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**Review Article**

# Effect of sugar intake towards human health

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**Abstract:** Sugars belong to glycan/carbohydrate group of chemicals. Realisation of their sweetness was earlier as compared to its use as an energy source and an important dietary component. Although sugar is vital for defraying many physiological functions of our body properly, "*Sweet tooth*" or "*Craving for sugar*" is of common occurrence in children. Of late, we have realised that an excess consumption of sugar is harmful leading to various elements affecting our health, more so in children and women. So one should not only be careful while consuming excess amount of sugar (more than the recommended) in one's diet, but rather advertently avoid it**.**
**Keywords:** essential, excess consumption, harmful, health, nutrition, sugar.

## INTRODUCTION

Sugars are polyhydroxy aldehydes/ketones belonging to glycans/carbohydrate group. By providing energy currency, ATP and some other beneficial physiological activities of the body, the carbohydrates have earned the sake of macronutrients which are found in several foods and beverages. The main function of carbohydrates is to offer energy to the body for its functioning and physical activities, utilizing glucose as its source. This instant energy is fulfilled by intake of sugars. Besides this, a therapy used for overcoming chronic back pain termed as Prolotherapy indulges sugar (glucose or dextrose) in injections for relieving pain [1]. In addition to, many drugs consists of glycans (type of sugar) as an essential ingredient. Drugs such as heparin (used for treatment and prevention of blood clots in veins, arteries or lungs), erythropoietin, some anti-flu drugs and drugs treating against cancer contain glycans [2]. Even though there are many uses of sugar but yet the fight of sugar being a friend or a foe, irresolvable, continues to be. In certain aspects, sugar is considered to be a foe, yet its complete absence in our diet will affect our health to a great extent. Thus, this review highlights the effect of sugar intake (beneficial or harmful) on human health.

### Role of sugar in body and effect of its intake on human health

Our body would cease to function properly if there is no sugar intake. Naturally occurring sugars causes huge profits in our diet like, sugars found in fruits, lactose, milk sugar, *etc*. However, the sugars called as "added sugars", *viz*., sugars added during processing of food, beverages and other preparations are harmful to our body [3] while the "essential sugars" are the carbohydrates required by the body in up-taking nutrients from its source. Basically, the latter, its nutrients are recognized as glyconutrients obtained from fruits and vegetables [4]. Intake of the fruit sugars does not harm our body, as besides fructose it also contains fibers as well as some other nutrients. The fructose provides our body with a quick energy while fibers counterbalances the fructose effects, leading to long lasting energy to body. Sugars in dairy foods are also beneficial for our body as they provide us with other nutrients too. Certain complex carbohydrates like whole grains and starchy vegetables also contain some healthy sugars and other nutrient fibers [5].

Some common types of sugar that we generally consume in our diet and their effects on our body health are given below –

**Glucose**-Consumption of glucose stimulate pancreas to secrete insulin. This increase in insulin signals by brain which instructs to stop eating as we had enough of it. There are many processes going in our body after consuming glucose but one that occurs in the liver produces very low density lipoproteins (VLDL) that causes cardiovascular disease in our body. However, about 1 out of 24 calories of the glucose we consume is processed in the liver and gets converted into VLDL [6].

**Sucrose and high fructose corn syrups (HFCS)** – Both sucrose and HFCS contain a large amount of fructose (50% in sucrose and 55% in the HFCS). Intake of these sugars is harmful to our body because fructose

is metabolized only by liver that means a large amount of VLDL is produced along with fats. Also, intake of these sugars cannot be controlled by brain as brain resists leptin (a protein for energy intake regulation and to check the efficacy of metabolism). This does not mean that intake of these sugars is always harmful. In case of athletes, intake of HFCS leads to accumulation of glycogen in their liver which is used later in their exercises or athlete activities. This vouches that intake of HFCS is beneficial to persons performing higher physical activity and requiring instant energy [6].

**Fucose-** It is exclusively found in large amounts in human breast milk, sea kelp, Brewer's yeast and even in some of the mushrooms. L-fucose (6-deoxy-L-galactose), a monosaccharide, is found in N- and O-linked glycans and glycolipids produced by mammalian cells. These are important in blood transfusion, selection–mediated leukocyte-endothelium adhesion, host microbe interaction and ontogenic events. An alteration in their expression is associated with pathological conditions like cancer and artherosclerosis [7]. Intake of this sugar encourages long term memory, prevents respiratory infections and growth of tumors. Besides, they also act as powerful modulators for immune system [8]. Glycoproteins and glycolipids associated with this sugar are vital for toning immune system as well as controlling inflammation [9]. This sugar execute antibodies function as well as that of major histocompatibility complexs (MHCs), platelets, interaction of egg-sperm or connective tissue health, exchange of substance across and building up of tissues. It also performs some hormonal functions like follicle stimulating hormone while the latter perform cellular membrane functioning in exchange of substance as well as interactions between the cells such as tissues build–up [10]. Lack of this sugar is associated with rheumatoid arthritis. In patients suffering from ailments like cystis fibrosis, diabetes, hepatic disorders, low levels of fucose are observed. Fucose is also important in extruding herpes virus from body [11]. Administering, this sugar also reduces wrinkles by thickening the skin and their hydration.

Brown algae and some sea weeds (*mozuku, kambu, bladder wrack, wakam, hijiki*) as well as animals like sea cucumber contains fucoridan polysaccharides which are used in some dietary supplements [12].

**Galactosamine-** These are found in shark cartilage and crustacean shells and also in some red algae (Phaeophyceae). Although it is least essential, but helps intercellular communication. Administering these sugars help in regulating immune system and inflammation. It is also necessary for proper health of joints. Its low levels are associated with cardio vascular diseases [13].

**Glucosamine-** This glyconutrient is helpful in maintaining health of the joints. Being precursor of cartilage, it helps in managing osteoarthritis problems and is. In shark cartilage and crustaceans shells found as galactosamine. Administer when in our body some of it gets oxidized while the remaining ones are converted into glycoproteins and glycolipids [13].

**Galactose-** This sugar which is found in milk is composed of lactose- a disaccharide in combination with glucose (nearly 5% solids in dairy products). This sugar is also present in variety of fruits, vegetables and also in some herbs [13]. Galactose helps in speedy healing up of injuries, aids in absorption of calcium and improve their memory power [14].

**Mannose-** Mannose is an integral component of our immune system. Lack of this sugar leads to inflammation and some diseases. As compared to glucose it is absorbed in the body at a relatively slower rate. After absorption it directly enters bloodstream. It is found in Aloe Vera, sea kelp, beans, capsicum, cabbage, eggplant, tomatoes, turnips, currants some mushrooms and Aloe Vera, the latter being main source of it [13].

**Neuraminic acid or N-acetyl–neuramic acid (or NANA)** - A unique sugar found in colestrum, is the first ever food a mammalian gets after his/her birth from his/her mother. This sugar is vital constituent of gangliosides present in grey matter of brain. The Follicle stimulating hormone (FSH) needed for ovulation also contains it. Besides, this sugar also distinguishes mammals from animals groups of other animals [15].

**Xylose-** Xylose, an aldo-pentose, found in embryo of most edible plants and is known for preventing digestive tract cancers. It is found in a number of fruits and vegetables, and to name few are Aloe Vera, blackberries, broccoli, eggplant, green beans, guava, pears, peas, raspberries, sea kelp and spinach [13].

**Sugar metabolism in the body**

Every cell in our body requires energy for its physiological activities and this is accomplished by enzyme catalyzed oxidation of the sugar. The flow of sugars in our body takes place as follows:

Glucose (sugars) ⟶ small intestine ⟶

blood stream $\xrightarrow{\text{Insulin}}$ liver and other tissues

Sugar molecules after reaching the cells in liver and tissues of our body could be metaboilsed by HSK pathway (glycolysis) and TCA cycle and various intermediates to synthesize a number of molecules that help various metabolic activities and storage [16]. After being processed by the digestive system and subsequent metabolism, the sugar gets converted into glycoproteins and glycolipids. In animal cells, cell membrane is

composed of glycoproteins and glycolipids, sugars and fats. Both of these (glycolipids and glycoproteins) form tiny antennae on cell wall, which serve as a communication between cells and also absorb and process nutrients, enzymes, hormones and various other chemicals required for the activity of our heart, healing in skin, taking cure of bacterial infections, arteriosclerosis, Alzheimer's and Parkinson's diseases [13].

Glycans are linear or intricate or branched chains of sugars moieties occurring in our body, composed of few to dozens of sugar molecules. The study of structure, biosynthesis and biology of saccharides is called as glycobiology while the systematic study of all glycans structures of a cell or gangilion is known as glycomics. Glycans regulate the proper folding of proteins ensuring their proper functioning. Glycans also serve as ZIP codes, to direct the newly synthesized proteins to proper place of their use in the body. Some of them also act as anchors to attach viruses on cell surfaces signaling to immune system and ensuring proper brain functioning [17].

As soon as we consume sugar, the primary function is to provide us with energy for our brain and nervous system that regulate performance of daily activities [18]. Besides, there are several other necessary reasons for us to consume of sugar in our diet. Some of these are-

- Metabolizing fats: Thus preventing use of proteins for energy in our body which are otherwise required as structural constituents.
- Reservoir source of energy: Glucose can be stored in liver in form of glycogen which act as reservoir of energy. This energy is used up by the body during exercise or when glucose is not available as energy source. Their reservoirs also maintain our blood sugar level stable.
- Energy source for brain and muscles- An adult brain uses about 140 g of glucose/day, viz *viz*., half of the total dietary carbohydrate consumed for its functioning. Studies have shown that sugar sweetened beverage or carbohydrate meal are associated with enhancing mental ability such as, improved memorizing power, reaction times, attention span and arithmetic ability. Also, it encourages cognitive effects and even reduces fatigue [19, 20]. Driving test using automobile stimulators have indicated that for a long distance (about 120 km) test, persons undertaking test after consuming sugars committed less error than the ones having water alone [21].
  In addition to, intake of sugar activates two hormones/neurotransmitters of the brain and serotonin (feel good hormone) and beta -endorphin which serve as pain reliever and overcoming anxiety.
- Maintain body temperature [22].
- Production of myelin- It is a sheath around axon of a neuron and insulating it for proper functioning of nervous system. It is composed of 70-85% lipids (glycolipid, galactocerebroside) and 15-30% protein. Myelin formation requires glucose as well as its derivative, glucosamine [22].
- *Transportation of monocytes*- Monocytes are the largest known leucocytes (WBCs) and an essential part of the immune system. Intake of sugars helps in their transportation [22].
- *Muscle formation*- Muscle is a connective tissue of the animals, filaments of which contain actin and myosin. These slide past over one another; provide contraction, maintains posture, movement, locomotion as well as function of the interior organs. Glucose and its derivative glucosamine are essential for formation of muscle [22] as well as keeping our muscles lean [18].
- *Skin formation*- Skin is the outer protective and sensory (for touch, heat *etc*.), covering of our body. Collagen and elastin, the two main constituents of the skin, require glucose as well as glucosamine for its formation. A lack of sugar in our body causes our skin to age early or speeds up ageing [22]. Fucose, by stimulating elastin formation, deposition and maintaining density of fibres improves skin elasticity [23].

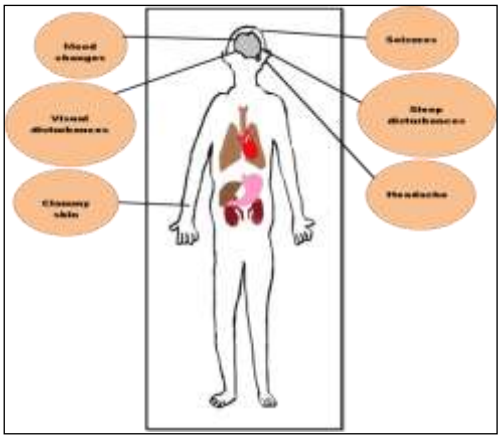

**Fig-1: Symptoms associated with low or no intake of sugar in diet.**

Lack of sugars in the diet leads to low blood sugar level which cause a number of problems like restlessness, distracted, feeling hungry and weakness. Some other observed symptoms include chills, lack of coordination, sweating and clammy skin. Persons on low sugar diet for longer time also experience blurred vision, headache, confusion and difficulty in performing even simple tasks. They may experience nightmares and crying (while sleeping) [24] (Fig. 1).

Contrary to the common myth that consuming sugars in our diets causes diabetes the fact is otherwise. Although diabetes is occasionally related to increase in blood sugar levels yet it has no association with sugar, *per se*. A recent study in Sri Lanka, however, has shown a correlation between per capita sugar consumption and prevalence of diabetes mellitus in various countries. The countries consuming relatively more of sugars were relatively more prone to this metabolic disorder. The correlation was found to be rather more in the Asian countries ($r= 0.660$, $p<0.001$) as well as South East-Africa ($r=0.916$, $p <0.001$). In Asian countries, Central Asian countries ($r=0.968$, $<0.001$) exhibited relatively higher correlation in comparison to the South Asian countries (0.684, $p<0.050$) [25]. Homeostatic mechanism maintains the normal range of blood sugar levels in the human body. Any disturbance in this as well as malfunctioning or failure of pancreas could lead to increase in blood sugar levels. The pancreas of the person having a pedigree of diabetes is less efficient. If the pancreas produces less of insulin due to its malfunction then the person suffers from diabetes (DM type I) but if cells of body does not respond for insulin production then the person suffers from diabetes (DM type II). Besides, in women, in family way not having otherwise detected for diabetes, if insulin is not produced in requisite amount then the women suffers with diabetes of gestational type [26]. Thus, in such patients this process gets aggravated with intake of more of sweets and more fats containing eatables. However, people with normal health conditions may not suffer with these by consumption of sweets and fat-rich foods [27].

It is well known that excess of everything is bad and so is true for the sugars as well. Higher consumption of sugars leads to several health problems or accelerate and may give rise to many diseases (Fig. 2). Sugar intake is solely not responsible for its harmful affect on human health but improper functioning of glands and organs are equally important.

Following are some of the recognised important health related foes associated with higher dietary sugar intake:

- *Suppression of immune system* [28].
- *Defence against bacterial infection*- By impairing functions of WBCs is impaired [29].
- *Disturbed mineral and vitamin balance in the body* [30].
- *Chromium deficiency* [31].
- *Disturbs role of calcium, magnesium in body* [31].
- *Macular degeneration of eyes* [32].
- *Ageing*- Sugar molecules enter into the blood along with proteins and produce some harmful molecules, AGEs (Advanced glycogen end products) which damage elastin and collagen, making the skin fragile and affect its firmness. AGEs also neutralise the anti-oxidative enzymes protecting the skin from harmful sun rays and ultimately our skin ages [33].
- *Causes inflammation* [28].
- *Lack of Matching Insulin activity* [28].
- *Sucrose intolerance*- It is sucrase enzyme that metabolises sucrose in the body; and when it is not produced in small intestine in sufficient quantities, sucrose intolerance occurs. As per Wikipedia, the latter could be visualised by abdominal cramps and bloating, diarrhea and constipation, hypoglycemia and headache, poor growth, viral infection in the upper respiratory tract, anxiety, etc. The people of Alaska are more prone to sucrose intolerance. It is also called as congenital sucrose-isomaltase deficiency or even as sucrose isomaltase deficiency [34]. Some other intolerances met with sugars are *fructose intolerance* (due to deficiency of fructose carrier in enterocytes), *trehalose intolerance* (due to lack of enzyme trehalase), *lactose intolerance* (when a person is not able to digest milk sugar (lactose), due to lactase enzyme non-availability) and *glucose-galactose intolerance* (a rare disorder, where only fructose is digestible) [35]. It may be sometimes called as *sugar malabsorption*.
- *Sucrose allergy* due to the malfunctioning of the immune system.
- *Sugar sensitivity*- Due to unstable blood sugar levels, low levels Serotonin- a feel good hormone, and beta-endorphin- the reliever for pain and anxiety [36].
- *Increase levels of triglycerides* elevating cholesterol levels leading to cardiovascular diseases [37].
- *Damage to the structure of DNA*: There is a positive relationship between sugar consumption and oxidative damage to the DNA [38]. A study conducted on 5309 healthy adults ranging between 20-65 years, whose diets consisted of sugar sweetened beverages, revealed that length of the telomeres (the protective DNA caps at the end of a chromosome) reduced [38].
- *Increase in uric acid* (hyperuricaemia) *in body* causing increased blood pressure, probability of heart attacks and CVDs [39].

Association of excess sugar consumption with other diseases like cancer [40-46], o*besity* [47-49], Tooth decay or dental caries [51-54], Arthritis (rheumatoid arthritis, gout and osteoarthritis) [55], cardiovascular diseases [56], encourages yeast infection (Candida albicans) [57], association with memory loss and brain functioning [58-59], atherosclerosis [60], cataract and myopia (short-sightedness) [62], *etc*.

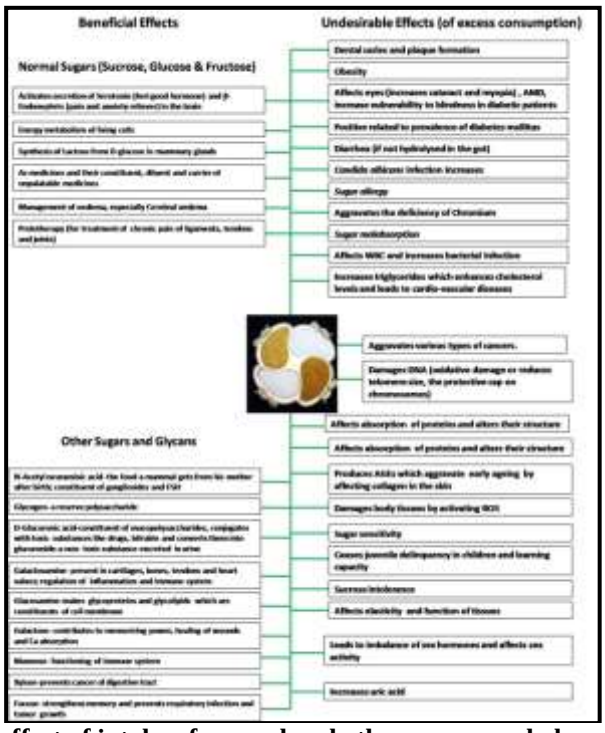


**Fig-2: An overall affect of intake of normal and other sugars and glycans in human body**

Consumption of excess sugars causes some diseases in men or women; and in children, as a group, excess intake of sugars also causes some diseases (Fig. 3).

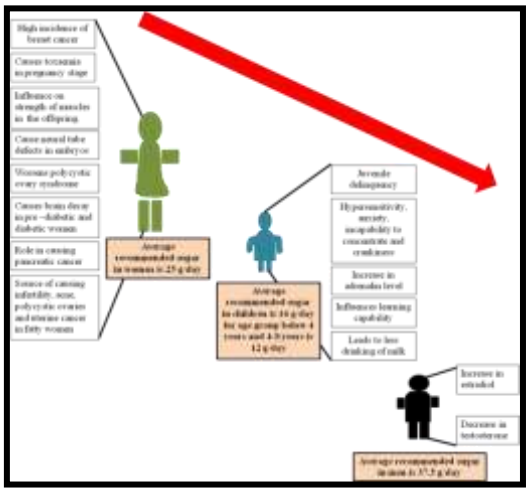

**Fig-3: Overall negative effects of excess sugar intake in women, children and men: Women are more affected by excess consumption followed by children and men.**

For men, American Heart Association (AHA) has recommended average consumption of sugar to be 150 calories per day which is equivalent to 37.5 g or 9 tsf [63]. Increase in this amount may lead to exclusive problems in men like increases estradiol level, decrease in testosterone level and affects their sex life [64].

For women, AHA recommends an average consumption of sugar to be 100 calories per day which is equivalent to 25 g or 6 tsf [63], however, higher consumption of sugars will be affecting their health (Fig. 3) with frequent occurrence of ailments like breast cancer, higher breast density in women who have not attained menopausal state [65]. High intake of sugars, both in pre-menopausal as well as post-menopausal

women lead to higher breast density [66]. Excess of sugar intake in women, in family way, causes toxaemia and even influences production and strength of muscle of their offsprings. Lactating women also exhibit a similar response to excess sugar intake. It may also increase neural tube defects in embryos; and more so in adolescent mothers. It also affects pre-menstrual syndrome (PMS), a hormonal imbalance associated with women craving for sugar [67]. The latter worsens the situation in women with Polycystic Ovary Syndrome (PCOS) due to a rise in insulin level. The latter may stimulate the androgen receptors and blocks egg release form the follicle, and symptoms of hair growth on face, arms, legs, head and acne are observed [68]. Excess consumption of sugar in pre-diabetic and diabetic women even causes brain decay [69] and pancreatic cancer [70]. Unlike men, excess consumption of sugar affects sex life in women and produces excess testosterone which results in decline of sex hormone binding globulin (SHBG) gene. Low activity of latter would result in infertility, polycystic ovaries, uterine cancer and more frequency of CVDs [71].

A child having no craving for sugar is rare as high intake of sugars (and their products), is common in this age group. It increases the negative effects like Juvenile delinquency [69], hypersensitivity, anxiety, incapability of concentration, increases in adrenalin level, decreased learning capacity and less of drinking of milk [54] (Fig. 3). The recommended intakes of sugars for children in different age groups are given in the table 1.

**Table 1: Recommended sugar consumption in various categories of children**

| Category | Calories requirement /day | Sugar intake/day |
|---|---|---|
| Pre-schoolers | 1,200 - 1,400 | 16 g (4 tsp) |
| 4-8 years of age | 1,600 | 12 g (3 tsp) |
| Pre-teens and teens | 1,800-2,000 | 20-32 g (5-8 tsp) |

(Source: Modified from *http://www.bjcschooloutreach.org/Nutrition/Featured-Content/Adding-it-Up-How-Much-Sugar-Should-Youth-Consume*, 07.08.2015)

The negative aspect of excess consumption of sugars does not end here. The innumerable undesirable effects of excess consumption of sugar as well as how we may overcome these, have been amply highlighted in many of the recently published books like *Lick the Sugar Habit* (1988) by Nancy Appleton and *Suicide by Sugar: A Startling Look at Our #1 National Addiction* (2009) by Nancy Appleton and G.N.Jacobs; *Sweet Poison- Why Sugar Makes us Fat* (2009), *The Sweet Poison- Quit Plan* (2013) both by David Gillespie, *Get the Sugar Out: 501 Simple Ways to Cut the Sugar Out of Any Diet* (2008) by Ann Louise Gittleman, *I Quit Sugar for Life* by Sarah Wilson (2014), and for children, *Beat Sugar Addiction Now! For Kids* by Jacob Teitelbaum and Deborah Kenndy (2012), and there are some more in the list. A blog on "The 141 reasons sugar ruins your body" by Nancy Appleton has also appeared [72].

## CONCLUSION

Sugar is one of the important ingredients in food products in today's life. Although consumption of sugar activates the "feel good hormone" of the brain but on other side it can even make you addicted towards it. No matter how sweet does the sugar tastes, it has some negative effects on human beings, especially its excess consumption which overweighs its positive effects on our health. Even in non-diabetic persons, excess intake of sugars is certainly harmful, more so for the women. So, one should not only be careful while consuming excess amount of sugar (more than the recommended) in one's diet, but rather advertently avoid it. It is important for the further studies on sugar consumption in humans.

## REFERENCES


1. http://www.spine-health.com/treatment/injections/what-prolotherapy-treatment-chronic-back-pain,07.08.2015
2. en.wikipedia.org/wiki/glycobiology, 27.07.2015
3. http://healthyeating.sfgate.com/importance-sugar-human-body-4424.html, 22.07.2015
4. http://nutrition-now.com/2010/04/what-are-essential-sugars-and-why-are-they-essential/,22.07.2015
5. http://www.livestrong.com/article/409694-importance-of-sugar-in-the-human-body/ , 22.07.2015
6. http://lifehacker.com/5809331/what-sugar-actually-does-to-your-brain-and-body, 22.07.2015
7. Backer, Daniel J and Lowe, John B. Fucose: biosynthesis and biological function in mammals. *Glycobiology*, 2003, 13(7):41R-53R.
8. http://osumex.com/fucose.php, 23.07.2015
9. http://nutrition-now.com/2010/04/what-are-essential-sugars-and-why-are-they-essential/,22.07.2015
10. http://www.healthknot.com/carbohydrates.html, 22.07.2015
11. http://www.glyconutritionforlife.org/Science_of_Glyconutrients/Fucose.php, 23.07.2015
12. en.wikipedia.org/wiki/fucoidan,25.07.2015
13. http://nutrition-now.com/2010/04/what-are-essential-sugars-and-why-are-they-essential/,22.07.2015

14. David Wolfe. Essential Sugars: The Healing Power of Polysaccharides. 2011, Pp-5.
15. Backer S.A. Carbohydrates and chemical industry: Achievements and Prospects. Endeavour, 1991, 15:155-157http://www.livestrong.com/article/508169-uses-functions-of-sugar-in-body-metabolism/, 22.07.2015
16. http://www.livescience.com/17349-sugars-glycans-nigms.html, 22.07.2015
17. http://www.livestrong.com/article/508169-uses-functions-of-sugar-in-body-metabolism/,22.07.2015
18. Westenhoefer J. Carbohydrates and cognitive performance. Aktuelle Ernaehrungsmedizin, 2006, 31 Supplement 1: S 96-S 102.
19. Sunram-Lea S I, Foster J K, Durlach P, Perez C. Glucose facilitation of cognitive performance in healthy young adults: examination of the influence of fast-duration, time of day and pre-consumption plasma glucose levels. Psychopharmacology, 2001, 157: 46-54
20. Keul J and Jakob E. Zur Wirkung von Saccharose auf Fahrverhalten, Kreislauf und Stoffwechsel. *Oesterreichisches Journal fuer Sportmedizin*, 1990, 20: 102-110
21. http://www.all-creatures.org/health/carbo.html, 22.07.2015
22. http://www.angiesoption.com/2015/03/skin-health-and-the-sugar-fucose/, 23.07.2015
23. http://www.healthline.com/health/low-blood-sugar-effects-on-body#sthash.FQwCzsCk.dpuf, 22.07.2015
24. www.ncbi.nih.gov/pubmed, 07.08.2015
25. www://en.m.wikipedia.org>wiki>Diabetes-mellitus, 07.08.2015
26. http://www.diabetes.org/diabetes-basics/diabetes-myths/, 22.07.2015
27. http://diettogo.com/blog/5-reasons-sugar-is-bad-for-you, 29.07.2015
28. http://www.humanillnesses.com/General-Information-and-Infectious-Diseases-A-Co/Body-Defenses.html, 30.07.2015
29. http://www.healthgolb.com/health/10-negative-effects-of-sugar-on-your-health/, 29.07.2015
30. http://www.mgwater.com/calmagab.shtml, 31.07.2015
31. http://www.rochestereyeassociates.com/macular_degeneration.html, 30.07.2015
32. http://www.ehow.co.uk/info_8571776_disadvantages-eating-much-sugar.html, 29.07.2015
33. https://en.wikipedia.org/wiki/Sucrose_intolerance,16.08.2015
34. http://www.eatingforenergy.com/sugar-intolerance/, 16.08.2015
35. http://radiantrecovery.com/7-steps/overview/,16.08.2015
36. Giovannelli Lisa, Saieva Calogero, Giovanna Masala, Givonnna Testa, Simonetta Salvini, Vanessa Pitozzi, Elio Riboli, Piero Dolara and Domenico Palli. Nutritional and lifestyle determinants of DNA oxidative damage: a study in a Mediterranean Population. *Carcinogenesis, 2002*, 23(9):1483-1489.
37. http://www.theguardian.com/lifeandstyle/2014/oct/16/sugar-soft-drinks-dna-ageing-study, 30.07.2015
38. http://doctor.ndtv.com/storypage/ndtv/id/002715/type/news/Sugar_can_also_increase_uric_acid.html, 31.07.2015
39. Boyd D. B. Insulin and cancer. *Inteqr cancer Ther*.,2003, 2 (4):315-29.
40. Biagio Archidiacono, Stefania Iiritano, Aurora Nocera, Katiuscia Possidente, Maria T. Nevolo, Valeria Ventura, Daniela Foti, Eusebio Chiefari, and Antonio Brunetti. Insulin resistance and cancer risk: an overview of the pathogenic mechanisms. *Experimental diabetes Research*, 2012. *http://dx.doi.org/10.1155/2012/789174*
41. Seely Stephen and David F Horrobin. Diet and Breast cancer: The possible connection with sugar consumption. *Medical Hypotheses*, 1983, 11(3):319-327.
42. Bostick Robert M, John D potter, Lawrence H Kushi, Thomas A Sellers, Kristi A Steinmetz, David R McKenzie, Susan M Gapstur and Aaron R Folsom. Sugar, meat, and fat intake, and non-dietary risk factors for colon cancer incidence in Iowa women (United States). *Cancer causes and Control*, 1994, 5 (1):38-52.
43. Slattery M L , J Benson, T D Berry, D Duncan, S L Edwards, B J Caan and J D Potter. Dietary sugar and colon cancer. *Cancer Epidemiol Biomarkers Prev*, 1997, 6:677.
44. http://blogs.naturalnews.com/12-reason-sugar-called-white-death/, 29.07.2015
45. http://www.ehow.co.uk/info_8571776_disadvantages-eating-much-sugar.html, 29.07.2015
46. Bray George A, Samara Joy Nielsen and Barry M Popkin. Consumption of high fructose corn syrup in beverages may play a role in the epidemic of obesity. *Am J. Clin Nutr*, 2004, 79 (4): 537-543.
47. Ludwing David S., Karen E Peterson, Steven L Gortmaker. Relationship between consumption of sugar sweetened drinks and childhood obesity: a prospective, observational analysis. *The Lancet*, 2001, 357(9255):505-508.
48. http://www.eurekalert.org/pub_releases/2010-06/tes-fsm062010.php, 29.07.2015
49. Touger-Decker Riva and Cor van Loveren. Sugar and dental caries. *Am J Clin Nutr*, 2003, 78(4):8815-8925.
50. http://healthyteeth.org/what-about-sugar/, 30.07.2015
51. http://time.com/3380563/sugar-tooth-decay/,30.07.2015
52. http://www.rethinksugarydrink.org.au/facts/tooth-decay.html, 30.07.2015

53. http://www.healthgolb.com/health/10-negative-effects-of-sugar-on-your-health/, 29.07.2015
54. http://www.wisegeek.com/what-is-the-connection-between-sugar-and-arthritis.htm, 31.07.2015
55. Kirkpatrick Kristin. 10 things you don't know about sugar and what you don't know could hurt. The blog, 2013 http://www.huffingtonpost.com/kristin-kirkpatrick-ms-rd-ld/dangers-of-sugar_b_3658061.html?ir=India&adsSiteOverride=in, 29.07.2015
56. http://www.drweil.com/drw/u/ART03502/Yeast-Infections.html, 30.07.2015
57. Emillie Reas. Sugar may harm brain health. Scientific American, 2014, 25(4). http://www.scientificamerican.com/article/sugar-may-harm-brain-health/, 31.07.2015.
58. *en.wikipedia.org/wiki/fucose*,25.07.2015
59. Monte De LaS M. Metabolic derangements mediate cognitive impairment and Alzheimer's disease: role of peripheral insulin resistance diseases. *Panminerva Med*.,2012, 54(3):171-8.
60. Stout R W, Belf M.B. Insulin –stimulated lipogenesis in arterial tissue in relation to diabetes and atheroma. *The Lancet*, 1968, 702-703.
61. http://www.nytimes.com/health/guides/disease/cataract/print.html, 30.07.2015
62. https://en.wikipedia.org/wiki/Myopia, 30.07.2015
63. Johnson RK, Appel LJ, Brands M, Howard BV, Lefevre M, Lustig RH, Sacks F, Steffen LM, Wylie-Rosett J. Dietary sugars intake and cardiovascular health: a scientific statement from the American Heart Association. *Circulation*, 2009, 120(11):1011-20.
64. Caronia LM, Dwyer AA, Hayden D, Amati F, Pitteloud N, Hayes FJ. Abrupt decrease in serum testosterone levels after an oral glucose load in men: implications for screening for hypogonadism. *Clin Endocrinol (Oxf).*, 2013, 78(2):291-296.
65. http://blogs.biomedcentral.com/bmcseriesblog/2014/06/26/is-sugar-intake-linked-with-breast-cancer-risk/, 30.07.2015
66. Caroline S Duchaine, Isabelle Dumas and Caroline Diorio. Consumption of sweet foods and mammographic breast density: a cross-sectional study. *BMC Public health*, 2014, 14:554.
67. http://www.thefooddoctor.com/Premenstrual-Syndrome-Ahealth_fdw_pms/,30.07.2015
68. http://www.virginiahopkinstestkits.com/pcos.html, 07.08.2015
69. Havasi Peter. Education of Cancer Healing Vol. VII – Heretics. Lulu Author, 2012, pp 304.
70. Larsson C Susana, Leif Bergkvist, and Alicja Wolk. Consumption of sugar and sugar-sweetened foods and the risk of pancreatic cancer in a prospective study. *Am. J. Clin.Nutr.*, 2006, 84 (5):1171-1176.
71. http://news.softpedia.com/news/Too-Much-Sugar-Finishes-Off-Your-Sex-Life-70524.shtml, 07.08.2015
72. nancyappleton .com. , 07.08.2015.