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MICROWAVE EXTRACTION OF INSTANT LIQUID TEA

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ABSTRACT
Tea is one of the most widely consumed beverages throughout the world and it is mainly produced in counties like Kenya, China, India and Indonesia. It is not only known for its distinct flavor and smell, but also for its great nutritive value. It is a rich source of bioactive compounds that include polyphenols like Catechin, L-epi Catechin gallate, DL-Gallocatechin, Gallic acid and L-epigallocatechin, flavonoids, alkaloids, amino acids, glycosides, minerals, trace elements, volatile compounds and caffeine. The tea polyphenols were found to have various health benefits like protecting against obesity, inflammation and diabetes. Some of these polyphenols with chemo preventive properties protect against all the stages of carcinogenesis. Out of all the varieties of tea, the tea used for commercial scale purpose is the Asian variety called Camellia sinensis that belongs to the family theaceae. Extensive research on other types of tea is also done by researchers all over the world. Though this shrub is of great nutritional value, most of the polyphenols are lost during extraction using conventional methods like Soxhlet. To solve this problem, Microwave assisted extraction method was developed. The various advantages of this method are use of lesser solvent, rapid extraction of product, less degradation of bioactive compounds and non-toxicity. This research paper focuses on the formulation and standardization of pre-brewed instant liquid black tea concentrate by microwave assisted extraction method and also the evaluation of its physical (Density, Total Soluble Solids), chemical (pH) and sensory characteristics. Three different variations in the sugar alcohol levels were taken for standardization, namely Trail 1 (T_1), Trail 2 (T_2) and Trail 3 (T_3). T_3 which contained 25% of glycerol and 66.8% of sorbitol was found to have the highest sensory scores in terms of the parameters: flavour, consistency, mouthfeel and taste, whereas T_2 had the highest score in terms of the parameter: Color. This indicates that T_3 had the highest overall acceptability score with its flavor, taste, mouthfeel and consistency similar to tea made using conventional method. This opens up a wide range of possibilities to develop tea products that are not only convenient to use but also instant.

Keywords: Bioactive compounds, Black tea, Microwave-assisted extraction, Sugar alcohols

1. INTRODUCTION
Tea is one of the most commonly consumed caffeinated beverages. It is known for its characteristic aroma and taste. Even though there are over 3000 varieties of tea, the asian native evergreen shrub Camellia sinensis is mainly used for commercial purpose. Tea is majorly classified into 3 types: unfermented green tea, partially fermented oolong tea, and fully fermented black tea. Out of these, black tea was found to have the most amount of caffeine and antioxidant polyphenols [Sharangi 2009].

Sri Lanka, Kenya, China, India and Indonesia are the major producers among the other tea producing countries [Basu Majumder et al. 2010]. It is comprised of a complex mixture of bioactive compounds like caffeine, polyphenols, flavonoids, alkaloids, amino acids, trace elements and other volatile compounds. It is also a rich source of antioxidants. The polyphenols in tea were found to have numerous health benefits like protecting against obesity, inflammation, diabetes and cancer [Kim et al. 2014]. Some of polyphenols are Catechin, L-epi Catechin gallate, DL-Gallocatechin, Gallic acid, L-epigallocatechin [Roberts and Wood 1951].

Extraction is an important step in many of the researches. Many of the food processing industries use conventional extraction techniques like Soxhlet and maceration. Microwave assisted extraction (MAE) is the non-conventional emerging technique that has increased the interest of researchers in the field of food processing and pharmaceutical research. It is known to have a lesser solvent consumption, makes the extraction process rapid, rises the extraction yield and reduces the degradation of bioactive compounds [Kaufmann and Christen 2002].

Sugar alcohols are solvents that can also be used for microwave extraction. They are white, water-soluble, organic compounds, typically derived from sugars. They are also called as polyhydric alcohols and are widely used in the food industry as sweeteners and thickeners. They are not readily absorbed into the blood stream as compared to sucrose, making it an excellent alternative for people with diabetes and those on low sugar diets. However, when these sweeteners are consumed in excess, it can lead to various gastrointestinal problems like bloating, diarrhea and flatulence [Godswill 2017]. Sorbitol (E420) is one type of sugar alcohol that is an isomer

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of mannitol which is usually made using corn syrup. It acts as a laxative by stimulating bowel movement and also as a sweetener in various commercial products. Glycerol (422) is another sugar alcohol that is colourless, clear, hygroscopic and a syrupy liquid. It acts as a co-solvent for water extraction and is found to have high efficiency in extracting polyphenols

Pre-brewed liquid tea was found to have the flavour and aroma of conventional tea powder in a liquid base through extraction technique. It can be directly added to hot/cold milk without the need for filtration, hence making it more convenient than conventional tea.

The objective of this study is to formulate and standardize pre-brewed instant liquid black tea concentrate extracted by microwave heating and

To also evaluate its physical, chemical and sensory properties.

2. MATERIALS AND METHODS

2.1. Materials

2.1.1. Plant Material

A Grade CTC (Crush-Tear-Curl) Black tea (Camellia sinensis) samples purchased from a local market in Assam, India.

2.1.2. Solvents Used

70% Sorbitol (66^0 Brix), Glycerol (72.2^0 Brix) and water were used.

2.1.3. Lab Equipment

Microwave with Reflux condenser (Model: Kenstar), laboratory weighing scale, Magnetic stirrer (Model: Bexco), Refractometer and pH meter.

2.2. Methods

2.2.1. Preparation of Tea Decoction

The tea decoction is prepared first by weighing and mixing the tea powder with the solvent mixture (61.8^0 Brix) using a magnetic stirrer, transferring the content to a round spherical flask, followed by the microwave assisted extraction (as shown in Figure 1) and finally filtration.

Three different trials (T_1,T_2,T_3) with variations in the amount of the sugar alcohols were performed.

Table 1 representation of variable parameters

Solvent Composition			
Parameters	Weight (In %)	Weight (In %)	Weight (In %)
	T_1	T_2	T_3
Sorbitol	91.8	76.8	66.8
Glycerol	_	15	25
Water	8.19	8.19	8.19

Table 2 Fixed parameters to be maintained during microwave-assisted extraction

Microwave power	7.72 W/g
Time	1m 10s
PR	Full power

Figure 1 Diagrammatic representation of a simple microwave extraction system

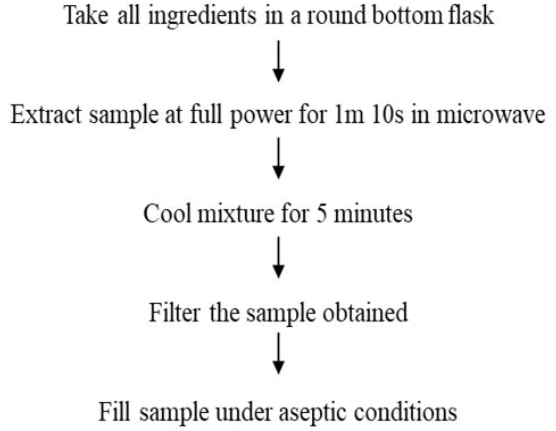

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Figure 2 Production Process of Pre brewed liquid tea concentrate

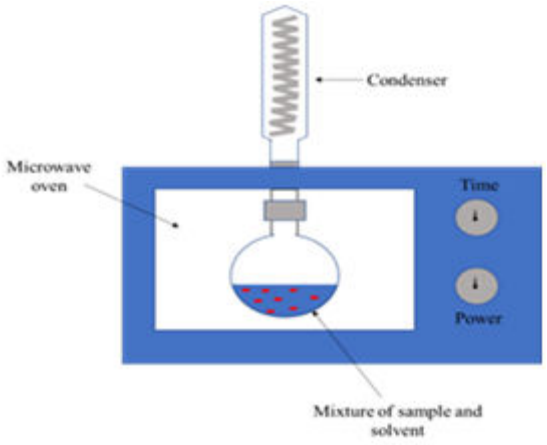

Figure 3.1 Filtered tea decoction Figure 3.2 Aseptic filling

2.2.2. Physicochemical analysis

2.2.2.1. Total Soluble Solids

Total soluble solids in the sample are measured as Brix with a hand refractometer by placing a drop of sample on the prism and reading the corresponding reading.

2.2.2.2. Ph

Electrodes and other equipment contacting the samples were rinsed with distilled water. An aliquot of sample was poured into suitable container. Sample was placed onto stirrer and electrode was introduced. When the pH meter was stabilized, the pH reading was noted and recorded.

2.2.2.3. Density

Measure 10 ml of the tea decoction sample using a measuring cylinder and weight the tea decoction. Note the weight of the sample.

2.2.2.4. Sensory Evaluation

To 10 ml of the tea decoction sample, either add 45 ml of hot water and 6 g of milk powder, or 45 ml of undiluted hot milk and 45 ml of hot water. It was served hot to the panellist for sensory evaluation.

For the sensory evaluation, a 5-point hedonic scale was used (where 1=dislike very much, 2=dislike slightly, 3=neither like nor dislike, 4=like slightly and 5=like very much) [Zhi et al. 2016]. It was done for 5 sensory parameters: colour, flavour, consistency, mouthfeel and taste.

3. RESULTS AND DISCUSSION

3.1. Total soluble solids

Table 3.1 Tabular representation of the TSS values for various samples

Trial No	° Brix
Trial 1 (T1)	65°
Trial 2 (T2)	66°
Trial 3 (T3)	63.9°
Control (C)	71^0

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T_2 was found to have the highest TSS value whereas T_3 had the lowest, among all the three trials. However, there was very slight variation among the samples.

3.2. pH

Table 3.2 Tabular representation of the pH for various samples

Trial No	pH
Trial 1 (T1)	5.08
Trial 2 (T2)	5.12
Trial 3 (T3)	5.13
Control (C)	5.38

T_3 had a slightly higher pH when compared to T_1 and T_2. This might be due to the higher concentration of glycerol that is basic in nature. This contributes to the increase in pH. T1, on the other hand, that contains no glycerol, was found to have the lowest pH among the three samples.

3.3. Density

Table 3.3 Tabular representation of the pH for various samples

Trial No	Density (g/ml)
Trial 1 (T1)	1.05
Trial 2 (T2)	1.17
Trial 3 (T3)	1.205

T3 sample was found to be the most dense (1.205 g/ml) due to relatively high amounts of glycerol (25%) when compared to T1 (0% Glycerol) and T2 (15% glycerol) with a density of 1.05 g/ml and 1.17 g/ml respectively.

3.4. Sensory Evaluation

From the radar graph represented below, T_3 got the highest sensory scores in all of the parameters except for the colour. In terms of colour, T_2 had the highest score and the second highest in all the other parameters. The overall acceptability was the lowest for T_1 and highest for T_3. This might be due to the good flavour, consistency, mouthfeel and taste provided by glycerol.

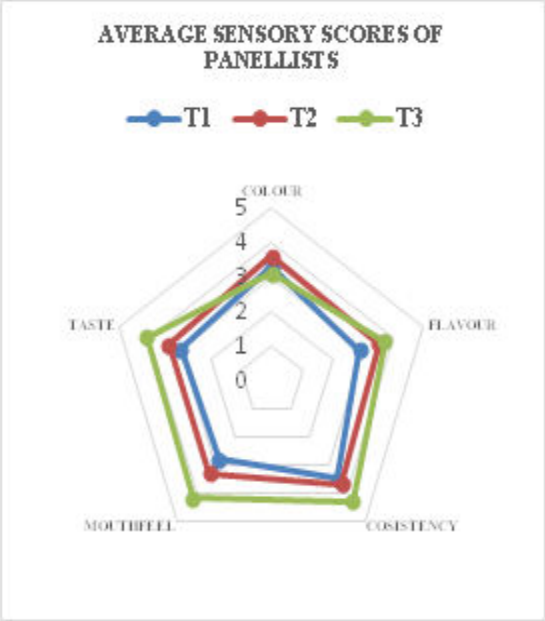

Figure 4. Average sensory scores of the tea sample

4. CONCLUSION

Tea being one of the most commonly consumed caffeinated beverages has made it essential to develop an instant pre-brewed liquid tea which is faster to prepare and also more convenient. Through microwave extraction, not only are the polyphenols and other bioactive compounds retained, but it also imitates the flavour and taste of the tea made by the conventional method. Studies on the use of microwave extraction in a large-scale level is still being studied extensively. From the data we have obtained, the pre-brewed liquid tea containing 25% glycerol and 66.8% sorbitol was most preferred. It was found to have higher sensory scores and thereby a greater overall acceptability.

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