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A LITERARY REVIEW ON POTENTIAL HEALTH RISKS OF "SOFT DRINKS"

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ABSTRACT

"Flavored carbonated beverages" are popularly known as "Soft Drinks" which typically contain carbonated water, a sweetener and a flavoring agent. It may also contain caffeine, colouring, preservatives and other ingredients including less than 0.5% of alcohol of the total volume if the drink is to be considered non-alcoholic. Soft drinks are the beverage of choice for millions of people, second only to water. The first marketed soft drinks in the Western world appeared in the 17th century, which were made of water and lemon juice sweetened with honey. There are no nutritionally beneficial components in soft drinks. Soft drinks mostly consist of filtered water and refined sugars. A recent report indicated that Sri Lankans have consumed 62 million liters of carbonated soft drinks in 2009, and 2012 report showed that overall, 82 % consumed sugar-sweetened soft drinks once weekly or more often. The consumption of soft drinks is mostly associated with weight gain & obesity, diabetes mellitus, weakened bones and risk of osteoporosis, increased blood pressure, heartburn, and metabolic syndrome risk factor, harmful effects on liver, impaired digestive system, dehydration, asthma and behavioral aggression. The present literary review was undertaken to assimilate the knowledge of potential health risks of soft drink consumption in healthy life of an individual. Details and facts on harmful effects of soft drinks were gathered from WHO reports, research articles, scientific journals and through web search. It is concluded that consumption of soft drinks is a threat for the future generation.

KEYWORDS: Flavored carbonated beverages, soft drinks, potential, health risks, non-alcoholic consumption.

1. INTRODUCTION

Flavored carbonated beverages (FCB) are popularly known as Soft drinks (SDs), which are defined as water-based flavored drinks usually with added carbon dioxide and with nutritive, nonnutritive, and/or intense sweeteners with other permitted food additives.[1] Carbon dioxide, a common factor to all carbonates, is added to make drinks fizzy. Other ingredients include sugar, acid (citric acid, malic acid, and phosphoric acid), fruit juice, preservatives, flavourings, and colourings.[2]

The sweetener may be sugar, high-fructose corn syrup, fruit juice, sugar substitutes in the case of diet drinks or some combination of these. Soft drinks may also contain caffeine.[3] Small amounts of alcohol may be present in a soft drink, but the alcohol content must be less than 0.5% of the total volume if the drink is to be considered non-alcoholic.[4] Soft drinks are refreshing beverages and they are typically formulated from 10 – 11% sugar content with about 0.3 – 0.5% of acid (usually citric) and flavoring, coloring and chemical preservatives, with the addition of carbon dioxide.[4]

Flavored carbonated beverages are having different names according to the places where they used. For instance, in parts of the United States and Canada, flavored carbonated beverages are referred to as "pop"; in other parts "soda"; in yet other parts "coke"; in England "fizzy drinks"; in Ireland "minerals"; and there are a variety of other names commonly used as well.[5]

The most popular types of soft drinks are as: ready-to-drink essence-flavored beverages; ready-to-drink beverages containing fruits or fruit juice; and beverages ready-to-drink after dilution.[6]

Soft drinks are a common component of the diet in many parts of the world today,[7] or it is the choice for millions of people, second only to water,[8] because, it is a source of water, energy, micronutrients, alternative to alcohol, rapid thirst quenching, and replace lost salt and energy quickly.[4] Almost all the food energy in soda- pop is from refined cane sugar or corn syrup. Each serving of a typical carbonated soft drink contains more than the recommended daily allotment of sugars.[5] According to World Health Organization (WHO) Guideline 2015 on the intake of free sugars, a single can of sugar-sweetened soda contains about the upper limit of the recommended 25–50 grams per day.[9] Current evidence suggests that reducing sugars intake, especially in the form of sugar-

sweetened beverages, may help maintain a healthy body weight and possibly reduce the risk of overweight and obesity in adults.[10]

Global Soft Drinks report-2008 indicates that a total of 552 billion liters of soft drinks were consumed in 2007, which is equivalent to 82.5 liters per person and carbonated soft drinks claimed 36.8% of the soft drink market.[7] The consumption of sugary drinks has increased worldwide in the last decades; according to the Global Burden of Disease.[11]

A recent report indicates that Sri Lankans have consumed 62 million liters of carbonated soft drinks in 2009,[7,12] and 2012 report showed that overall, 82 % consumed sugar-sweetened soft drinks once weekly or more often.[13] Average consumption worldwide increased from 9.5 gallons per person per year in 1997 to 11.4 gallons per person per year in 2010. An estimated 54% of soft drink consumption occurred in low- and middle-income countries from 1997 to 2010.[14] In 2010, Singh and colleagues estimated that among all worldwide yearly deaths from diabetes and cardiovascular diseases about 178 000 were attributable to sugary drink consumption.[11]

In fact, per capita consumption of carbonated soft drinks in Sri Lanka is 21 bottles compared to India's 5 bottles and Pakistan's 17 bottles,[15] with 62 million liters of carbonated soft drink consumed by Sri Lankans per year, [16] thus, carbonated soft drink industry is one of the growing industries in Sri Lanka, especially among the educated youth generation.[12] Soft drink intakes could be a marker for poor nutrition, with individuals who consume more sweetened beverages eating poorer diets in general. Soft drinks might also stimulate people's appetite for other non-nutritious foods.[17] The aim of the study was to assimilate the knowledge of potential health risks of soft drink consumption in healthy life of an individual.

2. METHODOLOGY

Details and facts on harmful effects of soft drinks were gathered from WHO reports, research articles, scientific journals and through web search.

3. LITERATURE REVIEW

3.1. History

A drink or beverage is a liquid specially prepared for human consumption. Apart from being a basic need, beverages form part of the culture of human society.[18] The first marketed soft drinks in the Western world appeared in the 17th century, which were made of water and lemon juice sweetened with honey. In 1676, the Compagnie de Limonadiers of Paris, France, was granted domination for the sale of lemonade soft drinks.[19] In the late 18th century, scientists made important progress in replicating naturally carbonated mineral waters. In 1767, Joseph Priestley first discovered a method of infusing water with carbon dioxide to make carbonated water is the major and defining component of most soft drinks. Thomas Henry, an apothecary from Manchester, was the first to sell artificial mineral water to the general public for medicinal purposes, beginning in the 1770s.[20] In 1772, he published a paper "Impregnating Water with Fixed Air".[21] Swedish chemists Jöns Jacob Berzelius started to add flavors (spices, juices, and wine) to carbonated water in the late 18th century. Schweppes Company in Geneva in 1783 to sell carbonated water.[20]

Businessmen in Philadelphia and New York City also began selling soda water in the early 19th century. America considered that the drinking of either natural or artificial mineral water was a healthy practice and promoted by advocates of temperance in the same period. In the 1830s, John Matthews of New York City and John Lippincott of Philadelphia began manufacturing soda fountains.[5]

Carbonated lemonade was widely available in British refreshment stalls in 1833, and in 1845, R. White's Lemonade went on sale in the UK.[20]

Commercial soft drinks first appeared in 1884 when a product called "Moxie" was made by a drugstore owner in Lisbon Falls in the USA. Soon afterwards, similar products appeared including Coca-Cola® and Pepsi-Cola®. Over the past century, soft drinks have changed dramatically from being a local pharmacy product to worldwide industry that earns $60 billion and produce 1 billion liters per year. These changes have been due to advances in manufacturing technology and marketing innovations.[2] In 1892, the "Crown Cork Bottle Seal" was patented by William Painter, which was the first very successful method of keeping the bubbles in the bottle.[5]

In the early 20th century, sales of bottled soda increased exponentially. In the second half of the 20th century, canned soft drinks became an important share of the market. In 1920s, soft drink vending machines have become increasingly popular.[5] In 1942, annual US production of carbonated soft drinks was 90 (8-oz or 240-mL) servings per person; by 2000 this number had risen to more than 600 servings.[17]

The size of the bottle and the volume of the drink markedly increasing. Before the 1950s, standard soft-drink bottles were 6.5 ounces. In the 1950s, soft-drink makers introduced larger sizes, including the 12-ounce can, which became widely available in 1960.[22] By the early 1990s, 20-ounce plastic bottles became the norm.[23] Today, contour-shaped plastic bottles are available in even larger sizes, such as 1-liter.[24]

3.2 Health hazards of soft drinks

Soft drinks contain many harmful substances such as carbonated water, high fructose corn syrup (sugar),

aspartame, sodium benzoate, phosphoric acid, citric acid and caffeine.[25] Sugar Sweetened Beverages (SSB) are the single largest source of added sugar in the US diet. A typical 12-oz serving of soda contains 140 to 150 calories and 35.0 to 37.5 g of sugar.[26] There are positive association between SSB intake and weight gain,[26] or obesity,[27,11] diabetes mellitus,[27,11] coronary heart disease (CHD),[26] and other non-communicable diseases (NCDs)[27] with cardiometabolic death.[11]

Caffeine is one of the main components in carbonated-soft drinks, which triggers the excitation of the reticular system within the brain. Excess excitation of the system leads to insomnia, psychomotor agitation and headaches;[9] excess caffeine links to anxiety and sleep disruption.[28] Both caffeine and sugar cause dehydration. Caffeine is a diuretic and causes an increase in urine volume. High concentration of sugar is drawing off water because kidneys try to expel the excess sugar out of the blood. When drink a caffeinated soda to quench thirst, will actually become thirstier.[8]

There are over 92 different health side effects associated with aspartame consumption, which is the most dangerous artificial sweetener, which is about 200 times sweeter than the table sugar.[29] Aspartame is made up of aspartic acid, phenylalanine and methanol. Aspartame links with insomnia, headaches, seizures, neurotoxicity and memory loss. The excess accumulation of these components results in cytotoxic effects.[9] After the consumption it breaks down into its starting components and they further converts to formaldehyde and formic acid, which are known carcinogens.[29]

Sodium benzoate has been investigated by researchers at University of Sheffield as a possible cause of DNA damage and hyperactivity.[30]

Soft drinks have been banned from schools in Britain and France and in the United States, school systems as large as those in Los Angeles, Philadelphia and Miami have banned or severely limited soft drink sales. Many US states have considered statewide bans or limits on soft drink sales in schools, with California passing such legislation in 2005.[17]

The high content of sugar and acids, which have cariogenic and acidogenic potential, can contribute to dental caries, tooth erosion, as well as contributing to health effects such as overweight and obesity and may be associated with an increased risk of type 2 diabetes. Efforts have been made by manufacturers and government agencies to reduce the potential harmful effects of sugar-containing soft drinks on teeth and general health. These include banning the sale of soft drinks in schools, restricting soft drinks advertising, modifying the composition of soft drinks and introducing tax on sugar-containing soft drinks.[2]

Researchers have reported that potential health risks of soft drinks in various conditions. These have been highlighted in detail in following headings.

3.2.1 Obesity and weight-related diseases

Obesity has recently emerged as a major global health problem. The World Health Organization (WHO) and Scientific Advisory Committee on Nutrition (SACN) recommend a diet where a maximum 5% of the energy comes from free sugars. A rising consumption of sugar-containing soft drinks has been suggested as a major contributor to the obesity epidemic. The increase in intake of sugar-containing soft drink has coincided with rising body weights and energy intakes in several populations.[2] Overweight and obesity can have major costs for individuals and their families as well as for the health care systems. It increases the risk of developing type 2 diabetes and heart disease as well as doubles the risk of dying prematurely.[31]

Rising consumption of Sugar-sweetened beverages are one of the major contributors to the obesity epidemic. A typical 20-ounce soda contains 15 to 18 teaspoons of sugar and upwards of 240 calories. A 64-ounce fountain cola drink could have up to 700 calories. People who drink this “liquid candy” do not feel as full as if they had eaten the same calories from solid food and do not compensate by eating less.[32] Many people either forget or don't realize how many extra calories they consume in what they drink. Drinking a single 330 ml can a day of sugary drinks translates to more than 1lb of weight gain every month.[8]

Several scientific studies have provided experimental evidence that soft drinks are directly related to weight gain,[33] for each additional soda consumed, the risk of obesity increases 1.6 times. According to the results of high-quality study[34] reducing consumption of sugar-sweetened beverages helped reduce body mass index in the heaviest teenagers.[35] An 18-month study was conducted to investigate the Sugar-free or Sugar-Sweetened Beverages and body weight in children. 641 primarily normal-weight children were randomly assigned to receive 250 ml (8 oz) per day of a sugar-free, artificially sweetened beverage (sugar-free group) or a similar sugar-containing beverage that provided 104 kcal (sugar group). They found that replacement of sugar-containing beverages with non-caloric beverages reduced weight gain and fat accumulation in the normal-weight children.[36]

A recent new study of 33,097 individuals showed that among people with a genetic predisposition for obesity, those who drank sugary drinks were more likely to be obese than those who did not.[37] It suggests that genetic risk for obesity does not need to become a reality if healthy habits, like avoiding sugary drinks. On the other hand, genetic obesity risk seems to be amplified by consuming sugary drinks.[24]

3.2.2 Diabetes

Overweight and obesity are major risk factors for a number of chronic diseases, including diabetes mellitus, cardiovascular diseases and certain types of cancer.[38,39,40] There has been a rapid and large increase of type 2 diabetes mellitus, which has emerged as a global public health concern, parallel to the global trends in the prevalence of obesity by increased consumption of soft drinks.[41,42]

The most striking link between soft drink consumption and health outcomes was the prospective evidence obtained for metabolic syndrome especially type 2 diabetes mellitus.[17] In a study of 91249 women followed for 8 years, those who consumed one or more servings of soft drink per day were twice as likely as those who consumed less than one serving per month to develop diabetes mellitus over the course of the study.[17]

Anything that promotes weight gain increases the risk of diabetes. Drinking soda not only contributes to making people fat, but it also stresses the body's ability to process sugar.[43] Some scientists now suspect that the sweet stuff may help explain why the number of Americans with type 2 diabetes has tripled from 6.6 million in 1980 to 20.8 million today.[35]

3.2.3 Effect on dental health

It is well documented that the consumption of soft drinks has detrimental effects on oral health,[7] because a large number of carbonated SDs is acidic with low concentration of calcium and fluoride ions.[13] The soft drinks contain acids mainly carbonic acid, phosphoric acid, malic acid, and citric acid have erosive potential.[44,45] Therefore, the consumption of soft drinks with high acidic content is significantly associated with dental erosion.[46,47,48,49,50,51,52]

Researchers say that soft drinks are responsible for doubling or tripling the incidence of tooth decay.[53] Many studies have shown a positive relationship between dental caries and intake of soft drinks.[46,47,48,49,50,54] Soda's acidity makes it even worse for teeth than the solid sugar found in candy. The greatest risk for dental caries development in children is associated with the consumption of soft drink between meals rather than with meals.[2]

Dental caries is a multifactorial disease that is affected by several factors including salivary flow and composition, exposure to fluoride,[45] consumption of dietary sugars,[7,45] and by oral hygiene practices.[45] The dental erosion, which is an emerging oral health problem in many societies, is related to its pH, titratable acidity and mineral content.[7] The solubility of dental tissues is affected by a pH and titratable acidity of both the oral cavity and the soft drink. When oral pH drops below the pH of 5.5, enamel dissolution occurs. Most soft drinks excluding bottled waters have a pH that ranges from 2.5 to 3.5 with an average pH of 3.44 for the carbonated drinks and fruit juices.[55]

Regular non-diet soft drinks excluding bottled waters contain large amounts of sucrose or high-fructose corn syrup that have cariogenic potential; a typical 350-ml can of regular carbonated soft drink contains approximately 40g of sugars.[2] Drinking acidic drinks over a long period of time and continuous sipping[2] may dissolve the mineral content of the enamel,[56,57] making the teeth weaker, more sensitive and more susceptible to decay [2, 57] and dental erosion.[57]

Dental erosion can contribute to significant tooth surface loss (TSL) not only in adults but also in children and adolescents resulting in teeth sensitivity, eating and drinking difficulties as well as dissatisfaction with appearance.[58]

3.2.4 Behavioral aggression

Sugary drink consumption was one of the behavioral risk factors that contributed the most to the increase in global attributable deaths and disability adjusted life years (DALYs) between 1990 and 2016.[11] Consumption of carbonated soft drinks has been rising among teens,[59] and is associated with link to violence,[59] aggression, depression, suicidal thoughts and suicidal behavior.[59,60]

Moderate consumption of caffeine can be tolerated by most healthy people, studies showed that its high consumption (>400 mg per day) has been associated with adverse effects on health including anxiety, restlessness, aggression, headaches, and depression. A prolonged exposure to high intakes of caffeine, levels greater than 500–600 mg a day, can result in chronic toxicity leading to nervousness, nausea, vomiting, seizures and cardiovascular symptoms in severe cases.[61,62,63]

Suglia S. F., et al (2013)[60] found that aggression, withdrawal behavior, and attention problems are linked to soft drink consumption in young children. They assessed 5-year-old 3,000 children from 20 different U.S. cities. Even after adjusting for factors such as maternal depression, paternal incarceration, and domestic violence, soft drink consumption was still linked to aggressive behavior. Further, they observed that the children who drank four or more soft drinks per day were more than twice as likely to destroy other people's belongings, get into fights, and physically attack people.

Solnick S. J and Hemenway D (2014)[59] analyzed a national data-set, the Youth Risk Behavior Survey, to examine the relationship between soft drink consumption and aggression, depression and suicidal behaviours among US adolescents. They found that higher soft drink consumption is associated with a range of undesirable behaviours: being in a physical fight, feeling sad or hopeless and having suicidal thoughts and actions.

3.2.5 Soft drinks related to bone density and bone loss

Excessive consumption of soft drinks can also reduce the intake of healthy drinks such as milk, leading to a lower intake of trace elements especially calcium and magnesium, which can increase the risk of osteoporosis and fracture.[27] Further, excessive intake of phosphoric acid changes and imbalance not only the calcium and phosphorus ratio but also the acid-base in the body, resulting in decreased bone density and even osteoporosis and fractures.[27] An observational study was conducted by Fung T.T., et al (2014),[64] to examine the association between soda consumption and d risk of hip fracture in postmenopausal women (n = 73,572) showed that the increased soda consumption of all types may be associated with increased risk of hip fracture in postmenopausal women.

Frequent consumption of soft drinks may also increase the risk of osteoporosis,[27,65] especially in people who drink soft drinks instead of calcium-rich milk.[27,66] High soda consumption in children poses a significant risk factor for impaired calcification of growing bones.[67] 1950s, children drank 3 cups of milk: 1 cup of sugary drinks. Today 3 cups of sugary drinks: 1 cup of milk. osteoporosis is a major health threat for 44 million Americans. Most experts now say that the real culprit is soda's displacement of milk in the diet, though some scientists believe that the acidity of colas may be weakening bones by promoting the loss of calcium.[68]

Several studies reported that SD consumption was associated with lower intakes of milk and dairy products, and one study showed that a 4-oz decrease in SD consumption was related to approximately a 1-oz increase in milk consumption per day.[17]

Soda consumption has been associated with poor bone health in children.[64] A cross sectional observational study (n= 1335) among boys and girls aged 12 and 15 years done to investigate the association between soft drink consumption and the effect on bone mineral density showed that the higher intakes of carbonated soft drinks were significantly associated with lower bone mineral density.[69] In a meta-analysis of 88 studies, drinking soda correlates with a decrease in milk consumption along with the vitamin D, vitamin B6, vitamin B12, calcium, protein and other micronutrients. Phosphorus found in cola-type beverages causes improper combination of too much phosphorus with too little calcium in the body can lead to a degeneration of bone mass.[3]

3.2.6 Kidney stones

Higher consumption of sugar-sweetened soda was associated with a higher incidence of kidney stones,[70,71] because of their acidity, radical mineral imbalances,[8] and the fructose content, which has been shown to increase the urinary excretion of calcium, oxalate, and uric acid, thus increasing the risk of stones.[72] Our body must buffer the acidity of soft drinks with calcium from our own bones.[8] Drinking two or more colas that are high in phosphoric acid not only increases one's chance of developing kidney stones but also chronic kidney disease.[73]

The study was conducted by Shuster J., et al (1992),[74] on 1009 men between the ages 18 to 75 who had already suffered from kidney stones and consumed 160 ml of soft drinks per day. Half of the subjects refrained from having aerated drinks, and the other half was monitored closely for their soft drink intake. They observed that men who refrained from soft drink intake had a 6.4 percent higher chances of having a three-year recurrence-free period from kidney stones.

3.2.7 Soft Drink Consumption and Energy Intake

Several studies showed that the increase in energy intake associated with soft drink consumption was greater than what could be explained by consumption of the beverages alone, suggesting that such beverages might stimulate appetite or suppress satiety, perhaps because of a high glycemic index.[17]

3.2.8 Soft Drink Consumption and Milk and Calcium Intake

Carbonated soft drinks contain mostly empty calories.[75] High consumption of soft drinks was related to low consumption of milk,[7,17,69] dairy products, calcium, fruit and dietary fibres contributing to an overall poorer diet.[69,75]

Several studies reported the correlation and association between soft drink consumption and poor or lack of milk and calcium intakes.[17] Calcium is found mainly in dairy products and is an essential nutrient for the structural integrity of bone and for maintaining bone density throughout life.[44] A study conducted by Vartanian L. R., et al (2007)[17] and found that a 1-oz decrease in soft drink consumption was related to approximately a 0.25-oz increase in milk consumption. In other words, reducing soft drink consumption by one 16-oz serving per day would be associated with an increase of approximately 4 oz of milk per day; and in the same study showed that the Calcium intake was also negatively associated with soft drink consumption. In addition, in two more studies done by Whiting S.J., et al. (2001)[75] and McGartland C., et al. (2003),[69] the high intake of carbonated soft drinks during adolescence was significantly associated with reduced bone mineral density among girls aged 12 and 15 years.

3.2.9 Soft drinks associated with asthma and COPD

Shi Z., et al (2012)[76] and Al Ibrahim A., et al (2019)[77] found that there was a positive association between soft drink consumption and asthma and COPD among adults.

3.2.10 Increased hypertension and Heart burn

Experts have reasons to believe that overconsumption of fructose, particularly in the form of soft drinks, leads to

an increase in blood pressure.[78] and a strong predictor of heartburn.[79]

3.2.11 Heart attack

Fung T.T., et al (2009).[80] conducted a study in nearly 90,000 women who drank more than two servings of sugary beverage each day had a 40 percent higher risk of heart attacks or death from heart disease than women who rarely drank sugary beverages. Another study was conducted by De Koning L., et al (2012).[81] in 40,000 men who drank averaged one can of a sugary beverage per day had a 20% higher risk of having a heart attack or dying from a heart attack than men who rarely consumed sugary drinks.

3.2.12 Effect on reproduction

It has been found that CSDs adversely affect reproduction.[82] A study was conducted to investigated the effects of carbonated drinks on ovaries and follicles of 150 female non-cycle mice found that the administration of coca-cola and pepsi-cola for a longer duration could reduce ovarian weights, inhibited the ovarian cortex thickness, affect the development of follicles and oocytes.[83]

3.2.13 Harmful Effects on Liver

There is an evidence that consumption of too many soft drinks puts under increased risk for liver cirrhosis similar to what chronic alcoholics have.[84]

3.2.14 Soft drink consumption and gout

Choi H.K., et al (2010).[85] done a 22-year-long study of 80,000 women and found that those who consumed a can a day of sugary drink had a 75% higher risk of gout than women who rarely had such drinks. Choi H. K and Curhan G (2008).[86] done a 12- year study of 46 393 men consumption of sugar sweetened soft drinks and fructose was strongly associated with an increased risk of gout in men than men who rarely had such drinks.

3.2.15 Cell damage

Chronic SDC induced oxidative stress, metabolic alterations and changes in gene expression in Wistar rats. Oxidative stress has been associated with the etiology and pathogenesis of various chronic diseases and serves a vital role in the aging process. High levels of free radicals or reactive oxygen species (ROS) can cause direct damage to lipids inside cells and induce peroxidation.[87]

Higher consumption of sugary drinks is associated with the risk of overall cancer and breast cancer.[11] Düsman e., et al (2013).[88] investigated that to evaluate the cytotoxic and mutagenic potential of specific cola and grape-flavored soft drink brands on bone marrow cells of Wistar rats proved that the cola soft drink has mutagenic potential in bone marrow.

3.2.16 Sleep pattern

Consumption of soft drinks and other beverages is mostly seen in children and young adults. It affects sleep pattern and its quality especially in students.[9] a recent study conducted by Chaput J. P., et al (2018).[89] illustrated that short sleep duration among children is associated with a longer intake of regular soft drink and earlier bedtimes are associated with regular use of soft drinks and other beverages.

3.2.17 Attention deficit Hyperactivity disorder

Children are getting 30% of sugar intake by soft drinks on a regular basis. Sodium benzoate is found in many food and beverages. Its increased consumption especially in soft drinks and other beverages in children links to attention deficit-hyperactivity disorder.[9] A study was conducted to investigate the effect of different levels of sodium benzoate on mice brain. The results revealed that the sodium benzoate significantly impairs memory and motor coordination, reduces glutathione (GSH) level and increases the malondialdehyde (MDA) level in the brain. These findings suggest that short-term consumption of sodium benzoate can impair memory performance and increase brain oxidative stress in mice.[90]

3.2.18 Use as a Pesticides

Coca-Cola has been tested in many cleaning scenarios and it can be compared to brands to clean oil stains, strip paint, and tile grout. The Center for Science and Environment (CSE) India's one of leading voluntary agencies, in 2003 analyzed samples from 12 soft-drink manufacturers and discovered that all of them contain residues of 4 toxic pesticides and insecticides and consequently many farmers have used to combat pests because of low costs compared to conventional pesticide brands.[91]

4. CONCLUSION

According to the findings, it can be concluded that any types of soft drinks produce harmful effects on human health and is a threat for the future generation.

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