ISSN : 2350-0743

www.ijramr.com

International Journal of Recent Advances in Multidisciplinary Research

Vol. 05, Issue 08, pp.4012-4015, August, 2018

RESEARCH ARTICLE

VARIOUS ASPECTS OF CARBOHYDRATES: AN OVERVIEW

[1*]Manoj Kumar, [2]Radha Rani and [3]Suresh Kumar

[1,2]Department of Pharmaceutical Sciences, Guru Jambheshwar University of Science and Technology, Post Box: 38, Hisar-125001, India

[3]Laureate Institute of Pharmacy, Kathog, Kangra (Himachal Pradesh)

ARTICLE INFO

Article History:

Received 07[th] May, 2018

Received in revised form 22[nd] June, 2018

Accepted 17[th] July, 2018

Published online 30[th] August, 2018

Keywords:

Carbohydrates,
Monosaccharides,
Disaccharides, Polysaccharides.

ABSTRACT

Carbohydrates are the biomolecules consisting of carbon (C), hydrogen (H) and oxygen (O) atoms which are major source of energy in the body. Brain and Red blood cell mainly utilizes the glucose. The storage form of glucose is glycogen which is stored in skeletal muscles and liver. The stored glycogen is converted into glucose and is used by body in a condition when there is low level of glucose in the body. In this review article, the author tries to cover various aspects of carbohydrates which may be helpful for the readers and researchers in research.

INTRODUCTION

Carbohydrates are the biomolecules consisting of carbon (C), hydrogen (H) and oxygen (O) atoms, usually with a hydrogen–oxygen atom ratio of 2:1 (as in water); in other words, with the empirical formula $C_m(H_2O)_n$ (where m may be different from n). This formula holds true for monosaccharides. Some exceptions exist; for example, deoxyribose, a sugar component of DNA, has the empirical formula $C_5H_{10}O_4$. The carbohydrates are technically hydrates of carbon; structurally it is more accurate to view them as aldoses and ketoses. They are the polyhydroxy aldehydes, ployhydroxy ketones or compounds that can be hydrolyzed to them (Doughlas *et al.*, 1986). The term is most common in biochemistry, where it is a synonym of 'saccharide', a group that includes sugars, starch, and cellulose. The word *saccharide* comes from the Greek word *sakkharon* meaning "sugar". While the scientific nomenclature of carbohydrates is complex, the names of the monosaccharides and disaccharides very often end in the suffix -ose, as in the monosaccharides fructose (fruit sugar) and glucose (grape sugar) and the disaccharides sucrose (cane sugar) and lactose (milk sugar). Carbohydrates perform numerous roles in living organisms. Polysaccharides serve for the storage of energy (e.g. starch and glycogen) and as structural components (e.g. cellulosein plants and chitin in arthropods).

***Corresponding author: Manoj Kumar,**
Department of Pharmaceutical Sciences, Guru Jambheshwar University of Science and Technology, Post Box: 38, Hisar-125001, India.

The 5-carbon monosaccharide ribose is an important component of coenzymes (e.g. ATP, FAD and NAD) and the backbone of the genetic molecule known as RNA. The related deoxyribose is a component of DNA. Saccharides and their derivatives include many other important biomolecules that play key roles in the immune system, fertilization, preventing pathogenesis, blood clotting, and development (Lei Zhao, 2015). Carbohydrates are found in a wide variety of foods. The important sources are cereals (wheat, maize, rice), potatoes, sugarcane, fruits, table sugar (sucrose), bread, milk, etc. Starch and sugar are the important carbohydrates in our diet. Starch is abundant in potatoes, maize, rice and other cereals. Sugar appears in our diet mainly as sucrose (table sugar), which is added to drinks and many prepared foods such as jam, biscuits and cakes, and glucose and fructose which occur naturally in many fruits and some vegetables (Wei Li *et al.*, 2013). Glycogen is a carbohydrate found in the liver and muscles (as energy source). Cellulose in the cell wall of all plant tissue is a carbohydrate. It is important in our diet as fibre which helps to maintain a healthy digestive system.

Types of carbohydrates: They are mainly of five types:

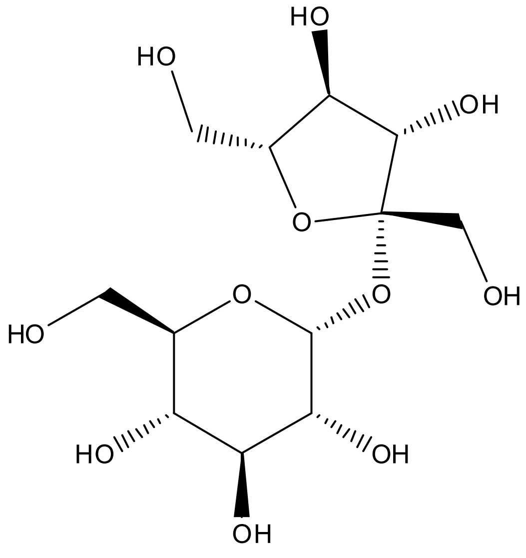
- Monosacharaides
- Disaccharides
- Oligosaccharides
- Polysaccharides
- Nucleotides

Monosaccharides: Fructose, glucose, and galactose are the common monosaccharides.

Every simple sugar has a cyclic structure and is collected of carbon, hydrogen and oxygen in ratios of 1:2:1 correspondingly. Every sugar primarily exists as a cyclic compound, it is essential to note that they are all in equilibrium to a small range with their undeviating forms. Glucose and galactose are formed by six-membered rings, fructose takes only five carbon atoms bonded to every other in ring form.

Disaccharides: Disaccharides are found in nature in different form such as maltose, lactose etc. They are made by a condensation reaction. In this one molecule of water condenses or releasedthrough the assembly of two monosaccharaides. Bond that is madeamong the two sugars is termed a glycosidic bond.

Sucrose: It is a non-reducing disaccharide made by fructose and glucose linked by their anomeric carbons. It is gained commercially from sugar beet, sugarcaneand other plants. It is gained by crushing and extract by sugarcane with water or extract by the sugar beet with water, evaporating, and purifying with lime, carbon, and several liquids. It is also gained by Sorghum. Honey & maple syrup show low percentage of sucrose. It is used as a sweetener in soft drinks and soft foods, in invert sugar, in the manufacture of syrups, confectionery, demulcent, preserves and jams, caramel and pharmaceutical products. It plays a role in chemical intermediary for emulsifying agents, detergents, and other sucrose derived products. It isprevalent inleaves, fruits, seeds, roots of plants, flowers and it roles as a carbon source for biosynthesis and an energy store for metabolism.



sucrose

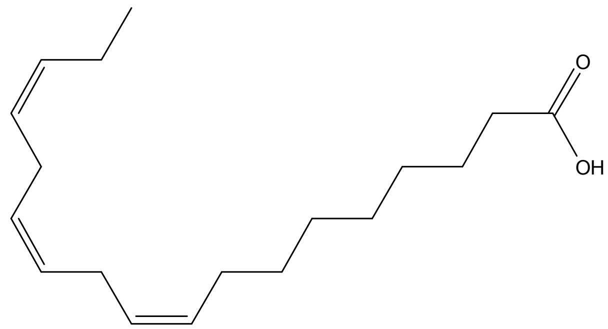
Oligosaccharides.and polysaccharides: They areconsist of two or more than two simple. sugars are described as oligosaccharides or polysaccharides, depending upon the length of the structure. They havegenerallyamong three and ten sugar units while polysaccharidesrequires more than three. Thousand units. These big structures are capable for the storage of sugars in plants and animals.

Oligosaccharides: The carbohydrates which gives a number of monosaccharide molecules changing from two to nine upon hydrolysis.. They have a nutritional significanceas they are found in legumes and beans. As of their unique glycosidic bonds, Stachyose and Raffinose cannot break down into simple sugars. They cannot be immersed by the small intestine and are frequently metabolized by bacteria in the large intestine to form undesirable gaseous byproducts.

Polysaccharides: They aremultifarious carbohydrate are generally monomers and made by thousands of repeating glucose units. They decide for the storage of huge quantities of glucose. Starch is the chief storage form in plants and has two dissimilar types: amylopectin and amylose and digestible alpha glycosidic bonds connect both types of starch, every type is unique in their branching of glucose. In starch amylopectin is highly branched and amylose is a straight chain polymer. These alterations indicate that amylopectin can form stable starch gels which are able to hold water while amylose is not capable to do so. That's why; amylopectin is regularly used by producers to produce variousdiversetypes of thick gravies and sauces. Beans, Potatoes, pasta,rice, bread and other bread products are the sources of starch (Zhang, 2014)

Nucleotides: Essential sugar occurs in nucleotides for eg. Ribonucleic acid (RNA) and Deoxyribonucleic acid (DNA).Both contain five sided cyclic sugars.DNA has less hydroxyl group than RNA. Glucose-6-phosphate is in-between in the breakdown of glucose for energy and used for the synthesis of these compounds

Fatty Acids: These are the carboxylic acids with a long hydrocarbon side chain. Saturated or unsaturated form with one or double bond formed by the hydrocarbon chain. They act as storage or transport vehicles for fatty acid.



alpha linolenic acid

Classification of fatty acids

- Saturated fatty acid
- Unsaturated fatty acid
- Polyunsaturated fatty acid
- Saturated fatty acid:-These are acids end in 'anoic'. e.g.

Stearic acid These fatty acids are highly flexible molecules can assume a wide range of conformations because in this free rotation around each of their C-C bond. They are obtained from animals e.g. butter fat.

Unsaturated fatty acid: These are the acids with one or more double bond end with "- enoic", e.g. Oleic acid, Linoleic acid, alpha-linoleic acid. Generally the unsaturated long chain fatty acids which are mostly naturally occurring exist as cis isomers which is less stable than the trans isomers. These are more reactive than the saturated fatty acids. Their melting point decrease with degree of unsaturation.

Polyunsaturated fatty acids: These are gained by plant seeds generally have two or more double bonds. In this double bonds normally occur after every three carbon atoms and always have a cis –configuration. These are obtained from plant oil e.g. sunflower oil,soyabean oil etc (Hongmei Zhang *et al*., 2015).

Properties of fatty acids

- Fatty acid between C_4-C_{10} are liquid and more than 16 carbon atom are solid at room temperature.
- Salts are formed by the fatty acid which present in various oil and react with alkali. These salts are used as soaps and emulsifying agents.
- Cis-trans isomerism exhibit by the unsaturated fatty acids because of the presence of double bond.
- These are separated from a mixture by gas liquid chromatography.

Different activities by sucrose ester derivative

ANTIBACTERIAL ACTIVITY: The antibacterial activity of. Eight Sugar fatty acid esters, (sucrose monocaprate, sucrose palmitate, fructose monocaprate, sucrose monostearate, glucose monocaprate, maltosemonocaprate, sucrose monolaurate and sucrose myristate) against five nutrient-related bacteria were evaluated strongest antibacterial activity indicated by Sucrose monocaprate specifically against Gram-positive bacteria. Sucrose monocaprate employed its antibacterial effect affecting the leading to leakage of some cellular components for e.g. Reducing sugar, Proteins, permeability of cell membrane and it observed by the SEM. On cellular DNA migration profiles no direct effect by sucrose monocaprate. In food industry emulsifying and antibacterial properties as a safe multifunctional food additive and food associated bacteria all are organized by Sucrose monocaprate.

Anti- biofilm ability: Development of food-borne Staphylococcus aureus inhibit by SE(sucrose esters). Twelve Staphylococcus aureus Isolate and identified strains and used for development of biofilm ability assay in presence or absence of SE for analysis of cell surface hydrophobicity rates of SEactions and associationamong biofilm formation ability &hydrophobicity by Bacteria adhesion the hydrocarbon test. Between all the isolates several level of biofilm formation inhibitory of SE were detected. For biofilm formation of food borne pathogens SE has great potential as an inhibitor.

Nf-κb Inhibitory Activity: 12 compounds, having four galactosyl acylglycerols ,SFAE(six sucrose fatty acid esters) & two sphingolipids, remained isolated from the roots of Astragal us membranaceus from isolation SFAE. 6′-O-palmitoyl sucrose was isolated from nature first time&6′-O-linoleyl sucrose was recognized as a new compound, It was the first report on SFAE components from A. membranaceus.HepG2 cells stimulated with TNF-α using a luciferase reporter system measured the nuclear factor-κB inhibitory activity of isolated compounds. In a dose-dependent manner compounds 1−6 exhibited significant inhibition of NF-κB activation, with IC50 values ranging from 4.4 to 24.7 μM. TNF-α-induced expression of iNOS and ICAM-1 mRNA and dose dependent inhibition of iNOS promoter activity, with IC50 values ranging from 3.3 to 5.0 μM. Also exhibited by Compounds 1−6.These data reveal the potential of SFAE from A. membranaceus to avoid and treat inflammatory diseases.

Antimicrobial activities of disaccharide monoesters:- medium chain fatty acid ester of Disaccharides prepared by Lipozyme TLIM through trans-esterification. Byvia three pathogenic microorganisms: Escherichia coli O157:H7, Staphylococcus aureus, and Candida albicans explore their antimicrobial activity. Additional properties are take in which is critical micelle concentration &, foaming stability, surface-active properties containing air–water surface tension, and emulsion power. All of the tested monoesters were effective against Gram positive bacteria (S.aureus) than Gram negative bacteria (E.coli).most essential factor carbon chain length effects the surface properties and little influenceshown by degree of esterification & hydrophilic groups.

Effect of formulation variables:_It is for evaluate &develop nanostructured lipid carriers & solid lipid nanoparticles using SE (sucrose ester) as a emulsifier & stabilizer for the controlled release of drug. By using different sugar ester SLN & NLC were prepared and to screen out the most appropriate stabilizer. The sample drug is used Clotrimazole comparison and evaluation of Polydispersity index, effect of different formulation variables on the particle size and drug encapsulation efficiency of NLC & SLN was done.comparison are done using Cryo SEM,DSC, & XRD. At 252 c & at 2-8 c physicochemical stability of the SLN &NLC was checked .SLN with 120 nm & NLC with 160 nm size were produced.In cryo SEM shown spherical particles with a smooth surface but didn't show any differences in surface morphology among NLC & SLN. Faster drug release observed in SLN than NLC.In terms of size NLC was more stable than SLN. It is show that both are stabilized by sucrose ester and used as controlled release carriers.

Cytotoxic activities of short carbon chain unsaturated sucrose esters:- for the antifungal,anti-bacterial and cytotoxic activity collection of C3–C5 unsaturated 6-O-sucrose esters have been observed.Good inhibitory activity showed by most of the targeted compound against a range of clinically & food contaminantsvital microbial pathogens. Maximum active bactericides against all the tested bacteria with MIC ranges from0.24 to 1.40 μm. Maximum anti-fungal activity with MICs from0.28 to 1.10 μMexhibited by the compound 9.Low cytotoxicity controlled by the synthesized compound against lung,human breast,cervical &hepatocellular carcinoma cell lines without viewing toxicity for non-tumor liver cells.Growth of new generation of sucrose –based anti-microbial agents signify by the library of short carbon chain unsaturated sucrose ester.

Effect of sucrose monolaurate on acid production:- sucrose monolaurate (antimicrobial compound)prevents Streptococcus mutans NCTC 10449 by defining its influence on the rate of acid production from sucrose and glucose and the intracellular and extracellular levels of glycolytic intermediates. In preventing acid production at pH 7.0 from glucose.Sucrose monolaurate was more in effect than either sodium laurate or sodium fluoride. Any sucrose or glucose was the carbon source and in the absence or presence of oxygen inhibition of acid production was the same. Quantitative analysis of several glycolytic intermediates shows that the steps withdrawn by sucrose monolaurate were the reactions catalyzed by phosphoglycerate kinase, phosphofructokinase and glyceraldehyde 3-phosphate dehydrogenase. Meanwhileby the addition of sucrose monolaurate the activities of the enzymes in cell-free extracts were also not decrease, the inhibition of acid production could not be ascribed to direct effects on the enzymes. A reduction in the rate of acid production with consistent elevations in the extracellular levels of glycolytic intermediates shows that sucrose monolaurate inhibits S. mutans b y changing the permeability of the cell membrane, which causes a loss of essential metabolites.

Antimicrobial activity: Six sucrose esters (SE) exchanged to different degrees by a mixture of fatty acids observed anti-microbial properties . 0.2%of the SE in the test medium not prevents the growth of Saccharomyces cerevisiae and the growth & acid production of several lactic acid bacteria . Anti mycotic activity also spotted by mold species which are from Penicillin aspergillus, Cladosporium, and Alternaria. In decreasing mold growth SE was the most active. The mold growth decreased by range from 37 to 91% through this ester at a 1% concentration .Inhibitory activity does not effected by change in pH. 0.1% SE also not affects Aflatoxinformed by Aspergillus parasiricus (Surajit Das *et al*., 2014; Krasimira *et al*., 2018).

REFERENCES

Constituents from Astragalus membranaceus". Journal of agriculture and food chemistry.2013.

Doughlas L. Marshall and Lloyd B. Bullerman, 1986. "Antimicrobial Activity of Sucrose Fatty Acid Ester Emulsifiers". *Journal of food Science*-Volume 51, No. 2.

Hongmei Zhang*, Yanlan Liu, Changli Wu, Dong Wang , Wenjia Deng, Jiankun Song, Guifen Zhao and Yan Jiang, 2015. Inhibitory Effects of Sucrose Fatty Acid Esters on Biofilm Formation by Food-borne Staphylococcus aureus.

Krasimira T. Petrova Email author M. Teresa Barros Ricardo C. Calhelha Marina SokovićIsabel C. F. R. Ferreira, 2018. "Antimicrobial and cytotoxic activities of short carbon chain unsaturated sucrose esters".Medicinal Chemistry Research, Volume 27, Issue 3, pp 980–988

Lei Zhao, Heyan Zhang, Tianyang Hao, Siran Li, 2015."In vitro antibacterial activities and mechanism of sugar fatty acid esters against five food-related bacteria". Food Chemistry 187 , 370–377.

Surajit Das, Wai Kiong Ng, and Reginald B H Tan, 2014. "Sucrose ester stabilized solid lipid nanoparticles and nanostructured lipid carriers: I. Effect of formulation variables on the physicochemical properties, drug release and stability of clotrimazole-loaded nanoparticles". Nanotechnology, Volume 25, Number 10.

Wei Li, Ya Nan Sun, Xi Tao Yan, Seo Young Yang, Seok Bean Song, Young Mi Lee, and Young Ho Kim, "NF-κB Inhibitory Activity of Sucrose Fatty Acid Esters and Related

Zhang X, Song F, Taxipalati M, Wei W, Feng F. 2014. "Comparative Study of Surface-Active Properties and Antimicrobial Activities of Disaccharide Monoesters". Plos one.

****