EFFECT OF FERMENTATION ON THE CONCENTRATIONS OF SOME ANIONS IN KOMBUCHA TEA

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ABSTRACT

Kombucha is a fermented tea that is brewed for medical purposes, its therapeutic effect to man has made the drink to be called "the remedy of immortality". Eight samples A, B, C, D, E, F, G and H of the tea were prepared with fermentation period of 1 day, 10 days, 11 days, 12 days, 13 days, 14 days, 15 days and 16 days respectively The pH of the samples had the following values 4.30, 3.68, 3.61, 3.54, 3.49, 3.33, 3.21 and 2.98 respectively indicating inverse proportionality. The concentration of chloride in samples A, B, C, D, E, F, G and H were 3.30 mg/l, 6.50 mg/l, 7.51 mg/l, 7.68 mg/l, 8.00 mg/l, 8.49 mg/l, 9.50 mg/l respectively, nitrate concentration was 9.98 mg/l; 14.54 mg/l, 25.16 mg/l, 26.66 mg/l, 27.10 mg/l, 29.05 mg/l, 30.51 mg/l 30.51 mg/l respectively, phosphate concentration 32.43 mg/l; 0.26mg/l, 0.57 mg/l, 0.60 mg/l, 0.78 mg/l, 0.90 mg/l, 1.13 mg/l, 1.16 mg/l and 1.38 mg/l respectively while sulphate concentrations were 9.23 mg/l, 23.02 mg/l, 23.78 mg/l, 24.43 mg/l, 25.04 mg/l, 25.58 mg/l, 26.32 mg/l, and 27.02 mg/l respectively indicating direct proportionality. The presence of these anions as micronutrients shows that Kombucha tea could have some health benefits.

Keywords: *Anions, concentrations, fermentation, Kombucha, tea.*

INTRODUCTION

Kombucha tea is a popularly fermented tea brewed for medical purposes. Its popularity is attributed to its therapeutic effects to man. It is referred to as the remedy for immortality, this name "remedy of immortality" according to the work of Ernst, came as a result of some over sensational claims for kombucha's benefits as a panacea of all ills [1]. It is commonly called Kargarsok as it is believed to originate from kargarsok village in Russia [2]. Gunther reported that, a Japanese lady went to kargasok a village in Russia for a visit and discovered many healthy old people, all over hundred years old. In fact, there was a man, one hundred and thirty years old who married an eighty eight year old lady, and they were still able to have babies. This Japanese lady was amazed at what she saw and wanted to find out the secret for a woman over eighty (80) years yet to attend menopause and hardly having wrinkles. She found that young and old alike in every home made and drink a tea about three cups daily, which is responsible for their astonishing health [3].

The tea is produced from three basic ingredients namely; kombucha funguses (mustroom), tea for instance lipton and any sweetening agent (sugar, honey etc). Kombucha fungus is a colony or culture of yeast and bacteria (micro-organisms) embedded in a pure cellulose "pancake". The fungus containing the yeast and the bacteria uses the tea and sugar as a source of its nutrient. The mushroom is a symbiotic yeast bacterium which ferments the mixture, feed on the sugar and in exchange, produces other valuable substances which change into the drink [4]. Kombucha mushroom is a symbiotic colony of bacteria and yeast as such can neither be classified as plant nor animal. It is scientifically called *Zooglead mat* with various genera as; *zygosaccharomyces, schizosaccharomyces, saccharomyces, brethanomyces, sacchoromycodes, pichia, torulaspora* and *candida* [5].

The tea is acidic in nature and has been known to taste like apple cider vinegar, slightly sweet and slightly sour. It has a fruity fragrance full of health given acids and nutrients [6]. The tea is always ready after ten (10) to fourteen (14) days of fermentation if properly cultured. The culture if properly treated will reproduce itself, so one can easily produce a new batch of tea every week. More so, a fresh batch of the infusion should have a pH of 4.3 in order not to be contaminated by pathogens [5].

Beneficial byproducts are always produced during the fermentation of the tea infusion which are said to have antibiotic and detoxifying properties [7]. The antibiotic and detoxifying properties of the tea is said according to be attributed by the acids produced [8]. These acids contain negative radicals called the anions. The benefit of anions in medical health care has aroused wide attraction in recent years. Many anions like fluoride (F^-), chloride (Cl^-), sulphate (SO_4^{2-}), nitrate (NO_3^-) and phosphate (PO_4^{3-}) are very important micronutrients at low concentration.

Kombucha tea improves the digestive tract, contains good bacteria which produces high levels of lactic acid and other acids which inhibit the growth of undesirable bacteria, moulds, mould spores and others intestinal micro flora [9]. According to cancer experts in Europe, kombucha tea aids detoxification in cancer patients. Cancer patients normally detoxify their body in order to let its natural defense mechanisms re-establish themselves. They reported that, kombucha tea has been part of their successful treatment of cancer patients [10].

According to Pierce J, a director of research at the centre of Applied Cognitive Science in Charlotte, kombucha tea therapeutic effect to man could be due to the presence of anions which are known to have the following health benefits: recovery from physical exhaustion due to the fact that anions increases oxygen level in the blood thereby facilitating more efficient oxygen utilization; stabilising brain function by promoting abundant oxygen levels in the blood [11]. They help normalise brain function, resulting in relaxation and calmness; blood purification by increasing the levels of calcium and sodium in the blood stream; helps restore a healthy (slightly alkaline) pH balance to the blood; increasing metabolism by stimulating the exchange of electronic substance in cell walls; increase metabolism; strengthening the immune system [12]. High levels of anions promote production of globulin in the blood, resulting in stronger resistance to illness; balancing of autonomic nervous system [13]. This work therefore aims at determining the effect of fermentation period on the pH and concentration levels of some anions in kombucha tea.

MATERIALS AND METHOD

Exactly 5000.00 ml distilled water was boiled in a stainless steel pot after which 200.00 g sucrose was added and further boiled for 5 minutes. The source of heat was turned off and 16.00 g tea bags (8 sachet Lipton) were added to the boiled solution. The tea bags were removed and discarded after fifteen minutes of insertion. The sweetened tea was poured into a stainless steel container and covered well. It was then set to cool to room temperature. After attaining room temperature, a starter from a previously prepared culture with very low pH value was added in order to adjust the pH to 4.3 and 1.50 kg of the tea fungus was placed on the sweetened cooled tea. The container was covered with a piece of loosely woven cloth to enable the bacteria access air. The culture was set to ferment at 28^oC in a thermostatic oven. The process was repeated for sample B, C, D, E, F, G, and H with fermentation periods of 10, 11, 12, 13, 14, 15, and 16 days respectively in which each of them was analyzed for the selected anions. The analysis was done in triplicates in each of the samples and mean concentration calculated [14].

The pH of the respective samples was determined by a method adopted by [15] using Cyberscan pH meter (1500 model). Standard titrimetry method as adopted by [16] was used in the determination of chloride ion. Nitrate was determined using UV-Vis spectrophotometer double beam (Lavo 27100-2800) at a wavelength of 410 nm as described by [17]. Phosphate ion was determined using standard Tin (II) chloride colorimetric method at 630 nm and sulphate was determined by turbidimetric method as adopted by [13]. All analysis was carried out in triplicates.

RESULTS AND DISCUSSION

pH values

Table 1 shows the pH of kombucha tea with respect to fermentation period. The pH of samples A, B, C, D, E, F, G and H with fermentation period of 1 day, 10 days, 11 days, 12 days, 13 days, 14 days, 15 days and 16 days respectively were 4.30, 3.68, 3.61, 3.54, 3.49, 3.33, 3.21 and 2.98 respectively indicating decrease in pH as the fermentation period increases (inverse proportionality). Comparison of these values obtained with the World Health Organization minimum permissible limit of pH values 3.00 shows that the pH values in the respective tea samples falls within the minimum permissible limit with the exception of sample H with pH value 2.98. This indicates that kombucha tea brewed above 15 day could be dangerous to both bifidobacteria and bacteriodes. More so, the pH range of the tea will ensure low level of contamination by pathogens during fermentation process.

Table 1. pH Values of Samples With Respect to Fermentation Period

Sample	A	B	C	D	E	F	G	H
Fermentation period (days)	1	10	11	12	13	14	15	16
pH	4.30	3.68	3.61	3.54	3.49	3.33	3.21	2.98

Chloride concentration

Table 2 shows that samples A, B, C, D, E, F, G and H contained 3.30 mg/l, 6.50 mg/l, 7.51 mg/l, 7.68 mg/l, 8.00 mg/l, 8.49 mg/l, 9.50 mg/l and 9.98 mg/l chloride respectively. This implies that there is a direct proportionality between fermentation period and chloride concentration. The presence of chloride ion indicates that the tea plays an important role in maintaining the body’s acid-base and fluid balance, which is essential component of the gastric (digestive) juice which helps in reducing constipation and also help in regulating the flow of fluid in blood vessels and tissues [18].

Nitrate concentration

The results also shows that sample A, B, C, D, E, F, G and H contained 14.54 mg/l, 25.16 mg/l, 26.66 mg/l, 27.10 mg/l, 29.05 mg/l, 30.51 mg/l 30.51 mg/l and 32.43 mg/l nitrate respectively as shown in Table 2. The presence of nitrate in the tea indicates that the tea helps in relaxing blood vessels thereby allowing more blood circulation in the body system and helps in the prevention of angina (chest pain) but not for already existing chest pain [11].

Phosphate concentration

Phosphate concentration in the tea is dependent on fermentation period as sample A, B, C, D, E, F, G and H were found to contain 0.26mg/l, 0.57 mg/l, 0.60 mg/l, 0.78 mg/l, 0.90 mg/l, 1.13 mg/l, 1.16 mg/l and 1.38 mg/l of phosphate respectively as shown in Table 2. The presence of phosphate in the tea makes it potent in preventing a number of diseases which include liver diseases [15].

Sulphate concentration

Sulphate concentration in the tea is dependent on fermentation period as sample A, B, C, D, E, F, G and H were found to contain 9.23 mg/l, 23.02 mg/l, 23.78 mg/l, 24.43 mg/l, 25.04 mg/l, 25.58 mg/l, 26.32 mg/l, and 27.02 mg/l respectively as shown in Table 2. The presence of sulphate in the tea helps in making the digestive tract too acidic for invaded bacteria. Fig. 1 shows the concentration of ions with variation in fermentation period.

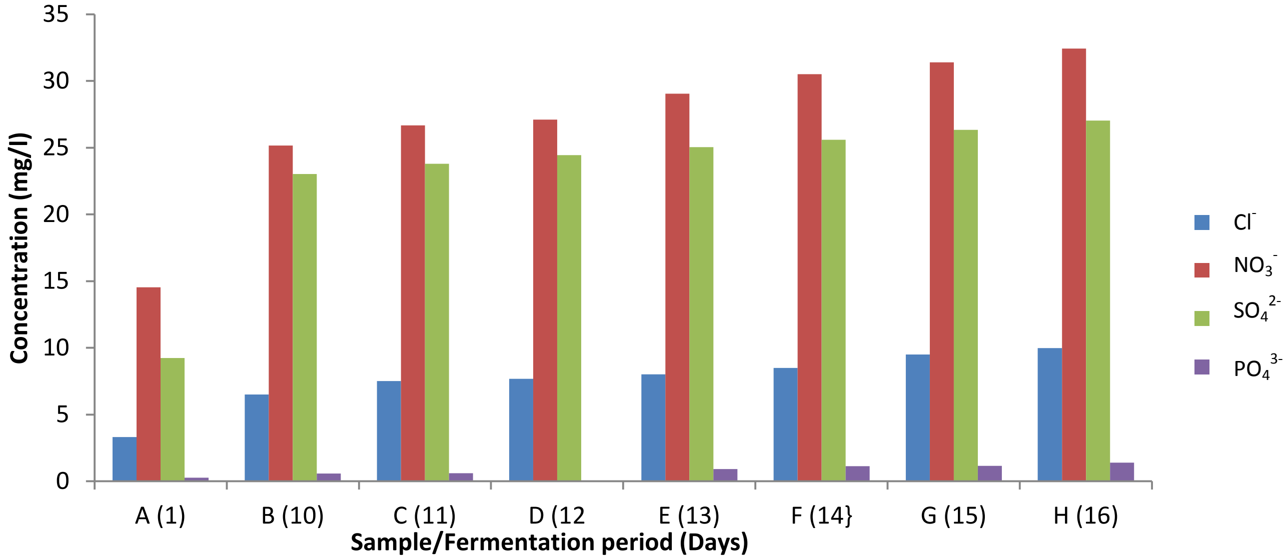

Fig. 1: Concentration of anions with respect to fermentation period

Table 2. Concentration of anions with respect to fermentation period

Anion	Sample/ Fermentation Period							
	A	B	C	D	E	F	G	H
	day 1	10days	11days	12days	13days	14days	15days	16days
Cl^- (mg/l)	3.30	6.50	7.51	7.68	8.00	8.49	9.50	9.98
NO_3^- (mg/l)	14.54	25.16	26.66	27.10	29.05	30.51	31.39	32.43
SO_4^{2-} (mg/l)	9.23	23.02	23.78	24.43	25.04	25.58	26.32	27.02
PO_4^{3-} (mg/l)	0.26	0.57	0.61	0.78	0.90	1.13	1.16	1.38

CONCLUSION

This work reveals that the pH of kombucha tea varies inversely to fermentation period while concentrations of chloride, nitrate, sulphate and phosphate vary directly to fermentation period. Fermentation of the tea infusion should not exceed 15 days as that could be detrimental to bacteriodes which help in keeping the digestive tract of humans free from invaded pathogens. Kombucha tea has some health benefits.

REFERENCES

1. W. T. Harald (1995). Kombucha; The Miracle fungus London: Salamander Books Ltd, 4, 25-30.
2. Benneth, C.K. (1995): ‘Kombucha Fermenting; a Revolution in Health Drinks’. Pittsburg postgazette **13** (14) 15-23

3. Dipti, P., Yoqest, B., Kain, AK., Pauline, T., Angu, B. (2003): Lead Induced Oxidative Stress: beneficial effects of Kombucha Tea. *Biomed Environ Sci.* **16**(3) 276-282.
4. T. Pauline, P. Dipti and B. Anju (2004). Studies on toxicity,anti-stress and hepato-protective properties of Kombucha Tea. Biomed. environ. Sci., 14(3), 207-213.
5. L. Teoh, G. Heard and J. Cox (2004). Yeast ecology of Kombucha fermentation. Int. J. Food Microbial**,** 95(2), 119 -26.
6. W. Z. Kendall (2000). Fermentation Condition of Kombucha Tea. http://www.kombucha-research.com/kcrg/aboutus.htm
7. R. Srinivasan, and S. Smolinsk (2007). Probably gastrointestinal toxicity of Kombucha Tea: is this beverage healthy or harmful? *J. Gen Intern Med.*
8. S. Umar, H. Kalicg, T. Malkam (2008). Kombucha, the fermented tea; Microbiology, Composition and claimed health effects. *J. Food Protection,* 63(8) 976-988.
9. E. Ernst (2003). Kombucha: A systematic review of the Clinical evidence. Research in Complementary and Classical Natural Medicine. 10, 85-87.
10. T. Joannes, M. Roussin and M. Walaszek (2006). Kombucha Consumer Research Group. Journal of Health Science, 71(2), 427-430.
11. S. D. Kumal and B. Mait (2008). The Microbial safety and quality of food, pp. 960-961.
12. J. Pierce (2002). Characterization of Tea Fungus Metabolites. Biotechnology Letters, 16**(**2-3), 199-205.
13. K. Malbasa and E. Benneth (2001). Food in the 21st Century. 1st international Symposium.
14. S. L. Markov, R. V. Malbasa, M. J. Hauk and C. Cvetkovic (2001). Investigation of tea Fungus. Microbe Association. The Yeast, Act a Periodica Technologica, 32, 133-138
15. V. M. Radomir, S. L. Eva and A. K. Ljiljana (2006). Influence of black tea concentrate on kombucha fermentation. Int. Jorn of Food Science, 37, 137-143.
16. C. M. A. Ademoroti (1996). Standard methods for water and effluents analysis, pp. 83-96.
17. S. Brad (1995). FDA Consumer on “Kombucha Mushroom Tea. Food and Drug Administration, 74, 5420-5421.
18. W. F. Gunther (1995). Kombucha: Health Beverage and Natural Remedy from the far East, Its correct preparation and uses, 13(4), 18-23.