Occur in: beets (red and yellow), chard, spinach, fruit of prickly-pear cactus

XANTHOPHYLLS

- Fourth common class of pigments
- Essentially oxidized carotenes
- Usually red and yellow
- Do not absorb energy as well as carotenoids

PLANT ENZYMES AND USES.

- The type (protein, sugar, starch, fat) and amount (caloric value) of the major components present in the food determine the type and amount of the various enzymes found in the food. For example, olives and bananas are higher in fat and lipase, while peaches are higher in carbohydrate and amylase.
- Protein, carbohydrates, fat, and fiber are building blocks but they do not possess the energy (capacity to do work) necessary for biochemical reactions. Only enzymes can furnish this energy. When raw food is eaten, chewing ruptures the cell membrane and releases the indigenous food enzymes. Once liberated the enzymes begin to digest food, but their action is very limited in the foods they can work on.

Four plant enzyme groups exist:

- Proteases
- Amylases
- Lipases
- Cellulases

- Proteases – break long protein chains into smaller amino acid chains and eventually into single amino acids
- Amylases – reduce polysaccharides to disaccharides: lactose, maltose, and sucrose
- Lipases – break triglycerides into individual fatty acids and glycerol
- Cellulases – digest specific carbohydrate bonds found in fiber

BROWNING REACTION

Browning is the process of food turning brown due to the chemical reactions that take place within. Though there are many different ways food chemically changes over time, browning in particular falls into 2 main categories: enzymatic versus non-enzymatic browning processes.

Enzymatic browning

Enzymatic browning is one of the most important reactions that takes place in most fruits and vegetables as well as in seafood. These processes affect the taste, color, and value of such foods. Enzymatic browning (also called oxidation of foods) requires exposure to oxygen. It begins with the oxidation of phenols by polyphenol oxidase into quinones, whose strong electrophilic state causes high susceptibility to a nucleophilic attack from other proteins. These quinones are then polymerized in a series of reactions, eventually resulting in the formation of brown pigments (melanosis) on the surface of the food. The rate of enzymatic browning is reflected by the amount of active polyphenol oxidases present in the food. Hence most research investigating methods to inhibit enzymatic browning has focused on hindering polyphenol oxidase activity. However, not all browning of food produces negative effects.

Examples of beneficial enzymatic browning:

- Developing color and flavor in Coffee, Cocoa beans, and tea.
- Developing color and flavor in dried fruit such as figs and raisins.

Examples of non-beneficial enzymatic browning:

- Fresh fruit and vegetables, including apples, potatoes, bananas and avocados.
- Polyphenols oxidases is the major reaction in the formation of Melanosis in crustaceans such as shrimp.

Non enymatic browning

Non-enzymatic browning involves a set of chemical reactions that take place during the preparation or storage of foods. It is responsible for the formation of brown compounds, which are volatile flavor molecules that affect the sensory quality of foods. Non-enzymatic browning is often associated with the Maillard reaction. However, a number of other chemical reactions that do not fall within the definition of the Maillard reaction are involved in non-enzymatic browning.

Effect of cooking on pigment, texture of fruits and vegetables

- Certain vegetable pigments change color when cooked. Heat alone will cause changes to occur for each of the vegetable pigments. However, the addition of an acid or base will cause different reactions, or changes to occur for each of these pigments.
- When heated, the red anthocyanin pigment in red cabbage will irreversibly break down however the addition of the base may affect quality (e.g. mushy texture).