International Journal of Advances in Engineering and Management (IJAEM)
Volume 3, Issue 2 Feb 2021, pp: 815-822 www.ijaem.net ISSN: 2395-5252

Preparation of kombucha tea review on:Different kinds of microorganism's used for development of the kombucha.

Vishal Ugale*
Lovely professional university, Jalandhar -Punjab (India) 144411.

Submitted: 15-02-2021 Revised: 02-03-2021 Accepted: 05-03-2021

ABSTRACT –Kombucha is a refreshing probiotic beverage like an apple cider, slightly acidic in nature due to combination of the bacteria and yeast during fermentation. It is provided the beneficial effects to human being:lower-down the cholesterol level in blood, effects on hypertension, boost the immune system and prevent various types of cancers. Main objective of this review paper is to check the functional properties and potentials of different kinds of the microorganisms used for the different types of kombucha.

Key points – Kombucha production, Lactic acid bacteria, Acetic acid bacteria, Culture activation.

I. INTRODUCTION

Kombucha is a potential source of probiotic beverage. It's also known as functional food (Jayawardena 2015; Hasler 2009). Its slightly acidic and refreshing beverage made up from theSymbiotic Culture of the Bacteria and Yeast (Jayabalan, 2018).It produce a flavour like an apple cider after the tea fungus added in the tea broth specially made in home (Jayabalan, 2014).GT's Living Foods was the first started selling bottled kombucha beverage in 1995 to Los Angeles Health Food Store, Erewhon. It is known to be the first commercial retailing of kombucha in the modern world (Dutta and Paul, 2019).Itproduces a specific flavour depend upon the how long its left to ferment process, type of tea used and addition of the of the other ingredients like herbs, fruits etc.Starter culture added in the sweetened tea at the time of fermentation process start. Bacteria and yeasts present in culture it helps in breakdown of tea sugars and converted into alcohol, carbon dioxide and acids (Maulina, 2017). SCOBY form a fibrous like structure during the fermentation process start after the inoculation of starter culture with the help of suitable environment and concentration of the substrates. Substrates are used forthe preparation of kombucha are carbon source i.e. sugar and acidic acid bacteria produce a fibrous network used as a secondary metabolites of fermentation process (Jayabalan2014).

Kombucha is composed of two parts one is floating cellulose pellicle layer and the sour liquid broth (Chen and Liu, 2000). Microbialcomposition depends uponthe starter culture origin. Cellulose structure has aspeciality i.e. water absorption capacity its about 99% moisture content. In aerobic condition fermentation process complete in 7-14 days.At the time of fermentation process A. xylinum produces a slim cellulose film this film attached with group of bacteria and yeast. It is a fungus - like mixture of cellulose and microorganisms (Sreeramulu, 2000). Reason behind this due its crystalline nature and fibrous nature, it having length about 25-100 nm and thickness about 100 time thinner than fibrous plant cellulose (Lee 2014).

Kombucha generally provides about 30 calories,five grams of carbohydrates, five milligrams of sodium, and negligible fat. Most kombucha tea also contains acetic acid, lactic acid, and good bacteria. Kombucha beverage contains variety of compounds which is produced by the starter culture SCOBY. Compounds contains organic acids, mainly acetic, gluconic, and glucuronic acid (GlcUA), although citric, L-lactic, malic, tartaric, malonic, oxalic, succinic, pyruvic, and usnic acids may also be found (Malbasa 2002). Kombucha provides abeneficial effectdue to the presence of tea polyphenols, gluconic acid, glucuronic acid, lactic acid, vitamins, amino acids, antibiotics and lot of micronutrients produced during fermentation (Vijayaraghavan, 2000). These components are acetic acid (mildly antibacterial), butyric acid, B-vitamins (Aleksandra, 2007), alcohol, gluconic acid, lactic acid, malic acid, oxalic acid and usnic acid.

Commonly local SCOBY contains at least five yeast strains:Saccharomycodes ludwigii, Saccharomyces cerevisiae, Saccharomyces bisporus, Torulopsis sp. and Zygosaccharomyces

sp., This study conducted by Markov and Cvetkovic in 2001. Some Acetic acid bacteria are, Acetobacter xylinum, Acetobacter xylinoides or Bacterium gluconicum and Yeasts are Saccharomyces cerevisiae,

Zygosaccharomycesbailii,Schizosaccharomycespombe,Saccharomycesludwigii,Zygosaccharomyces rouxii, Torulaspora delbrueckii, Brettanomyces bruxellensis, Brettanomyces lambicus, Brettanomyces custersii, Candida sp. or Pichia membranaefaciens(Chen and Liu 2000; Teoh 2004).Osmophilic yeast and bacterias having scientific name is Medusomyces gisevii.

Regular consumption of the Kombucha, prevents degradation of polyunsaturated fatty acid in the human body, due to its glucuronic acid content that takes part in glucuronidation, increasing polyphenol bioavailability, that's helps to neutralize free radical to promote lipid peroxidation (Jayabalan, 2008).Itsincreases the level of intestinal microbiota,reduce level of nutrient absorption and/or reduce the risk of chronic non-communicable diseases(Croweand Francis,2013).Green and black tea extracts can be reduced blood sugar level and prevent absorption of sugar by another manner (Zeyuan and Bingying 1998). Decrease the level of cholesterol and blood pressure, improve immune system and gastrointestinal function(Leal, Suarez, and Jayabalan, 2018). Kombucha provides the therapeutic benefit after consumption result gives weight loss, cure the cancer and AIDS. Free radical scavenging and activities of antioxidant it has been recently reported by Jayabalan, 2008 and malabasa 2011.

II. DISCUSSION

- **Production of kombucha -**

The amounts of tea, sugar, and tea fungus differ in different places according to their requirement. Thestandard procedure for the kombucha are followed: 1000 ml Tap water for boiling purpose and add 50 g sugar at the time of boiling water with continuous stirring (Greenwalt and a Ledford, 2000; Nummer,2013; Jayawardena, 2015; Torie 2018). Add 5g of tea leaves or powder in boiled water, green tea was used by Farnwort, 2000 this scientist as well as used black tea and alternative option are tea bags (Morshedi, 2010). The After extraction of flavour and colour powder or leaves removed with the help of filtration medium(Jayabalan, 2014). Tea broth cooled at room temperature approximate 20 ℃ then add Erlenmeyer flask was inoculated with 5% culture, its obtained from the culture collection of CBB, Fuzhou University, which is composed of Saccharomyces cerevisiae Meyen ex Hansen (108 CFU/mL), Gluconacetobacter sp. (108 CFU/mL, and Lactobacillus plantarum (108 CFU/mL), with the ratio of 1:1:1 and reported to be optimal strains for kombucha fermentation this study conducted by (Fu, 2014). Tea fungus that contains medicinal and nutritional value (Loncar and others 2000).Starter culture added in tea broth it helps to reduce the pH of solution and inhibit the undesirable growth of microorganism. Sterile instruments used at the time of kombucha production for avoid the cross-contamination of the foreign matter(Ledford, 2000). Jar that contains tea broth it put for the fermentation process in suitable environment and avoid the drosophila fruit flies by covering of paper towel to jar. Temperature for incubation to kombucha at 20 -22℃ its suitable for the fungus activity to form a fibrous structure in broth in fermentation period. In next few days mother culture forms a newly culture i.e.daughter culture it will be star to float on surface and clear thin gel like membrane across the present area. After 10 to 14 days, a new tea fungus will have developed on the surface of the tea as a disc of 2-cm thickness covering the whole diameter of the beaker. The mother culture remains its original volume and sink at the bottom site of jar. kombucha beverage is rich in organic acids: acetic acid, gluconic acid and vitamins as well as polyphenols (Jaybalan, 2014).

This study was conducted by Francesca and Galiano in 2018 about the kombucha prepared from consortium of symbiotic microorganisms using two traditional substrates, green and black teas, and a never tested substrate, the tea obtained from rooibos (Aspalathus linearis) leaves.(Kanuric, 2012) in this study analysed two type of milk used for production of the kombucha that contain low fat (0.9%) and reduced fat (2.2%) with normal kombucha culture it's a newly produced product. In 2018 scientist Chunhai Tu and Sijie Tang conducted study on liquid soya whey extracted from soya protein and tofu its fermented product from manufactured industry investigate the changes of metabolic process, also the improvement of antimicrobial activity and antioxidant capacity at the time of fermentation.In 2019 scientist Zubaidah, Ifadah and Afgani was studied on changes in different flavours extracted from the various cultivars of snake fruit at the time of fermentation of kombucha. That's fruits contain salak Suwaru (Malang, JawaTimur), salak Pondoh (Sleman, Yogyakarta), salak Madura (Bangkalan, Madura) and salak Bali (Karangasem, Bali) its Indonesian fruits. Herbal used for extraction flavour of thyme, lemon verbena, rosemary, fennel,

International Journal of Advances in Engineering and Management (IJAEM)
Volume 3, Issue 2 Feb 2021, pp: 815-822 www.ijaem.net ISSN: 2395-5252

and pepper mint added in tea broth this study conducted by Battikh in 2012.

- **Used Microorganisms -**

1. Lactic acid bacteria–

Kombucha culture contains a large proportion of lactic acid bacteria, which primarily makes it a suitable inoculum for milk fermentation(Malbasa 2009). Lactic acid bacteria are used in production of the fermented products at industrial level as well as improve flavour in products like yoghurt, cheese, kefir and cabbage pickle it concluded by Dufresne and Farnworth in 2000. These provides health benefits include stimulation of the human immune system and antimicrobial activity. Adding LAB to any food products it can improve biological activities such as food preservation, wheat bread and cocoa fermentation, and D-Saccharic acid1,4 Lactone (DSL) production in kombucha this study conducted byNguyen in 2015. Now a day production lactic acid bacterium increased by modern and traditional way. Presently lactic acid bacteria reported production from kombucha culture up to 30% its stated by Marsh2014; Yang 2010. Newly research conducted Farnworth and Mainville in 2003 its stated that lactic acid bacteria interaction with kefir its probiotic beverage made up from kefir grains with yeast and bacteria fermentation starter culture and acetic acid bacteria from kombucha with respect to growth rate, biomass and secondary metabolites.

The positive stimulation in growth rate, bio-mass and secondary metabolites provided by the co-cultures of Lactobacillus spp. in kombucha, the human health benefits. Therefore, we focused on the significance of Lactobacillus spp. in mixed culture kombucha in enhancing its three important biological functions: glucuronic acid (GlcUA) production, antibacterial activity and antioxidant ability. This study conducted by yang in 2010, they isolate lactobacillus strains from kefir, kombucha and pickle cabbage. Culture of this strains obtained from the sweetened black tea it used as kombucha substrate. They produce higher quantity of the healthy kombucha tea from the lactobacillus species. And combination of the Lactobacillus species with acetic acid bacteria in kombucha it improves the D-Saccharic acid 1,4 Lactone concentration which determine the level of glucuronic acid in a glucuronate pathway.Strains of genus Acetobacter, lactobacillus according to the sequence-based analyses stated that by Tang 2018. Soymilk is suitable substrate for the growth of lactic acid bacteria and kefir culture sated by Garcia in 2014.

One role of acetic acid bacteria in lactobacillus its increase cellulose production by glucon- acetobacter in co-culture (Seto, 2006). Recently, lactic acid bacteria shown to support to growth of Glucon-acetobacter in kombucha (Yang 2010). In milk substitute kombucha exhibit protein gelatinization at higher pH than commercial yogurt, better texture provide to the probiotic beverage in milk contains (Hrnjez, 2014).

Acetic acid bacteria–

Acetic acid is the organic compound responsible for the acetic flavour and taste produces like vinegar. Acetic name comes from Latin word called as acetum, which means vinegar (Bramforth, 2014). Different studies conducted by Balentine, in 1997 they conclude that, microbial commodity that contains acetic acid bacteria present in tea fungus is Acetobacter xylinumand other species are Acetobacter xylinoides, Bacterium gluconicum (Reiss, 1994), Acetobacter pasteurianus, and Acetobacter aceti (Liu, 1996). Recently identified new bacterial strain are Gluconacetobacter sp. A4 its investigated by (Wang, 2010), Gluconobacter oxydans (Greenwalt,2000; Kurtzman, 2001), Acetobacter nitrogenifigens sp. nov., and Gluconacetobacter kombuchae sp. nov. (Dutta and Gachhui, 2006, 2007), and Komagataeibacter (Chakravorty, 2016). After 7 days of fermentation, Gluconacetobacter species produced more than 90% papulation of bacteria and Acetobacter increases papulation of bacteria about 3-5% after completion of 21 days of fermentation (Danilo Ercolini, 2017). Initial load of acidic acid bacteria on media are 105 -196 CFU/ml. After 7dys completion of fermentation process AAB increased about 1.5 log. Acidity decreased from 3.5 to 2.5 finished fermentation process (Jayabalan, in 2007; 2014).

Main microbes present in tea fungus are acetic acid bacteria: Acetobacter xylinum, Acetobacter aceti, Acetobacter pasteurianus, Gluconobacter oxydans(Greenwalt, 2000) and yeasts: Saccharomyces sp., Zygosaccharomyces sp., Torulopsis sp., Pichia sp., Bret anomyces sp.this microbe responsible for the production of kombucha**Table 1**.Most important acetic acid bacteria species found in kombucha were identified as Acetobacter xylinoides, A. pasteurianus, A.xylinum, A. aceti, and Bacterium gluconicum (Malbasa, 2008 and 2011; Greenwalt, 2000; Chu and Chen, 2006). Moreover, the genus Gluconacetobacter has recently been subdivided into three genera: Nguyenibacter, Komagataei-bacter and Gluconacetobacter (Vu 2013; Yamada, 2012). Acidic acidbacteria and osmophilic yeasts

International Journal of Advances in Engineering and Management (IJAEM)
Volume 3, Issue 2 Feb 2021, pp: 815-822 www.ijaem.net ISSN: 2395-5252

are the dominant microorganisms during Kombucha 64 fermentation.They produce a cellulosic pellicle tea fungus floating on the fermented liquid, where 65 they remain embedded and that can be transferred to propagate the inoculum (Francesca De Filippis 2017).Acetobacter (formerly Bacterium) xylinum is the most commonly mentioned bacterium from the Kombucha consortium.

Enumeration of acetic acid bacteria and yeast by using two media that's are PDA (potato dextrose agar) and GYCA media (Chen and Liu, 2000). When glucose and fructose acts as a metabolite they produce ethanol and acetic acid by using microorganism (Spedding, 2015). In particular, authors reported the dominant presence of Komagataeibacter spp. and Acetobacter spp. and less than 1% of Lactobacillus spp., among bacteria; Zygosaccharomyces spp. and Brettanomyces spp. are the most abundant yeasts (Marsh and Sullivan 2014). Regarding therapeutic effects, functionality and safety aspects of kombucha consumption reported that Acetobacter xylinoides, A. pausterianus, A. xylinum, A. aceti and Bacterium gluconicum are the most common species of bacteria found in kombucha cultures. Regarding therapeutic effects, functionality and safety aspects of kombucha consumption reported thatAcetobacter xylinoides, A. pausterianus, A. xylinum, A. aceti and Bacterium gluconicum are the most common species of bacteria found in kombucha cultures (Viduranga, 2015).

Modification in temperature at the time of incubation process acetic acid bacteria will increase the concentration of organic acid, which is helpful to health promoting effect at the time of daily consumption of kombucha beverage (Jayabalan 2007 and 2014). Genus of ssAcetobacter was consistently found in Irish- sourced kombucha only where proportions were highest in the pellicle (1.9%) but represented <1% of the bacterial population in the fermentation. Reclassification of A. xylinum to G. xylinus according to the high level of sequence homology (Yamada 1997), a species considered to be the dominating bacterium and principal contributor of bacterial cellulose in kombucha (Mikkelsen 2009, Strap 2011).

Other species –

Recently Dutta and Gachhui in 2007 identified new species other than lactic acid bacteria and acetic acid bacteria. Komagataeibacter and Gluconacetobacter species identified in kombucha including Komagataeibacter kombuchae, Gluconacetobacter SpA4 (Yang 2010), Glucoacetobacter sacchari (Trovatti 2011), Acetobacter aceti (El-salam 2012), Acetobacter nitro-genificans (Dutta and Gachhui, 2007), Acetobacter pasteurianus (Chen and Liu, 2000; Liu 1996) and Acetobacter liquefaciens (Zhang 2011).

Acetobacter xylinum	Kwanashie1990; Mollenda1928; Roussin 1996; Sievers 1995
Acetobacter aceti	C. Liao. 1996
Acetobacter pasteurianus	C. Liao. 1996
Gluconobacter	C. Liao. 1996
Yeasts	
Brettanomyces	Mayser,1995
Brettanomyces bruxellensis	C. Liao. 1996
Brettanomyces intermedius	Herrera, 1989
Candida	Jankovic, 1994
Candida famata	Herrera, 1989
Mycoderma	Jankovic, 1994
Mycotorula	Jankovic, 1994
Pichia	Hesseltine, 1965; Jankovic, 1994
Pichia membranaefaciens	Herrera, 1989
Saccharomyces	Kwanashie1990; Mayser,1995
Saccharomyces cerevisiae subsp. aceti	Herrera, 1989
Saccharomyces cerevisiae subsp. cerevisiae	Herrera, 1989; C. Liao. 1996
Torula	Jankovic, 1994
Torulaspora delbrueckii	Herrera, 1989
Torulopsis	Jankovic, 1994
Zygosaccharomyces	Hesseltine 1965; Mayser,1995; Roussin 1996; Sievers 1995
Zygosaccharomyces bailii	Herrera, 1989; C. Liao. 1996
Zygosaccharomyces rouzii	Herrera, 1989

Table 1 List of Microbes

International Journal of Advances in Engineering and Management (IJAEM)
Volume 3, Issue 2 Feb 2021, pp: 815-822 www.ijaem.net ISSN: 2395-5252

Activity of fungus culture–

Acetic acid bacteria produce "tea fungus" or cellulose floating network on the surface of tea broth, cell mass attached with bacteria and yeast (Sreeramulu 2000).Osmophilic yeast and bacteria responsible for the development of semi-solid structure known as tea fungus. It having scientific name: Medusomyces gisevi. There are many types of bacteria used for the kombucha fungus that's are Aerobacter, Agrobacterium, Azotobacter, Rhizobium, Salmonella and Gluconacetobacter (Villarreal-Soto, 2018; mohite and patil, 2014). For development of the kombucha two stage of fermentation occurred in first stage increase the population of cellulose producing bacteria by consumption of dissolved oxygen in tea broth.Second stage of fermentation is sucrose is converted into ethanol and acetic acid with the help of beneficial microbes and produce carbon dioxide. Symbiotic culture of bacteria and yeast type of activity in tea broth shown in Figure 1(May, 2019).During this time, the microorganism synthesizes certain amount of fibrous network in the liquid medium. As fermentation time increases, then the membrane thickness is increased by the generation of new layers on the surface, forming a suspended structure in the culture medium. The development of the biofilm along with hydrogen and C-H bonding will continue through all fermentation, its synthesis will reach its limit when it grows downward entrapping all bacteria, which then will become inactive due to insufficient oxygen supply (Esa, Tasirin and Rahman, 2014).

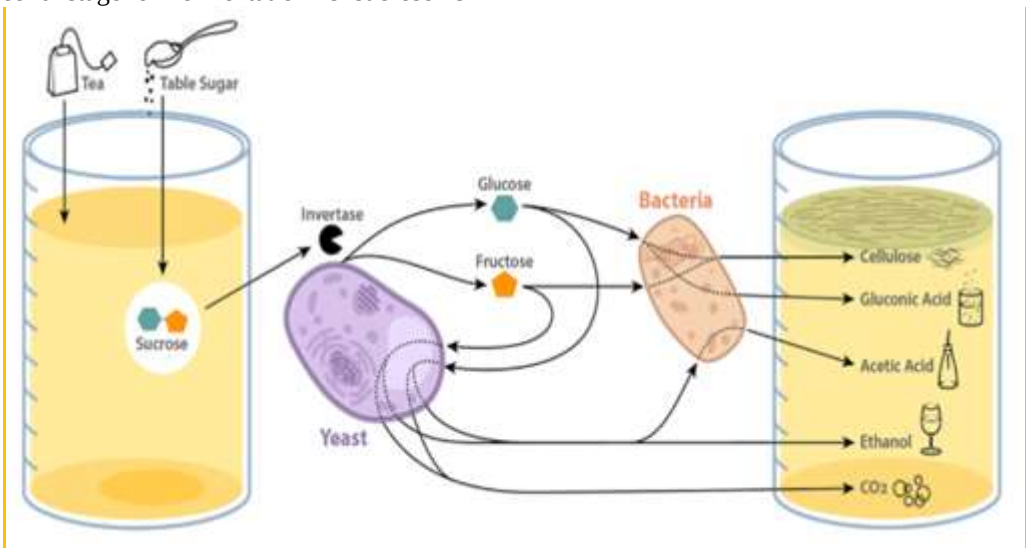

Figure 1 Activity of yeast and bacteria in kombucha

Tea fungus contains no spores present, it reproduces on basis of sprouting phenomenon. Ability of tea fungus it produces fibrous structure with the help of mother culture that's added at the time of fermentation. Mother culture float at top side when they added then its slowly immersed in tea broth. Immersion time it produces small threat like structures in broth medium(Dutta and Paul, 2019). Cellulose produced during the fermentation of A. xylinum as a thin film in 7- 12 of fermentation days. Symbiotic culture is a powerful inhibition for potential contaminating bacteria (jayabalan 2010). Cellulose created on the stable medium of broth.The fermented tea is produced by the action of a floating microbial colony consisting of aerobic bacteria and yeasts. The colony's appearance often resembles a surface mushroom but is actually a floating cellulose colony produced during microbial growth. Production of thefloating colony facilitates aeration for the aerobic microorganisms (Ledford, 2000; Asai, 1968). With every batch of Kombucha a new film is formed, and this new film is the colony that can be used to make subsequent batches of Kombucha.The initial weight of SCOBY before to inclusion in the green tea substrate was 2.3 g, at 1-day fermentation of cellulose weight to 2.5g, day 2.7g, 5th day 5.8g, 7th day 8.7g, day 9th 10.3g and 11th day 11,9g(Health, 2017). As per fermentation time increases it increases weight of floating cellulose. Total sugar present in the kombucha its completely breakdown in to monosaccharides its easy to digest for microorganism (Maulina Nurikasari 2017).

III. CONCLUSION

Kombucha drink consumed whole world as a refreshing beverage and helps to improve medicinal value in human being. Different kinds of kombucha prepared from the different sources i.e.

fruits, vegetables extract, sugar industry by-product i.e. molasses etc. It is made up from the different kind of sugary sources by traditional as well as modern way. It is a good source fibre obtained from the activity of themicrobes during fermentation process. Flavours development occurred due to the activity of microbes at the time of fermentation process. Microbes play important role in fermentation, without microbes don't occurred fermentation process.This microorganism helps to improve the production for required species. Microbes play important role due to antimicrobial propertyhelps to health benefits for human.

REFERENCE'S

[1]. Watawana MI, Jayawardena N, Gunawardhana CB, Waisundara VY. Health, wellness, and safety aspects of the consumption of kombucha. Journal of Chemistry. 2015;2015

[2]. Hasler CM, Brown AC, American Dietetic A. Position of the American Dietetic Association: functional foods. J Am Diet Assoc. 2009;109(4):735-746.

[3]. Leal JM, Suárez LV, Jayabalan R, Oros JH, Escalante-Aburto A. A review on health benefits of kombucha nutritional compounds and metabolites. CYTA - Journal of Food. 2018;16(1):390-399.

[4]. Jayabalan, R., Malbaša, R. V., Lončar, E. S., Vitas, J. S., & Sathishkumar, M. (2014). A review on kombucha tea-microbiology, composition, fermentation, beneficial effects, toxicity, and tea fungus. Comprehensive Reviews in Food Science and Food Safety, 13(4), 538–550. https://doi.org/10.1111/1541-4337.12073

[5]. Dutta, H., & Paul, S. K. (2019). Kombucha Drink: Production, Quality, and Safety Aspects. In Production and Management of Beverages (Issue January). Elsevier Inc. https://doi.org/10.1016/B978-0-12-815260-7.00008-0

[6]. Health, P. (2017). Journal of Global Research in Public Health 90. 2(2), 90–96

[7]. Chen, C., & Liu, B. Y. (2000). Changes in major components of tea fungus metabolites during prolonged fermentation. Journal of Applied Micro- biology, 89, 834–839.

[8]. Sreeramulu, G., Zhu, Y., & Knol, W. (2000). Kombucha fermentation and its antimicrobial activity. Journal of Agricultural and Food Chemistry, 48(6), 2589-2594.

[9]. Lee KY, Buldum G, Mantalaris A, Bismarck A (2014) More than meets the eye in bacterial cellulose: biosynthesis, bioprocessing and applications in advanced fiber composites. Macromol Biosci 14:10–32

[10]. Malbaša, R., Lončar, E., & Kolarov, L. (2002). L-lactic, L-ascorbic, total and volatile acids contents in dietetic Kombucha beverage. Roum Biotechnol Lett, 7(5), 891-895.

[11]. Vijayaraghavan, R., Singh, M. A. N. I. N. D., Rao, P. V. L., Bhattacharya, R., Kumar, P., Sugendran, K., ... & Singh, R. (2000). Subacute (90 days) oral toxicity studies of Kombucha tea. Biomedical and Environmental Sciences, 13(4), 293-299.

[12]. Velićanski, A. S., Cvetković, D. D., Markov, S. L., Tumbas, V. T., & Savatović, S. M. (2007). Antimicrobial and antioxidant activity of lemon balm Kombucha. Acta periodica technologica, (38), 165-172.

[13]. Markov, S. L., Malbasa, R. V., Hauk, M. J., & Cvetkovic, D. D. (2001). Investigation of tea fungus microbe associations, 1: the yeasts. Acta Periodica Technologica (Yugoslavia).

[14]. Teoh A. L., Heard, G. and Cox, J. 2004. Yeast ecology of Kombucha fermentation. International Journal of Food Microbiology 95: 119-126.

[15]. Jayabalan, R., Subathradevi, P., Marimuthu, S., Sathishkumar, M., & Swaminathan, K. (2008). Changes in free-radical scavenging ability of kombucha tea during fermentation. Food Chemistry, 109(1), 227-234.

[16]. Crowe, K. M., & Francis, C. (2013). Position of the academy of nutrition and dietetics: Functional foods. Journal of the Academy of Nutrition and Dietetics, 113, 1096–1103.

[17]. Zeyuan, D., Bingying, T., Xiaolin, L., Jinming, H., & Yifeng, C. (1998). Effect of green tea and black tea on the metabolisms of mineral elements in old rats. Biological trace element research, 65(1), 75-86.

[18]. Leal, J. M., Suárez, L. V., Jayabalan, R., Oros, J. H., & Escalante-Aburto, A. (2018). A review on health benefits of kombucha nutritional compounds and metabolites. CyTA-Journal of Food, 16(1), 390-399.

[19]. Greenwalt, C. J., Steinkraus, K. H., & Ledford, R. A. (2000). Kombucha, the fermented tea: microbiology, composition, and claimed health effects. Journal of food protection, 63(7), 976-981.

[20]. Nummer, B. A. (2013). SPECIAL REPORT: Kombucha Brewing Under the Food and Drug Administration Model Food Code: Risk Analysis and Processing Guidance. Journal of environmental health, 76(4), 8-11.
[21]. Watawana, M. I., Jayawardena, N., Gunawardhana, C. B., & Waisundara, V. Y. (2015). Health, wellness, and safety aspects of the consumption of kombucha. Journal of Chemistry, 2015.
[22]. Murphy, T. E., Walia, K., & Farber, J. M. (2018). Safety Aspects and Guidance for Consumerson the Safe Preparation, Handling and Storage of Kombucha—A Fermented Tea Beverage. Food Protection Trends, 38(5), 329-337.
[23]. Dufresne, C., & Farnworth, E. (2000). Tea, Kombucha, and health: a review. Food research international, 33(6), 409-421.
[24]. Morshedi, A., & Dashti-Rahmatabadi, M. H. (2010). Chronic consumption of kombucha and black tea prevents weight loss in diabetic rats. Iranian Journal of Diabetes and Obesity, 2(2), 23-26.
[25]. Fu, C., Yan, F., Cao, Z., Xie, F., & Lin, J. (2014). Antioxidant activities of kombucha prepared from three different substrates and changes in content of probiotics during storage. 2013(006227), 123–126.
[26]. Loncar ES, Petrovi´c SE, Malbaˇsa RV, Verac RM. 2000. Biosynthesis of glucuronic acid by means of tea fungus. Nahrung 44:138–9.
[27]. Ledford, R. A. (2000). Kombucha, the Fermented Tea: Microbiology, Composition, and Claimed Health Effects. 63(7), 976–981.
[28]. Gaggìa, F., Baffoni, L., Galiano, M., Nielsen, D. S., Jakobsen, R. R., Castro-Mejía, J. L., ... & Di Gioia, D. (2019). Kombucha beverage from green, black and rooibos teas: a comparative study looking at microbiology, chemistry and antioxidant activity. Nutrients, 11(1), 1.
[29]. Tu, C., Tang, S., Azi, F., Hu, W., & Dong, M. (2019). Use of kombucha consortium to transform soy whey into a novel functional beverage. Journal of Functional Foods, 52, 81-89.
[30]. Zubaidah, E., Ifadah, R. A., & Afgani, C. A. (2019). Changes in chemichal characteristics of kombucha from various cultivars of snake fruit during fermentation. E&ES, 230(1), 012098.
[31]. Battikh, H., Bakhrouf, A., & Ammar, E. (2012). Antimicrobial effect of Kombucha analogues. LWT-Food Science and Technology, 47(1), 71-77.
[32]. **Malbaša**, R. V., Milanović, S. D., Lončar, E. S., Djurić, M. S., Carić, M. Đ., Iličić, M. D., & Kolarov, L. (2009). Milk-based beverages obtained by Kombucha application. Food Chemistry, 112(1), 178-184.
[33]. Nguyen, N. K., Dong, N. T. N., Nguyen, H. T., & Le, P. H. (2015). Lactic acid bacteria: promising supplements for enhancing the biological activities of kombucha. Springerplus, 4(1), 91.
[34]. Marsh, A. J., O'Sullivan, O., Hill, C., Ross, R. P., & Cotter, P. D. (2014). Sequence-based analysis of the bacterial and fungal compositions of multiple kombucha (tea fungus) samples. Food microbiology, 38, 171-178.
[35]. Yang, Z., Zhou, F., Ji, B., Li, B., Luo, Y., Yang, L., & Li, T. (2010). Symbiosis between microorganisms from kombucha and kefir: potential significance to the enhancement of kombucha function. Applied biochemistry and biotechnology, 160(2), 446-455.
[36]. Farnworth, E. R., & Mainville, I. (2003). Kefir: a fermented milk product. Handbook of fermented functional foods, 2, 89-127.
[37]. Baú, T. R., Garcia, S., & Ida, E. I. (2014). Evaluation of a functional soy product with addition of soy fiber and fermented with probiotic kefir culture. Brazilian Archives of Biology and Technology, 57(3), 402-409.
[38]. Seto, A., Saito, Y., Matsushige, M., Kobayashi, H., Sasaki, Y., Tonouchi, N., ... & Beppu, T. (2006). Effective cellulose production by a coculture of Gluconacetobacter xylinus and Lactobacillus mali. Applied microbiology and biotechnology, 73(4), 915-921.
[39]. Hrnjez, D., Vaštag, Ž., Milanović, S., Vukić, V., Iličić, M., Popović, L., & Kanurić, K. (2014). The biological activity of fermented dairy products obtained by kombucha and conventional starter cultures during storage. Journal of Functional Foods, 10, 336-345.
[40]. **Bamforth**, C. W., & Cook, D. J. (2014). Food, fermentation, and micro-organisms. John Wiley & Sons.
[41]. Balentine, D.A., Wiseman, S.A., Bouwens, L.C., 1997. The chemistry of tea flavonoids. Crit. Rev. Food Sci. Nutr. 37 (8), 693–704.
[42]. Reiss, J., 1994. Influence of different sugars on the metabolism of the tea fungus.

Zeitschrift fuÈr Lebensmittel-Untersuchung und Forschung 198 (3), 258–261.

[43]. Liu, C.H., Hsu, W.H., Lee, F.L., Liao, C.C., 1996. The isolation and identification of microbes from a fermented tea beverage, Haipao, and their interactions during Haipao fermentation. Food Microbiol. 13, 407–415.

[44]. Greenwalt, C.J., Steinkraus, K.H., Ledford, R.A., 2000. Kombucha, the fermented tea: microbiology, composition, and claimed health effects. J. Food Prot. 63 (7), 976–981.

[45]. Kurtzman, C.P., Robnett, C.J., Basehoar-Powers, E., 2001. Zigosaccharomyces Kombuchaensis, a new ascosporogeneous yeast from Kombucha tea. FEMS Yeast Res. 2, 133–138.

[46]. Dutta, D., Gachhui, R., 2006. Novel nitrogen-fixing Acetobacter nitrogenifigens sp. nov., isolated from Kombucha tea. Int. J. Syst. Evol. Microbiol. 56 (8), 1899–1903.

[47]. Dutta, D., Gachhui, R., 2007. Nitrogen-fixing and cellulose-producing Gluconacetobacter kombuchae sp. nov., isolated from Kombucha tea. Int. J. Syst. Evol. Microbiol. 57 (2), 353–357.

[48]. Chakravorty, S., Bhattacharya, S., Chatzinotas, A., Chakraborty, W., Bhattacharya, D., Gachhui, R., 2016. Kombucha tea fermentation: Microbial and biochemical dynamics. Int. J. Food Microbiol. 220 (2), 63–72.

[49]. Marsh, A.J.; O'Sullivan, O.; Hill, C.; Ross, R.P.; Cotter, P.D. Sequence-based analysis of the bacterial and fungal compositions of multiple Kombucha (tea fungus) samples. Food Microbiol. 2014, 8, 171–178.

[50]. **Trovatti, E., Serafim**, L. S., Freire, C. S., Silvestre, A. J., & Neto, C. P. (2011). Gluconacetobacter sacchari: an efficient bacterial cellulose cell-factory. Carbohydrate Polymers, 86(3), 1417-1420.

[51]. Abd El-Salam, S. S. (2012). 16S rRNA gene sequence detection of acetic acid bacteria isolated from tea Kombucha.

[52]. Liu, L., Chen, K., Zhang, J., Liu, J., & Chen, J. (2011). Gelatin enhances 2-keto-l-gulonic acid production based on Ketogulonigenium vulgare genome annotation. Journal of biotechnology, 156(3), 182-187.

[53]. **Sreeramulu** G, Zhu Y, Knol W. Kombucha fermentation and its antimicrobial activity. J. Agr. Food Chem. 48: 2589-2594 (2000)

[54]. Villarreal-Soto, S. A., Beaufort, S., Bouajila, J., Souchard, J. P., & Taillandier, P. (2018). Understanding Kombucha Tea Fermentation: A Review. Journal of Food Science, 83(3), 580–588. https://doi.org/10.1111/1750-3841.14068

[55]. Mohite BV, Patil SV. Physical, structural, mechanical and thermal characterization of bacterial cellulose by G-hansenii NCIM 2529. Carbohydr. Polym. 2014, 106:132-141.

[56]. May, A., Narayanan, S., Alcock, J., Varsani, A., Maley, C., & Aktipis, A. (2019). Kombucha: A novel model system for cooperation and conflict in a complex multi-species microbial ecosystem. PeerJ, 2019(9), 1–22. https://doi.org/10.7717/peerj.7565

[57]. Esa, F., Tasirin, S. M., & Abd Rahman, N. (2014). Overview of bacterial cellulose production and application. Agriculture and Agricultural Science Procedia, 2, 113-119.

[58]. Health, P. (2017). Journal of Global Research in Public Health 90. 2(2), 90–96.

[59]. Nurikasari, M., Puspitasari, Y., & Siwi, R. P. Y. (2017). Characterization and analysis kombucha tea antioxidant activity based on long fermentation as a beverage functional. Journal Of Global Research In Public Health, 2(2), 90-96.

International Journal of Advances in Engineering and Management
ISSN: 2395-5252

IJAEM

Volume: 03 Issue: 02 DOI: 10.35629/5252

www.ijaem.net
Email id: ijaem.paper@gmail.com