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FUNCTIONAL AND MEDICINAL BEVERAGES: HEALTH EFFECTS AND CLINICAL APPLICATIONS

V. Devi Rajeswari*[1], D. Sathya Prabu[1], Kanagavalli Ramasubbu[1], Abbas Alam Choudhury[1], Rosmi Jos[1], Menaka Priya Balaji[1], Manosi Banerjee[1], Shreya Chakraborty[1]

[1*]Department of Biomedical Sciences, School of Biosciences and Technology, VIT University, Vellore –632 014, Tamilnadu, India.

ABSTRACT

Demand for food and increasing with the population increasing thus may impart health benefits beyond basic nutrition. Beverages are a major part of the food industry and are composed of alcoholic and non-alcoholic drinks. Beverages were consumed to deliver high concentrations of functional ingredients. Vegetables, fruits, grains, legumes, grains and seeds were the major functional foods that provide health benefits. Recently, the number of functional foods that have a potential benefit on health has hugely grown and scientific evidence is supporting the role of functional foods in the prevention and treatment of several diseases. Due to the increased consumption of beverages, it has become very important to ensure the proper assessment of the antioxidant properties of beverages. The present study deals with the preparation of raw materials, traditional processing, composition, and ethnomedicinal importance of each food to encourage entrepreneurs to develop large-scale production to meet the growing market demand for functional foods.

KEYWORDS

Alcoholic Beverages, Non-alcoholic beverages, Anti oxidant properties, Medicinal herbs and Large-scale production.

Author for Correspondence:

Devi Rajeswari V,
Department of Biomedical Sciences,
School of Biosciences and Technology,
VIT University, Vellore, Tamilnadu, India.

Email: vdevirajeswari@vit.ac.in

INTRODUCTION

Nourishment which will be strengthened to moving forward wellbeing clinched alongside people is known as Functional foods (Singer, 2011)[1]. Recent advancement in food science and innovation technology intensified numerous huge developments done making nourishment taster, healthier what's more nutritious (Madureira, Gomes and Pintado, 2014)[2]. Beverages are important food products consumed by the majority of the people worldwide.

Beverages can be defined as aliquid which is consumed by humans devoid of water. The beverages occupy the major part of the food industry. They are classified into three types, alcoholic, non-alcoholic, dairy-based beverages. They play a vital role in human health and diseases. The beverages are consumed largely as refreshments, energy boosters, Stressbusters (WHO, 2011)[3].

The soft drinks industries were booming day to day as largest economy sector creating many jobs directly and indirectly. The competition between the beverage industries leads to adopting producing new flavors with aroma. There is a heavy demand for alcoholic and non-alcoholic (Figure No.1 and Figure No.2) beverages among the consumers (Thiele and Weiss, 2003)[4]. Soft drinks were largely consumed beverages worldwide. Among the soft drink beverages available, more than half of the soft drinks market percentage was occupied by Cola beverages (Navarro e*t al*, 2010)[5]. The soft drinks are available in every corner of the world with many flavors and varieties. Some of the drinks are enriched with nutrients, calorie restricted (zero calories) and some are energy boosters (Kleiner and Greenwood, 2015)[6].

Recently, consumer health awareness leads to the production of healthy beverages with additional nutrients. Addition of bioactive compounds in food products helps in improvement of biological properties, hence, it is used in many beverages and food industry (Lagos *et al*, 2015)[7]. Additionally, many formulations like Nano-emulsion, Micro-emulsion have been made to maintain the quality and physiochemical properties, biological properties of the soft drinks (Piorkowski and Clements, 2014)[8]. To increase the shelf life of the beverages, chitosan-based formulations are preferred for all major types of beverages. Chitosan is a natural polysaccharide from chitin present in fungi used as preservatives in many food products. It is completely safe and eco-friendly which is stable in the stomach and getsadsorbed in the intestine (Rocha, Coimbra and Nunes, 2017)[9]. Similarly, many studies have been carried out by the scientists to increase the shelf life with many health benefits.

Anthocyanins are flavonoids and commonly used natural colorants added to beverages (Andersen and Markham, 2005)[10]. The anthocyanin has abiological activity like anti-diabetic, anti-inflammatory activity (Kuntz *et al*, 2014)[11]. However, long storage tends to lose its physical and biological properties. This problem can be subsided by using gum arabica (2.5%), which enhance the stability of Anthocyanins (Chung, Rojanasasithara, Mutilangi and McClements, 2016)[12]. Likewise, Vitamin E is formulated with food grade ingredients orange oil in water beverages to maintain its stability and properties. Whereas, mild heating of this beverage is stable for aprolonged period (28 days at 4□) (Raikos, 2017)[13].

However, despite health benefits, there are major disadvantages due to excessive intake of the beverages. Excessive intake could lead to metabolic disorders and diseases. The major diseases which might occur due to excessive consumption of beverages are Obesity, type 2 Diabetes mellitus, Cancer, liver problems and sexual disorders (James and Kerr, 2005)[14]. Whereas, in some cases, minor problems like acidity and respiratory problems were noticed. Apart from health issues, excessive intake of alcoholic beverages leads to serious disturbances of personal and to the public life (Edwards, 1994)[15]. The persons who are aberrated with alcoholic beverages could lead to abnormal behavior (psychological, physical), unwanted sexual habits, public nuisance (violence, accidents), affected family relations, affected social-economic relations, affected job profile, prone to commit suicide were commonly noticed in alcoholic beverage consumers (drinkers) (Gmel, Kuntsche and Rehm, 2011[16], Windle, 2003[17], Corrao *et al*, 2004[18]). In India, more than 70% of the road accidents are due to drunk and drive. Hence, the supreme court of India in 2017 ordered to remove the liquor shops besides highway roads (Ruikar *et al*, 2013[19], Sikdar, Rabbani and Dhapekar, 2017[20]). The drinking of alcohol was excessive on weekends particularly in evenings (Heeb, Gmel, Rehm, Mohler-Kuo, 2008)[21].

In this chapter, we discussed the types of beverages available around the world. The health implications of beverage consumption were discussed briefly. An

awareness of beverage consumption is need of the hour. The chapter is written in simple language and it is easy to understand by the general readers. This chapter will be useful in understanding the advantages and disadvantages of the beverage consumption, in terms of health and nutrition.

Alcoholic beverages

Since ancient times (10,000 BC) alcoholic beverages are synthesized and consumed by humans globally. The process of synthesis and purification of these beverages has been evolved to great high since the consumption of alcohol by increased tremendously. The major drinks are wine, beer, whiskey, rum, etc. (Figure No.3). Whereas excessive consumption leads to obesity, diabetes, cancer, liver damage, hypertension, cardiovascular disease, gout, dementia (Sohrabvandi, Mortazavian and Rezaei, 2012)[22].

Wine is one of the healthiest drinks presents since biblical times. Wine is available in many types such as white wine, red wine etc. Red wine is rich in antioxidants like flavonoids, which is composed of bioactive compounds (Catanese, 2013)[23]. Due to the presence of bioactive compound like resveratrol in red wine, the risk for getting Cardiovascular diseases decreases, controls the blood sugar level, stops the early aging process and improves immune system (Fernandez-Mar *et al*, 2012)[24]. The blood cholesterol, low-density lipoproteins levels were found to be low and High-density lipoproteins were increased in red wine consumers (Brownlee, 2006[25], Catanese, 2013[23]). The antioxidant property and nutrients present in red wine were responsible to increase the life span of people in France (Renaud and De Lorgeril, 1992[26], Catalgol, Batirel, Taga, Ozer, 2012[27]). The life expectancy in French population is high when compared to other countries because they consume ared wine daily average of 2-3 glasses (Brownlee, 2006)[25]. It is believed regular consumption of red wine leads to youth full days both mental and physical health, interestingly, getting the chance of diseases is rare (Biagi and Bertelli, 2015)[28]. Despite its health benefits, wine consumers with awareness of its health benefits were limited in number. Still, many people are not aware of health benefits of red wine consumption (Lindsey, 2015)[29]. Beer is comparatively less alcoholic with wine. It contains many bioactive compounds like caffeic acid, catechin, resveratrol, hydroxytyrosol, and melatonin (Li, Cao and Zhu, 2006)[30].

Excessive consumption of alcoholic beverages is harmful to health is due to the presence of alcohol is a high percentage. However, we can't deny health benefits of alcoholic beverages. The alcohol products with minimum alcohol percentage will be beneficial to health. Hence, various techniques were employed to reduce the alcoholic content and enrich the beverage. The enriched beer or wine consists of vitamins, minerals, antioxidants, bioactive compounds that will boost the immune system. Boosting immune system will ultimately cut the risk of getting diseases like cancer, diabetes, aging, etc. (Sohrabvandi *et al*, 2010)[31].

There are many proteins present in the beverages. It is important to study about proteins present in beverages because it has many advance and disadvantage properties. Proteins are the responsible for haze formation in white wines (D'Amato, Fasoli, Kravchuk and Righetti, 2011)[32]. Chitinase and lipid transfer protein are allergenic proteins found in grapes and wine as well (Vassilopoulou *et al*, 2007[33], Pastorello *et al*, 2003[34]). Gluten was found abundant in beer (Colgrave, Goswami, Howitt, Tanner, 2011)[35]. The gluten diet may cause Coeliac, an autoimmune disorder that can occur in people who are genetically predisposed. Gluten is present in many food products like barley, wheat, and rye. The person with this disorder will fail to absorb nutrients, as the small intestine was damaged due to Coeliac (Agrawal, 2013)[36]. Blended coffee preparation can be an alternative drink for Coeliac patients. Whereas, a study determined that beverages are not suitable for the patients suffering from gout disease due to proline content. However, they could not able to figure out the exact association of beverages with gout disease (Eastmond, Garton, Robins, Riddoch, 1995)[37]. A retrospective case study found a strong association between colorectal cancer and alcoholic beverage consumption. The ingredients present in beverages could induce germline mutations in genes involved in repair mechanism. The study concludes people who intake excessive alcoholic beverages, inappropriate diet with a family history of colorectal

cancer is at high risk of getting the disease (Fardet, Druesne-Pecollo, Touvier, Latino-Martel, 2017)[38].

Alcoholic beverages are more considered as more hazardous to human health. The use of alcohol was present since Old Testament times. Bible, Quran and all other religious book mentioned to avoid consumption of alcohol. The alcoholic beverages lead to various organ damage when consumed excess. Recently, the alcohol use in Halal products became controversial. Halal is derived from the Arabic word which means permissive limits. Based on the quantity of ethanol present in Halal products it is classified into Mubah (less than 1% ethanol), Haram or non-halal (1-15% ethanol). More than, 15% is not recommended to drink, hence, can be used for industries. The halal-certified products are alcohol-free, recommended to eat (Alzeer and Hadeed, 2016)[39].

There are several methods employed to produce alcohol fewer beverages. The synthesis of alcoholic beverages can be achieved by adding immobilized yeast. But this method lacks aroma and taste, hence, consumers pay less attention to these beverages. Traditionally distillation process, ethanol will get evaporated in the heating process. There is an advanced technique known as the spinning-cone column is used to separate ethanol using water vapor. Membrane technology is employed in industries widely as it won't affect the taste and nutrition quality. Membrane-based technology aredistinct types such as Reverse osmosis, Nanofiltration, Dialysis, Osmotic distillation, Pervaporation (Mangindaan, Khoiruddin, Wenten, 2017)[40]. The major problem for neglecting dealcoholic beverages by drinkers is due to poor aroma and taste properties, which is lost during the dealcoholic process. Spinning cone column is one of the techniques which solved the problem as it retains the aroma and other properties during the dealcoholic process. In this technique, the alcohol content is removed from alcoholic beverage by pervaporation and blended with afresh alcoholic beverage to retain its aroma and its properties as such in an alcoholic beverage (Catarino and Mendes, 2011)[41].

Non-alcoholic beverages

The non-alcoholic beverages are completely devoid of alcohol considered to be healthy drinks. Coffee, tea, cola are the popular beverages consumed by the majority of the people worldwide regularly (Figure No.4). The antioxidants present in these beverages known for the health benefits. The antioxidants engulf the free radicals and protect from various diseases. However, there are reports which show that certain beverages like coffee, tea, cola, etc. can exhibit harmful effects to humans (Day, Made, Too, 2015)[42].

Coffee

Coffee is one of the most favorite beverages consumed by almost all the people in the world. Coffee is produced from the coffee beans of coffee plants. The coffee plants are grown in southern parts of Africa and tropical regions of Asia. Countries like Brazil, Vietnam, Indonesia, and Colombia shares majority of the coffee production. The coffee beans are collected, processed, milled and transported as green coffee. The green coffee beans were further roasted at 280□ to make it brown (Day, Made, Too, 2015)[42].

A cup of coffee approximately contains 65-75mg caffeine. Caffeine may have serious effects on health for those who consume excessively. Hence, decaffeinated coffee can be preferred by those who consume excessive coffee. The decaffeinated coffee can be synthesized using analytical techniques like solvent extraction process or supercritical carbon dioxide.Regular coffee consumption (2-3 cups a day) may reduce occurring of various chronic diseases like fibrosis, cirrhosis, hepatitis B and C, and hepatocellular carcinoma. Coffee consumption keeps the liver enzymes like alanine amine transferase in normal levers. Whereas, gamma-glutamyl transferase (GGT) expression was decreased in coffee consumers, the enzyme usually found high in alcoholics. Caffeine content in coffee may be responsible for medicinal benefits. Caffeine regulates ARE-dependent genes by regulating MAPK pathway. Apart from caffeine, the key compounds responsible for this activity are Cafestol and kahweol (Muriel and Arauz, 2010)[43]. Drinking coffee in enormous number regularly can cut the risk

of getting type 2 diabetes mellitus by regulating incretins levels (Chang *et al*, 2013[44], Van Dam and Hu, 2005[45]). Hence, diabetic patients can be advised to consume coffee regularly (Beidokhti and Jager, 2017)[46].

Caffeine acts in an anti-inflammatory way on multiple components of the immune system, innate immune System (Vivier *et al*, 2008)[47], cell signaling (releases cytokines interleukin 10) involves in the anti-inflammatory process, adaptive immune system. Caffeine decreases the risk of getting Multiple sclerosis (Sharif *et al*, 2017)[48].

In rheumatoid arthritis, decaffeinated coffee favors the diseases, caffeinated coffee doesn't favor (Mikuls *et al*, 2002)[49]. Caffeine was believed to be an antagonist to methotrexate, a standard drug for rheumatoid arthritis (Nesher, Mates, Zevin, 2003)[50], but some studies disproved it (Benito-Garcia *et al*, 2006)[51]. The coffee consumption shows anegative effect on type 1 diabetic patients as it increases insulin sensitivity. Hence, it is advisable to rheumatoid arthritis, type 1 diabetes patients to avoid coffee consumption (Sharif *et al*, 2017)[48].

Chlorogenic acid is an important polyphenol found in large quantity in coffee and found in tea, berry fruits, cocoa, citrus fruits, apples, and pears. The Chlorogenic acid has many biological properties such as Antimicrobial, the antioxidant activity shows Anti-hypertension, anti-inflammatory effects. Anti-diabetic was exhibited by inhibiting the enzyme glucose-6-phosphate and inhibiting glucose absorption. Anti-obesity properties are exhibited by regulating key enzymes related to fat metabolism (PPAR gamma, acetyl-CoA carboxylase, fatty acid synthase etc) (Naveed *et al*, 2018)[52].

In some cases, the role of caffeine is unclear, caffeine could have a strong influence on thyroid hormone, caffeine found to decrease the thyroid hormone levels (Spindel, Arnold, Cusack, Wurtman, 1980)[53]. Contrastingly, the thyroid hormones increased with chronic caffeine administration (Clozel *et al*, 1983)[54]. A case-control study found bladder cancer was found frequent in men in Uruguay followed by white Americans. Consumption of Mate, an herbal tea/coffee from *Ilex paraguariensis* was the major reason for the incidence of cancer. The study also suggests coffee and tea as major risk factors for bladder cancer (De Stefani *et al*, 2007)[55].

A beverage prepared using ginger (*Zingiber officinale*) was used since Ayurvedic time. Ginger extract drink can be used an alternative to coffee. The ginger beverage is rich in antioxidants and minerals like selenium, zinc, copper, Iron, manganese, sodium, magnesium, calcium and potassium. The beverage is helpful in combating diseases like diabetes (Al-Amin *et al*, 2006)[56], cancer (Habib, 2008)[57], gout, rheumatic disorder (Funk, Frye, Oyarzo, Timmermann, 2009)[58] and acts as an anti-inflammatory (Dugasani *et al*, 2010)[59]. Apart from this ginger beverage also acts as remedy for flu-like symptoms, headaches, migraines (Blumenthal, 2000[60], Svarc-Gajic *et al*, 2017)[61].

Tea

Tea is a favorite beverage obtained from *Camellia sinensis,* a shrub. The leaves and leaf buds of this plant are used to produce tea. Tea is one of healthiest beverage with full of antioxidant activity, contains polyphenols, polysaccharides (Hui Cao, 2013)[62]. China, India, Kenya, Sri Lanka, and Turkey are the key players in the production of Tea (Day, Made, Too, 2015)[42]. Tea is produced from the leaves and seeds of the Tea plant. The leaves and seeds of the tea plant are dried immediately after collection to prevent oxidation. Tea is available in different varieties like black tea, white tea, green tea etc.

In countries like Paraguay, Brazil, Argentina and Uruguay different extract beverages are prepared from the plant Yerba mate (Da Silva *et al*, 2014[63], Bracesco *et al*, 2011[64]). Tea is prepared from Yerba mate in some parts of Asia, Europe, and North America. The antioxidants rich Yerba mate has antioxidant, antibacterial, antitumor Activities, anti-inflammatory, hepatoprotective, neuroprotective and anti-depressant properties (Junior and Morand, 2016[65], Correa *et al*, 2017)[66]. The properties were found to be stable in vitro gastrointestinal digestion and in vitro colonic fermentation (Correa *et al*, 2017)[66].

Black tea is largely consumed by people in the west, people in China and Japan prefer green tea. A small percentage (2%) of Chinese prefer Oolong tea. Since

Japanese people consume green tea regularly the lifespan of the people was high (79 years). Cancer mortality, premature death was relatively low in Japanese people due to green tea consumption (Nakachi, Eguchi, Imai, 2003)[67]. Tea consumption also has Antihistaminic and anti-arthritic effects, particularly in women mineral bone density was increased (Johnell *et al*, 1995[68], Kanis *et al*, 1999[69], Hegarty, May, Khaw, 2000[70]). Apart from this, tea leaf extract was proven to have antibacterial, antiviral, Immunostimulator activity (Bandyopadhyay *et al*, 2005[71], Nance and Shearer, 2003[72]).

Apart from this biological activity, tea polyphenols arrest G2/M phase in cancer cell lines. Hence tea can be useful in controlling carcinogenic effect (Wei, Mao, Cai, Wang, 2011[73], Fan *et al*, 2011[74], Chen *et al*, 2012[75]). Tea is rich in anti-oxidants, which prevents oxidative damage in humans. The important bioactive found in the tree is catechin, epicatechin gallate, epicatechin catechin, epicatechin, quercetin, Kaempferol, and myricetin. Particularly, green tea contains high levels of anti-oxidants, it is believed to prevent humans from getting cancers like oral, Breast cancer, Pancreatic, Bladder, pharyngeal, lung, colon, prostate, Gastrointestinal tract and laryngeal cancer, Alzheimer's disease, atherosclerosis, cardiovascular diseases and type 2 diabetes.

Skin cancer

The tea polyphenols cure the skin cancer and in animal models (BALB/c mice). Topical application of tea polyphenols halts the tumor initiation causes due to chemicals and radiation. In animal models, Catechin present tea mediates the induction of apoptosis and arrest the cell cycle in animal models. There are several studies reported where the ingredients present in green and black tea, stop the progression of malignancy (Squamous cell carcinoma) (Wang, Khan, Bickers, Mukhtar, 1989[76], Afaq, Ahmad, Mukhtar, 2003[77], Lu *et al*, 2005[78], Khan and Mukhtar, 2007[79]).

Liver cancer

The ingredients in tea decrease the GST positive hepatic foci was observed. Particularly, green tea decreases the risk of cancer in smokers and alcoholics in humans (Xu *et al*, 1992[80], Zhong *et al*, 2001[81], Sueoka *et al*, 2001[82], Mu *et al*, 2003[83]). Inhibition of hepatocarcinogenesis, multiplicity and tumor incidence of p21, inhibition of cyclin D1 and cdk4 were observed in animal models (Jia, Han, Chen, 2002)[84].

Lung cancer

In animal models, the admiration of tea was found to decrease the volume of tumor size lungs (Landau *et al*, 1998)[85]. In humans, green tea and black tea reduces the risk of getting lung cancer and stop the progression in case of cancer. The chance of getting lung cancer is high among smokers. Hence, it is advisable largely benefitted by smokers as well (Zhong *et al*, 2001[81], Naldi *et al*, 2004[86], Kubik *et al*, 2004[87]). Green tea intake reduces the tumor promotion, gastric cancer, esophageal cancer and stomach cancer, Pancreatic and bladder cancer, Breast cancer, Prostate cancer, Prostate cancer, (Hiura, Tsutsumi, Satake, 1997[88], Takada *et al*, 2002[89], Qanungo, Das, Haldar, Basu, 2005[90], Wang, Guo, Li, 1999[91], Mu *et al*, 2003[83]) Regular consumption of tea protects cardiovascular diseases in men and women (Nakachi *et al*, 1998[92], Nakachi *et al*, 2000[93]). It is proven to have Vasculoprotective, antioxidative, anti-thrombogenic, anti-inflammatory, lipid-lowering effects in animal models (Wu *et al*, 2003)[94] Further, lipid profile was maintained in normal levels with consumption of one cup of tea per day (Sesso, Gaziano, Buring, Hennekens, 1999[95], Raederstorff, Schlachter, Elste, Weber, 2003[96], Stangl, Lorenz, Stangl, 2006[97]). The blood pressure also kept in check to normal levels in cardiac patients with green tea consumption (Sasazuki *et al*, 2000[98], Peters, Poole, Arab, L, 2001[99]). The myocardial infarction, atherosclerosis was reversed to normal with green tea consumption (Wu *et al*, 2003[100], Hirano *et al*, 2002[101]).

Obesity

Mortality rate due to obesity-associated diseases is more prevalent compared to diseases caused due to malnourished (World Health Organization, 2011)[3]. Green, Oolong, and black tea reduced the high lipid profile to normal levels in animal models. The mechanism for the lipid-lowering effect may be caused by stimulating thermo genesis, beta-oxidation by bioactive compounds like catechins,

Epigallocatechin gallate present in tea. By which we can conclude tea helps in management of obesity (Rudelle *et al*, 2007[102], Lin and Lin-Shiau, 2006[103], Klaus, Pultz, Thone-Reineke, Wolfram, 2005[104], Murase *et al*, 2002[105], Kao, Chang, Lee, Chen, 2006[106], Dulloo *et al*, 1999[107], Dulloo *et al*, 2000[108]).

Diabetes

Globally millions (382 million) of people of people are suffering from type 2 diabetes mellitus (IDF, 2013)[109]. It is one of the increasing deadly disorder affects the whole-body metabolic system if not maintained (Ezuruike and Prieto, 2014[110], Castro, Kolka, Kim, Bergman, 2014[111]). In diabetes type 2, the beta cell impairment and insulin resistance lead to a condition called hyperglycemia (LaSalle and Berria, 2013)[112] Black tea reduced the hyper glucose levels to normal in adiabetes-induced rat model (Gomes *et al*, 1995[113], Abeywickrama, Ratnasooriya, Amarakoon, 2011[114]). Diabetes was controlled by African black tea extract with normal food intake in animal models. Similarly, to obesity, catechins, Epigallocatechin gallate could be the possibly managing diabetes (Kao, Chang, Lee, Chen, 2006[106], Shoji and Nakashima, 2006[115], Yang, Wang, Chen, 2001[116]). The antioxidant-rich tea polysaccharides have many biological activities. Polysaccharides in tea controls type 2 diabetes by inhibiting alpha-glucosidase (Wei *et al*, 2010)[117], Wang *et al*, 2010[118]. Reported the alpha-glucosidase inhibition can be enhanced used Microwave assisted technique. Wei *et al*, 2012[119] reported Polysaccharides inhibit alpha-amylase and alpha-glucosidase activity. Hence, it is necessary to advise to people who are a risk of getting diabetes to consume tea regularly, especially black tea (Beresniak, Duru, Berger, Bremond-Gignac, 2012[120], Odegaard *et al*, 2008[121]). Regular consumption can cut off the risk of diabetes. In diabetic patients' tea consumption will maintain the homeostasis ofblood sugar levels. However, precautions should be taken in choosing sweeteners.

Sugar free

Low-calorie sugar is rich in sweetness (Taste) devoid of calories. Low-calorie sugars can be used in beverages as a substitute for regular sugar (Sucrose, Fructose syrup). This substitution can help in regulating the high calorie related diseases like obesity and diabetes. Some of the sweeteners available in the market are acesulfame-potassium, aspartame, advantage, neotame, saccharin, and sucralose. Presently, Sucralose is the wide sweetener in beverages, confectionary, bakery products, and certain food products. However, the substitute sweeteners are controversial due to the carcinogenic properties (Cyclamate banned in 1969) (Sylvetsky and Rother, 2016)[122].

Miracle fruit (*Synsepalum dulificum* Daniell) are red berries, sweeter in taste devoid of calories. The miracle fruit is rich in phytochemicals, antioxidants have artificial sweetener properties, (Rodrigues *et al*, 2016)[123]. Studies proved Miracle fruit has anti-diabetic, anti-obesity, anti-cancer properties (Chen *et al*, 2015)[124]. Hence, miracle fruit ingestion in beverages can better substitute for sugar used in beverages.

Fruit juices

Fresh fruit juices are obtained from the fruits by mechanical squeezing, macerating using electric mixers etc. Industries produce more quantity of fruit juices and preserve in universal standard preservative techniques. Fruit juices are naturally rich in vitamins, antioxidants, and high energy content. The fruit sugar present in fruit juices is fructose, a monosaccharide, sweetest of all sugars.

Soft drinks

Soft drinks are an artificially sweetened beverage, widely prepared in large scale industries and distributed throughout the world (Day, Made, Too, 2015)[42]. They are majorly carbonated artificial sweeteners with no fruit. Small-scale industries also synthesis soft drinks, however, the reach is less. Cola and related soft drinks occupy majority percentage around the world. Soft drinks were are liable source of energy with high calories of carbohydrates. The preservatives and the ingredients are believed to cause many side effects and diseases. Diabetes, Obesity, and Cancer are the major diseases may occur due to over-consumption of soft drinks. However, it is still controversial.

Soft drinks contain high calories, regular consumption will lead to a disorder like obesity (Hu, 2013[125], Malik *et al*, 2010[126]). In a meta-analysis study (173,753 participants), the relation between

sugar-sweetened beverages (SSBs) consumption and risk of coronary heart disease (CHD) was studied with the literature up to February 2013 in available databases using Random-effects models. The analysis found a significant association for men but not for women. It is important to notice that additional one-severing per day of SSBs will increase the CHD risk about 16%. This study concludes consumption of sugar-sweetened beverages may increase the risk of CHD. The risk is high in men compared with women (Chen *et al*, 2014)[127]. Allostatic loadis an early warning sign of getting diseases. Allostatic load is being studied using different health parameters (Biomarkers). Consumption of Soft drinks in excess increases allostatic load (Van Draanen, Prelip, Upchurch, 2017)[128]. The reduction of sugar quantity in beverages was the only solution to curb many diseases (Miele *et al*, 2017)[129]. However, are cent study in the US between 2003-2014 show consumption of beverages declined among children and adults (Bleich, Vercammen, Koma, Li, 2017)[130].
Beverages with high sugar content are arisk for thehealth of people around the world. The increase in deadly disorders like Obesity and diabetes in recent tears makes a concern. In developing and underdeveloped nations, where people are lack of knowledge about beverages (alcoholic and non-alcoholic) and its implications on health. Action must be taken by the government and health-related organizations in regulating these beverages. Complete abolition of sugary beverages will not make a solution. To decrease the harmful sugary beverages, the Gulf nations doubled the taxes. Many countries have relocated the sugary beverage shops away from schools and colleges (Kwawaja, 2012[131], Popkin, 2012[132]).
The excessive intake of beverages causes overweight and not everyone who is obese will get diabetes (Olsen and Heitmann, 2009[133]). Despite weight gain from sweetened beverages, most of the youngsters in Latino feel sports drinks are healthy (Bogart *et al*, 2013)[134]. But there are chancesfor obesity-associated diseases in risk group based on their familial history and genetic factors. However, diabetic patients should follow adiabetic diet to maintain the normal blood glucose level. As per American diabetic association (ADA), diabetic patients should consume low salt, low trans-fat, avoid starch containing vegetables, sweetened beverages, and alcoholic beverages (Falling and Rising. 2017)[135]. There is a myth diabetic diet decreases the blood glucose, but the diabetic diet is what we consume produces less sugar which maintains the blood homeostasis (Chandalia *et al*, 2000)[136].

Fermented beverages

Fermentation is a process used for many years to protect food from spoiling. The use of this technique in beverages is trending for its health attributes. It is further divided into dairy and non-dairy products. Dhoog, Ayran, Chass, Lassi, Kefir, Shubat, Amasi, Kivisto etc. are some of the fermented dairy products available across the world. Likewise, there are many non-dairy fermented products such as Boza, Bushera, Koko, Kvass, Mahewu, Pozole, Togwa, Hardaliye, Kombucha, Water Kefir etc. (Marsh, Hill, Ross, Cotter, 2014)[137]. These fermented products help in maintaining the gastrointestinal health (Metchnikoff, 2004)[138], aids in lowering blood pressure, provides adequate nutrition and enhance immunity (Kumar *et al*, 2012)[139]. The health benefits of the fermented products help in combatting the major diseases (Tillisch *et al*, 2013)[140].
Soy Milk was the best source for health it is enriched with bioactive compounds, nutrients, anti-oxidants etc. Other hands, Soy-tea (Zhao and Shah, 2014)[141], Soy-apple juice (Icier, Gunduz, Yılmaz, Memeli, 2015)[142], mixes like soy peanuts (Do Amaral Santos, Da Silva Libeck, Schwan, 2014)[143], Soy cereals and soy legumes (Mridula and Sharma, 2015)[144] are different varieties of preparations are made in combination with soy milk. Tofu is a beverage made from soybean with rich in protein content available worldwide, particularly popular in Asia due to the health benefits (Yeo and Liong, 2010[145], Belen, Sanchez, Hernandez, Auleda, Raventos, 2012[146]).
Functional foods are fermented using microorganisms like Lactic acid bacteria, Actinobacteria, Proteobacteria, yeast and molds (De Roos and De Vuyst, 2018)[147]. Dongmo *et al*, 2016 has listed the lactic acid fermented malt-based beverages (Dongmo, Procopio, Sacher, Becker,

2016)[148]. The fermented products are pH tolerance, NaCl resistance, Temperature, Bile resistance. Lambic beer native of Belgium is made up of barley (malt), wheat (unmalted), hops (dry) and required an amount of water and left in the wooden box for three years for fermentation (Matsushita *et al*, 2016)[149]. Microorganisms involved in fermentation process are *Enterobacteriaceae*, *Saccharomyces cerevisiae, Saccharomyces pastorianus, Pediococcus damnosus, Lactobacillus brevis*, *Dekkera(Brettanomyces) bruxellensis, Acetobacter lambic*, *Gluconobacter cerevisiae* and *Acetobacter Orientalis* (Spitaels *et al*, 2014[150], Spitaels *et al*, 2015[151], Snauwaert *et al*, 2016[152]) Low alcoholic beverages like Water Kefir were made using sugar, dried fruits, kefir and required amount of water was added. The mixture is allowed to fermentation for few days (2-4 days) (Laureys and De Vuyst, 2014)[153], using, *Lactobacillus hilgardii*, *Lactobacillus angelic*, and *Lactobacillus paracasei* (Laureys and De Vuyst, 2017)[154] *Acetobacter sicerae* (Li *et al*, 2014)[155].

Probiotics are live microorganisms present in beverages help to mankind by exhibiting many health benefits. The major probiotics present in dairy products and in fermented foods are lactic acid bacteria and bifido bacteria. Bifidus milk is produced using bifidobacteria using fermentation under optimum conditions. Whereas, Koumiss-Kumiss (Koumiss/airag), a naturally fermented milk product was apopular beverage in Russia. This fermented milk is recommended in patients suffering from asthma, pneumonitis, tuberculosis, cardiovascular diseases and gynecological diseases (Yerlikaya, 2014[156], Marsh, Hill, Ross, Cotter, 2014[157]). Commercially, acidophilus milk is produced using Lactobacillus acidophilus under optimum conditions (Shiby and Mishra, 2013)[158]. Probiotics beverages are also prepared from human-derived microorganisms like *Lactobacillus acidophilus*, *Lacto Plantarum, and Lacto bacilusreuteri using* oats, barley and malt were widely accepted for human consumption (Salmeron, Thomas, Pandiella, 2014)[159].

In India, the fermented beverages are in practice traditionally for many generations (Masson, 1996)[160]. Since ancient times, medaka (spiced rice beer), Prasanna (spiced barley or wheat beer), asava (sugarcane beer) etc. were the popular beverages mentioned in the literature. Fermented beverages were produced using cereals, pulses, vegetables, fruits and milk (Ray, Ghosh, Singh, and Mondal, 2016)[161]. Rice is the staple food for Indians, particularly in south India. India was the second largest producer of rice in the world after China (Muthayya, Sugimoto, Montgomery, and Maberly, 2014)[162]. There are many fermented popular foods produced from rice Idli, Dosa, Dhokla, Uttapam, Selroti, Babru, Ambeli, Adai and vada, Sour rice, Sez, Chitou/appam, Anarshe, pitha, Chakuli, Enduripitha, Munha pitha, Chhuchipatra pitha, Podo pitha. The popular beverages produced from rice are Haria, Apong, Judima, Zutho, Bhaati jaanr, Rice Jann. These beverages and food products are rich in nutrients, majorly carbohydrates, protein, fiber, minerals, trace elements (Ray, Ghosh, Singh and Mondal, 2016)[161]. There are many beverages made using rice with enriched nutrients and supplements in Asia and American countries. Haria a low alcoholic fermented beverage (Bifidobacterium sp.) found in central and northeast India, asimilar type of beverage called “Chhang” was found in Himalayan regions. In Brazil, arice-based beverage called chichi was found (Ghosh *et al*, 2014[163], Ghosh *et al*, 2015[164], Thakur, Saris, Bhalla, 2015[165], Puerari, Magalhaes-Guedes, Schwan, 2015[166]).

Despite India, one of the leading producers of cereals, Indian Institute of Horticultural Research, Bengaluru insists the need for the requirement of Zinc and Iron as the deficiency of minerals rises alarm across the country. The mineral deficiency can be overcome by taking small measures in the diet adding pulses, fermented beverages, fermented foods (Ganeshamurthy, Kalaivanan, Manjunath, 2017)[167]. The fermented food Idli and Dosa is a traditional highly consumed diet in south India will fight against mineral deficiency. Idli and Dosa effectively absorb the minerals like Iron and Zinc from thediet. This diet is highly beneficial to vegetarians (Ganeshamurthy, Kalaivanan, Manjunath, 2017[167], Sathish, 2017[168]).

The coconut water also helps to fight against mineral deficiency, as it is rich in minerals and nutrients

Coconut water is a nutritious fluid obtained from the fruit of coconut plant, *Cocos nucifera* L. Coconut water is rich in electrolytes, vitamins, and health factors. The functional beverage was made using Coconut water by fermentation process with *Lactobacillusplantarum* at required conditions. This is a non-alcoholic beverage can have additional benefits when compared with normal coconut water (Prado *et al*, 2015)[169]. The antioxidants present in coconut water helps to fight against carcinogens, cardioprotective, maintaining the homeostatic of blood glucose and lipid levels (Deb Mandal and Mandal, 2011)[170].

Recently, novel strategies were approached by scientists to produce healthy beverages. Lu *et al*. 2017[171] produced a non-dairy beverage from the fermented pulp using durian pulp by inoculation of yeast (*Williopsis saturnus*). This beverage found to an alternative to people who are allergic to dairy products (Lu *et al*, 2017)[171]. Similarly, the kombucha is a sweet carbonated beverage produced by fermentation of tea with fungus in presence of oxygen. The name Kombucha is derived in respect of the doctor Kombu, who used treat the digestive problem with tea fungus (Liu, Hsu, Lee, Liao, 1996[172], Teoh, Heard, Cox, 2004[173]). The non-alcoholic beverage, Kombucha is prepared using tea, sucrose, water with the inoculation of kombucha culture. The prepared Kombucha mixture is allowed to ferment for few weeks (1-3weeks) at room temperature (Marsh, Hill, Ross, Cotter, 2014[137], Reva *et al*, 2015[174]), using *Komagataeibacter xylinus* (Dutta and Gachhui, 2007)[175]. Using *Acetobacter pasteurianus* the cocoa was fermented for four days at room temperature (Illeghems, De Vuyst, Papalexandratou, Weckx, 2012)[176].

Recently, alternative method to conventional pasteurization (high-temperature short-time pasteurization) method is developed, in order maintain the physical and medicinal properties of the beverages called high-intensity ultrasound (HIUS) were tested for fermentation (Monteiro *et al*, 2017)[177]. Beverage macroemulsions (More than 2 microns) are prepared using biopolymers like gum acacia, modified starch, chitosan, sodium dodecyl sulfate etc., to maintain the stability, targeted delivery, enhancing the shell life and physiochemical properties (Peters, Poole, Arab, 2001)[99].

Mycotoxins

There is a chance for contamination of both alcoholic and non-alcoholic beverages with toxic substances called as mycotoxins. There are hundreds of mycotoxins found and are majorly belongs to fungi (Richard, 2007)[178]. Mycotoxins are harmful to humans in many ways as it can be nephrotoxic, immunotoxin, mutagen, and carcinogenic (aflatoxin B1) (Van Egmond, Schothorst, and Jonker, 2007)[179]. These toxic substances can't be easily destroyed by heating (Cooking) as it is stable even at elevated temperatures (Bullerman and Bianchini, 2007)[180]. Hence, the beverages or food contaminated with mycotoxins can be toxic even after cooking and cause serious health problems if consumed. Mycotoxins in beverages can be removed by using a method called a Quick, Easy, Cheap, Effective, Rugged and Safe method (QuEChERS) (Azaiez *et al*, 2014)[181]. Soy products don'tfavor the growth of mycotoxins, however, there is a chance for contamination of soy, products with the mycotoxin (Nesheim and Wood, 1995)[182]. Some studies using QuEChERS method confirm the presence of mycotoxins in beverages of soy, oat, and rice (Miro-Abella *et al*, 2017)[183]. In china, a survey conducted during 2007-2009 indicate the presence of carcinogens like Ethyl carbamate naturally in alcoholic beverages. Even government set permissible levels for Ethyl carbamate in the alcoholic beverages, the study says there is a significant risk for the consumers (IARC, 2010[184], Chen *et al*, 2015[124]). While giving importance to the health of beverages, care must be taken about the ice/ice cubes, added to the beverages. The contaminated ice may contain pathogens like enteric bacteria, predominantly, *Enterococcus* and *Stenotrophomonas* were present (Gaglio *et al*, 2017)[185].

Recycling

The waste from beverage industry was disposed of using landfills as unused product. There are lot attempts made to convert the waste into auseful product. In such effort, Kefir was made using the waste product whey instead of milk (Marsh, Hill,

Ross, Cotter, 2014[137], Tuorila, Cardello, 2002)[186]. The waste parts of coffee plant parts from coffee industries can be utilized as fertilizer. The fertilizer from coffee plants was rich in nutrient properties, which could help to make land fertile. Apart from this, conversion of coffee waste to fertilizer will cut off the industrial waste and land fill (Janissen and Huynh, 2018)[187].

Figure No.1: Different types of alcoholic beverages in a super market

Figure No.2: Different types commercial non-alcoholic beverages available in the local market

Figure No.3: The alcoholic beverages available in the market. a) Spirit drink, b) Scotch Whisky, c) Whisky, d) Ginger beer, e) Malt whisky

Figure No.4: Different types of Non-alcoholic beverages available in local markets. a) Choco-Oreo thick milk shake, b) Tea, c) Choco-chip thick shake d) Pineapple souffle

CONCLUSION

Beverages become a part of food practices in people present around the world. Alcoholic and non-alcoholic beverages have both merits and demerits. The beverages provide adequate nutrition to humans and boost our immune system. However, excess consumption may cause serious diseases. There is lot misconception that non-alcoholic beverages will aid in removal of excess amount of fat. Some of them think the beverages will be stored as fat in in the body (Kant, Graubard, Atchison, 2009[188], Hellerstein *et al*, 1991[189]). Awareness of beverage consumption should be provided to the people who do not have known about it. Labels with the nutrient chart areprinted on all the products, however, it is still a big question whether the consumer is aware of the contents and its health implications. Particularly, school children tend to have consumed excessive beverages and become overweight (Lora *et al*, 2016)[190]. Now a day due to a busy environment, children were usually grown up by grandparents. The grandparents were not aware of the beverage and its consumption (Eli, Hornell, Malek, Nowicka, 2017)[191]. A study reported awareness created in adolescents about harmful effects of sugary beverages by rural family nurse practitioner students in rural places was helpful. The study found a decline in sugar beverage consumption by the same adolescents in 24 hours (Delpier T, Giordana, Wedin, 2013)[192]. Hence, we conclude public awareness is important for consumption of beverages. Doctors' advice must be taken is in case of patients or persons who are in risk zone with familial history. It is the time to educate every person including adolescents about beverages and its health effects and clinical applications.

ABBREVIATIONS

ADA	American Diabetic Association
ARE	Antioxidant Response Elements
CHD	Coronary Heart Diseases
BALB	Bagg albino
GGT	Gamma-Glutamyl Transferase
GST	Glutathione S Transferase
HIUS	High Intensity Ultra Sound
MAPK	Mitogen Activated Protein Kinases
PPAR	Peroxisome Proliferator- Activated Receptor
SSB	Sugar Sweetened Beverages

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CONFLICT OF INTEREST

We declare that we have no conflict of interest.

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