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Indigenous Tea Production From Calyces Of *Hibiscus Sabdariffa* L.

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Abstract
Studies were carried out on the possibility of producing an acceptable indigenous tea from a commonly available indigenous raw material, *Hibiscus sabdariffa* L. The said tea was blended with ground dried leaves of *Cymbopogon citratus and* ground dried peels of *Citrus limon*. The commonly consumed commercial green tea, *Camellia sinensis* was employed as control and also for the purposes of comparison. Both the experimental *H. sabdariffa* tea and the control were served to a panel of tasters. The tasters rated the *H. sabdariffa* experimental tea higher than the commercially sold control tea, *C. sinensis*. The microbial loads of the experimental tea and control were also assessed. No harmful or toxic species of microorganisms were isolated from both teas. The pH of the experimental tea was found to be 4.8 while that of the control was 5.8. The experimental tea components and the final blended tea were found to contain glucose, protein, oil and minerals such as sodium, potassium, calcium and phosphate. The implications of the various results obtained have been discussed.

Key Words: Tea production, *Hibiscus sabdariffa* , *Cymbopogon citratus*, *Citrus limon*
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Introduction

Tea is a beverage prepared by making an infusion of the processed, dried leaves of *Camellia sinensis*. It is perhaps the most popular of all the non-alcoholic drinks and about half of the world population drink it regularly.

Tea has been used as medicine in South-East China since very ancient times and the beverage has been drunk there for the past 2000 – 3000 years. The tea drinking habit began to spread from China around the 5th Century A.D but it did not reach Europe until the sixteenth century and China remained the only exporter of tea leaves. Cobley (1976) reported that Britain became the chief importer and Britons came to be among the world's leading tea drinkers, and encouraged the production of the crop in India and Sri Lanka. Now it is also grown in Africa, Russia, Turkey, South America and Australia.

Tea is a popular drink because it has pleasant aroma and flavour which are derived largely from essential oils in the plant parts from which it is made. The beverage is also popular because of the refreshing and stimulating effects of the alkaloid, caffeine or related substances which they contain. In small amounts, caffeine acts on the central nervous system to increase mental activity and decrease fatigue. Caffeine also aids digestion by stimulating increased production of digestive juices and it has a diuretic effect, increasing the excretion of uric acid. The plant part from which tea is made contains 1 - 3% caffeine. Indian tea has an energy value of 108kcal per 100g and contains sodium, potassium, calcium, magnesium, phosphorus, iron, copper, zinc, sulphur and chlorine. It also contains proteins, fat and carbohydrate (Paul and Southgate, 1985) .

Tea plant is a shrub or straggling tree which grows wild to a height of 10m or more and belongs to a small family of dicotyledons, the Theaceae which includes about 200 species of trees and shrubs in the wetter tropics.The harvested tea shoots are taken to the factory soon after they are plucked and there they are subjected to a series of complex processes during which the flavour and aroma of the "made" tea are developed. Different grades and black tea from different sources are blended in the importing country before the tea is sold.

The most popular tea in Nigeria is Lipton tea which is imported from England. Other types of imported tea in Nigeria include Twinings pure peppermint herbal tea

(a minty drink) blended by R. Twining & Co. Ltd, London (Export blenders), Bigelow assorted herbal tea from U.S.A., Earl Grey Herbal tea from China and Anti malarial tea from China.

Nigeria with a population of over 140 million people imports about 85% of its tea. This is a huge drain on the national economy. Highland tea is the major tea product of Nigeria and even at that foreigners hold a major share of the company. In view of this it has become imperative to develop other brands of tea in the country, moreso, now that the tea market is embracing other types of tea that are made from different medicinal herbs. The present study was therefore designed to find out the possibility of producing an acceptable tea from *Hibiscus sabdariffa* L. which is very abundant in Nigeria.

This plant belongs to the family, Malvaceae which is economically important (Cobley, 1976). The Plant is a red sorrel and a Roselle. It is an erect plant with big yellow flowers and a purple centre. The epicalyx and calyx eventually become succulent. The plant is cultivated for the fleshy calyx (potherb and mucilage), for the oily seeds and the fibre stem. The leaves, calyces and flowers are rich in vitamin C and thus used in local medicine as a diuretic, anti-scorbutic and to relieve coughs, (Oliver, 1960).

Materials and Methods

The samples employed for the study included calyces of *Hibiscus sabdariffa* (L) which formed the major tea component, leaves of C*ymbopogon citratus* (lemon grass) and peels of *Citrus limon* (lemon) which were employed as flavouring agents. Tea leaves of *Camellia sinensis* were used as control.

Fresh calyces of *Hibiscus sabdariffa*, fresh leaves of C*ymbopogon citratus* and C*. limon* were collected from garden behind students village hostel, University of Jos. Sample of *C.sinensis* which served as control were bought from Jos main market. The fresh calyces of *H. sabdariffa* fresh leaves of *C. citratus* and peels of *C. limon* were dried in a corner of a well ventilated room for a period of 7days. The samples were then taken to the laboratory for processing.

Tea Preparation from the Experimental Test Samples: Dried forms of the three tea components were separately ground to fine powder with the aid of a sterilized laboratory Kenwood blender model KW 10. The ground samples were then mixed in a ratio of 5:1:1 and extracted with the aid of boiling water (at 100^0C).Milk and Sugar were added in the same way conventional tea is made. The control tea sample which is commonly consumed in Nigeria was also prepared in a similar conventional manner. The control tea was chosen for the purpose of comparison. The new product (experimental tea) was given to a panel of 100 student tasters (50 males and 50 females) for sensory organoleptic characteristics ratings. The results were recorded as percentages.

Portions of the raw tea components were plated out on Malt Extract Agar, Nutrient Agar and Sabouraud Dextrose Agar media in order to determine their microbial loads. Portions of the ground and mixed experimental hot tea were exposed at the laboratory for a period of 7days. The exposure was carried out in order to determine the type of microorganisms that could colonize and deteriorate the newly processed tea. Portions of the exposed tea were plated out employing the pour plate method described by Warcup (1950) and the dilution plate method described by Bisby *et.al.,* (1933). The resultant culture plates were incubated at 37^0C for a period of 7days and then examined under the microscope for the presence of bacteria, fungi and yeasts. The pure cultures of the microbial isolates were identified under the microscope together with cultural characteristics. References were also made to Domsh and Gams (1972), Von Arx (1974), Barron (1977), Raper and Fennel (1977), Samson *et.al.,* (1984), Cheesbrough, (2002).

A weight of 3g of the experimental tea was dissolved in 30ml of sterile water. The pH of the liquid was measured with the aid of Unicam pH meter, Kent E/L/7020 model. The experiment was replicated thrice and the means value was recorded. The pH of the control tea was also measured.

Biochemical analyses were carried out on the ground experimental tea components and also on the resultant tea. Similar analyses were carried out in the control tea using the method described by the Association of Analytical Chemistry (AOAC, 1990). The mineral contents of the experimental tea, (potassium, sodium, calcium, phosphate) were also determined. The cholesterol, protein, glucose and caffeine constituents of the tea were also

assessed employing the method described by AOAC, (1990).

Results

Very tasty and highly acceptable delicious tea was produced from *H. sabdariffa* (L), *C. citratus* and *C. limon* mixture. The conclusion was drawn judging from the ratings given by the panel of the tea tasters. The formulated tea appeared attractive and there was no significant difference between it and the control (*C. sinensis*) in terms of colour and taste. The details of both tea's physical look, taste and panel ratings are given in Table 1.

The experimental tea components; *H. sabdariffa*, *C. citratus, C.limon,* the experimental tea mixture and the control *C. sinensis* were found to contain 5,4,6,5 and 3 species of microorganisms respectively. Microbial isolates from the mixed experimental tea powders stuff yielded mainly fungi, bacteria and yeast.

Table 1: Evaluation of the *H. sabdariffa* and the *C.sinensis* (control) teas by panel of tasters

Ratings of *H. sabdariffa* and control teas	Level of acceptance of teas in %	
	H. sabdariffa	*C. sinensis*
Exceptional	80.00	70.00
Good	20.00	30.00
Unacceptable	-	-
Total	100.00	100.00
Colour acceptance	+++	+++

Table 2: Species of microorganisms associated with the experimental tea and its components.

Microbial isolates	Specimen					
	A*	B	C	D	E	Total
Fungi						
Aspergillus clavatus	+*	-*	-	+	-	2
A. fumigatus	+	-	+	-	-	2
A. niger	+	-	+	-	+	3
A. terreus	-	-	+	+	-	2
Mucor racemosus	-	+	-	-	-	1
Bacteria						
Bacillus cereus	+	-	+	+	-	3
B. Subtilis	+	+	-	+	-	3
Lactobacillus acidophilus	-	-	-	-	+	1
Staphylococcus species	-	+	-	-	-	1
Yeast						
Kloeckera apiculata	-	-	+	+	-	2
Saccharomyces cerevisiae	-	+	+	+	+	4
Total	5	4	6	6	3	24

A* = *H. sabdariffa,* B = *C. citrates,* C = *C.limon,* D = Experimental tea mixture (*H. sabdariffa)* E = *C.sinensis* tea (control), + = *present,* - = absent

These included four species of *Aspergillus*, four species of *Bacillus*, one species of *Saccharomyces* and one species of *Kloeckera*. The details of the microbial isolates are presented in Table 2. The exposed experimental tea mixture was found to have been colonized by species of microorganisms and the isolates included bacteria, fungi and yeasts. The details are given in Table 3.

The pH of the resultant tea was found to be 4.80 as compared to the control tea which had a pH of 5.80. The details of the pH results are presented in Table 4.

The resultant experimental tea was found to contain alkaloids and caffeine, flavonol-glycoside, hibiscitrin which on hydrolysis yielded glucose and a dyestuff hibiscitrin, citric, tartaric and mallic acids, gossipetin, an anthocyanin, hisbiscin chloride which on hydrolysis yielded a pentose and cyanidin chloride.

Both the experimental tea components and the resultant tea were found to contain glucose, protein, oil and

minerals including sodium, potassium, calcium and phosphate. The *C. citratus* oil was found to contain citral. The details of the mineral constituents of the tea components and the resultant tea are presented in Table 5.

Table 3: Microbial isolates from the laboratory exposed tea

Microbial Isolates	Samples		
Fungi	*H. sabdariffa*	C.sinensis	Total
A. fumigatus	+	+	2
A. niger	+	+	2
A. terreus	-	+	1
Penicillium expansum	+	+	2
Yeast			
Candida krusei	+	+	2
Rhodotorula sp	+	+	2
Saccharomyces cerevisiae	+	+	2
Bacteria			
Bacillus cereus	+	+	2
B.megaterium	+	-	1
Lactobacillus acidophilus	-	+	1
Pseudomonas aeruginosa	+	-	1
Total	9	9	18

Table 4: pH values of experimental samples.

Name of sample	pH
H. sabdariffa	2.5* ± 0.10
C. limon	6.3 ± 0.15
C. citratus	6.2 ± 0.15
H. sabdariffa tea mixture*	4.8 ± 0.45
C. sinensis tea*	5.8 ± 0.44

* Means of three determinations ± SD

* Both contains milk & sugar

Table 5: Biochemical analysis of the samples (Mmol/L)

	A*	B	C	D	E
Sodium	167	-	-	-	-
Potassium	17.4	18.2	8.4	11.4	8.75
Calcium	4.36	2.7	3.29	3.58	1.11
Phosphate	5.15	2.9	5.15	3.58	5.09

A* = *H. sabdariffa* , B = *C. citrates,* C = *C.limon* D = *H. sabdariffa* tea mixture
E = *C. sinensis* tea (control)

Discussion

The study has shown that acceptable tea can be produced from *H. sabdariffa* calyces. A total of 80% of the panel of tasters rated the tea produced from the *H. sabdariffa* exceptionally acceptable. There was no significance difference in the physical appearance of the experimental tea as compared to the control tea produced from C. *sinensis.* The aroma of the tea was enhanced by the aroma and flavour of the other components. *Cymbopogon citratus* contains citral in its oil and the amount of citral in the oil has been reported to increase with the leaf age (Cobley, 1976). Citral is an aldehyde derivative of terpene and constitutes 70-80% of lemon grass oil. It is useful in the synthesis of vitamin A. Lemon grass oil is important in medical and pharmaceutical industry.

The species of micro-organisms isolated from the tea components might have been leaf surface and fruit surface micro-organisms which were harvested together with the leaves and *C. limon* fruits. The mixed and exposed experimental tea was also found to contain species of micro-organisms. It is therefore necessary to subject the new tea to preservation treatment before packaging if it were to be produced on commercial scale.

The fresh leaves of *H. sabdariffa, C. citrus* and peels of *C. limon* were dried for a period of seven days prior to their being processed in a herbal tea in order to minimize their colonization by microorganisms. The concept of water activity (a_w) effectively quantified the relationship between moisture in foods and other commodities and the ability of microorganisms to grow on them. There is therefore need for any food commodity to be dried adequately to a critical water content in order to prevent its deterioration by microorganisms.

The pH of the resultant experimental tea was found to be 4.80. Thus a pH value that would support

microbial growth. Samson *et al*.(1984) reported that good preservation of canned products with a pH 3.4 or lower can be obtained by pasteurization. The heat treatment is directed towards inactivation of vegetative bacteria, yeasts, fungal mycelium and conidia. A product may contain more heat-resistant ascospores so in view of this a higher pasteurization temperature will be required.

Both the experimental tea components and the resultant herbal tea (*H. sabdariffa* tea) were found to contain glucose, protein, oil and mineral nutrients. The nutrient status of food or material is very important in terms of its colonization and decay by microorganisms. In view of the fact that the *H. sabdariffa* tea contains essential food and mineral nutrients and with appropriate pH value shows that it is liable to be colonized and decayed by microorganisms if is not adequately preserved or dried. Dried foods including tea should be ground to fine powder before blending and should be further dried to constant weight prior to packaging in order to make sure that there is no free water available for use by microbial deteriogens.

C.citratus and *C. limon* were used as flavouring agents for the tea. Lund and Dinsmore (1978) reported that compounds which contribute to flavour include acetaldehyde, ethyl vinyl ketone, ethyl butyrate, n-octanal, citral, ∞-terpinol and 4-vinyl guaiacol. The *C. citrus* oil was found to contain citral and therefore may have contributed to the taste of the *H. sabdariffa* tea. Herbal teas could be medicinal. Herbal tea laced with yak butter was found to be the only medicine available to a mother in western Tibet who was found to be badly jaundiced and who bled for two months after the birth of a child (Swerdlow, 2000). She was too weak to travel to the nearest hospital that she had to be treated with herbal tea. The Chinese have already started managing malaria with their anti-malaria tea.

An infusion of *H. sabdariffa* has been found to be diuretic, choleretic and hypotensive. It has been found to decrease the viscosity of the blood and stimulates intestinal peristalsis (Oliver, 1960). This therefore shows how important the *H.sabdariffa* tea is and why it should be patented and put into commercial production for nutritional and medical uses.

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