Original Research Article

Quality evaluation of tea brewed from blends of soursop (*Annona muricata*) and moringa (*Moringa oleifera*) leaves.

.ABSTRACT

Tea is commonly made from the leaves of *Camella sinensis*. Production of similar drinks from other plant leaves with potential health benefits would help to prevent diseases. This study examined the chemical composition and antioxidant activity of tea made from blends of dried moringa and soursop leaves. Mature, fresh and green leaves from both plants were washed in water and sun-dried for 10 h. The dried leaves were milled and sieved to obtain the tea powders. Blends of soursop:moringa tea were formulated as follows: A:100% Soursop, B: 100% Moringa, and soursop:moringa blends as: C:50:50% ; D: 60:40% and E: 40:60%. Ten grams of each blend of tea powders was brewed in 100 ml of hot water (90^{o}C) for 10 min and cooled to room temperature (28 ±.2^{o}C) prior to analysis. From the result, 50:50 soursop-moringa tea gave the highest levels of vitamins C and A. Mineral levels were significantly different among the samples (p<0.05) with higher values recorded for calcium (2117.10 mg/100ml) sodium (146.02 mg/100ml), magnesium (362.03 mg/100ml), phosphorous (241 mg/100ml), zinc (7.13 mg/100ml) and potassium (1207.20 mg/100ml) in 50:50 soursop-moringa tea. The pH differed significantly (p<0.05) in all the tea samples and ranged from 7.28–7.81. Total solids gave values ranging from 3.47mg/l-3.82mg/l (p<0.05) and total sugars 1.12–3.07% (p<0.05 The amount of tannin was significantly higher (p<0.05) in all tea blends compared to other antinutrients analyzed in this study and ranged from 8.95-9.84%. Assessment of the antioxidant capacity by Diphenol-2,2picrylhydroxyl (DPPH) and Ferric reducing antioxidant power (FRAP) showed significant differences (p<0.05) among the tea samples with the 50:50 soursop:moringa blend having the highest antioxidant activity with values up to 89.04 % and 531.44 (µM/L) in each case. Overall the soursop-moringa tea blends exhibited good chemical composition and antioxidant activity, with 50:50 formulation showing the best nutritional quality attributes.

Keywords: [soursop, moringa*, tea, antioxidant activity, DPPH, FRAP]*

1 INTRODUCTION

Tea is an aromatic beverage commonly prepared by pouring hot or boiling water over cured leaves of the *Camella sinensis,* an evergreen shrub native to Asia [1]. It is one of the most widely consumed drinks in the world. Different kinds of tea exist, which include Chinese green with a cooling, slightly bitter and astringent flavor and others having different sweet, nutty, floral or grassy notes [2]. Although tea is known to come from the tea plant; *Camella sinensis,* today there are various sources of such drink made from other plant leaves. Soursop (*Annona muricata*) is a tropical plant belonging to the *Annonaceae* family. The plant is widely promoted for its health benefits [3]. Soursop leaf extract is very good for the prevention of various diseases such as cancer through the inhibition of cancer cell growth [4]. Other benefits include the ability to boost the immune system, improve digestion and reduce inflammation. The leaf contains calcium, potassium, iron, vitamins A, B and C, lipids, stearic acid, gentisic acid, and annomuricin A, B, C and E [5]. Moringa, which is of the flowering plant family *Moringaceae,* is native to parts of Africa and Asia and the most widely cultivated specie is Moringa *oleifera*. It contains significant amount of vitamins A, C and E; calcium, potassium and protein [6]. Moringa leaves, flowers and seeds contain antioxidants like flavonoids, polyphenols and ascorbic acid. The leaf extract has high antioxidant activity free-radical scavenging capacity and inhibition of lipid, protein and DNA oxidation [7]. This prevents the damage and degradation of cells caused by free radicals in the body. Moringa also confers health benefits such as reducing some diabetes symptoms, protecting the cardiovascular system and the liver, supporting brain health, exhibiting antimicrobial and antibacterial properties [8].The prevalence of chronic non communicable diseases such as cancer, cardiovascular diseases and high blood pressure in developing countries has been a great concern. The formulation of food products such as tea and other healthy beverages with significant nutrients to alleviate and prevent these diseases is of great importance. Therefore this study aims to evaluate chemical composition and antioxidant activity of tea made from blends of soursop and moringa leaves.

2 MATERIAL AND METHODS

2.1 Preparation of Samples

Mature, fresh and green soursop and moringa leaves were washed in tap water and sun-dried (10 h) on an elevated platform. The dried leaves were milled to obtain the tea powders using a blender for 5 min and sieved respectively, with 355 microns sieve. Blends of soursop:moringa tea powders were formulated as shown in Table 1. Ten grams of each formulation was brewed in 100 ml of hot water (90^{o}C) for 10 min. The tea extract was cooled to room temperature (28±2^{o}C) prior to analysis. All samples were formulated and analyzed in triplicates and 100% soursop and moringa tea powders (A and B) served as controls.

Table 1: Formulation of soursop:moringa tea powder

Treatment	Weight of sample (g)		
	soursop	moringa	Soursop:Moringa blends (%)
A	10	0	100:0
B	0	10	0:100
C	6	4	60:40
D	5	5	50:50
E	4	6	40:60

[A:100% Soursop, B: 100% Moringa, and soursop:moringa blends (C:60:40%:D:50:50%;and E: 40:60%). Total weight of tea powder was based on 10 g.

2.2 Chemical Analysis

<u>2.2.1 Chemical composition</u>

Calcium and magnesium were analyzed using EDTA complexiometric titration [9] while potassium and sodium were determined using the flame photometry method as described by [10]. Phosphorus was determined using Molybdovandate method of [9]. Iron was determined using redox reaction and colorimetry [9] and zinc by atomic absorption spectroscopy [11]. Beta carotene was determined according to the method of [9] and vitamin C by titrimetric method described by [12]. Total phenol was determined using the Folin Ciocalteu reagent colorimetric method of [13]. Flavonoid and saponin and tannin were determined using the method of [14] and Alkaloids by [15]. Cyanogenic glucoside was determined by spectrophotometric method as described by [12]. Total solids and total sugars were determined using the method of [9].

<u>2.2.2 Antioxidant activity</u>

2.2.2.1 Diphenol-2-2-picrylhydroxyl (DPPH) assay

The antioxidant properties of the tea samples were determined using Diphenol-2-2-picrylhydroxyl (DPPH) method as described by [16] with slight modification. One milliliter of each extract was added to 10 ml of methanol. Then the solution was mixed using a vortex and left to stand at room temperature (28 ± 2^{o}C) for 1 h in a dark cupboard. It was stirred and filtered into a clean beaker. One milliliter of the filtrate was transferred into a test tube and left to stand in the dark for 30 min after the addition of 1 ml of DPPH solution. The absorbance of the solution was measured at 517 nm using a spectrophotometer, with the degree of discoloration of the solution indicating the scavenging efficiency of the added substance. The free radical scavenging activity was calculated as a percentage of DPPH discoloration using the equation:

$$Free\ radical\ scavenging\ activity = 100 * \ 1 - absorbane\ of\ \frac{sample}{Absorbance\ of\ reference}$$

2.2.2.2 Ferric reducing antioxidant power (FRAP) assay

The ferric reducing antioxidant power (FRAP) was determined using method described by [17]. Three milliliters of prepared FRAP reagent was mixed with 200 µl of sample in a test tube. Blank sample was also prepared. With deionized water. The absorbance of the tea sample was determined at 593 nm against the blank, after 30 min incubation at 37^{o}C. The absorbance of standard solutions of 200, 400, 800, 1200, and 1600 µM prepared from aqueous solution of FeSO4.H2O was used to plot the calibration curve. FRAP values obtained for the samples were expressed as µM of Fe^{2+} equivalent per litre of tea extract.

2.3 Statistical Analysis

Data obtained from triplicate determinations of the samples were analysed and significant differences between the samples were tested using Analysis of variance (ANOVA) Duncan's multiple range with SPSS statistical software (version 20, IBM SPSS, UK).

3 RESULTS AND DISCUSSION

3.1 Chemical Composition

3.1.1 Vitamin and mineral compositions of soursop-moringa tea

The results of vitamin and mineral compositions of soursop-moringa tea blends are shown in Table 2. The amount of vitamins in the tea blends were significantly different (p<.05). Soursop-moringa tea (50:50%) and 100% moringa tea had the highest (44.22 mg) and lowest (18.41 mg) levels of beta-carotene respectively. Beta carotene is the precursor of vitamin A and is converted to vitamin A by the liver. Vitamin A is important for the maintenance of immune systems, good vision and skin health. Soursop-moringa tea blends contain appreciable amount of vitamin A which could help to boost the immune system and improve vision. Vitamin C (ascorbic acid) ranged from 20.02 - 91.72 mg/100ml with the highest level found in soursop-moringa tea (50:50%) and the least level in 100% moringa tea.

Table 2: Vitamin and mineral composition (mg/100 ml) of soursop:moringa tea blends

Soursop:Moringa tea blends	Beta carotene (µg/100 ml)	Vit.C	Ca	Na	Mg	P	K	Fe	Zn
100:0	36.58^{b}±0.01	88.23^{a}±0.02	608.05^{e}±0.04	101.63^{e}±0.02	157.32^{e}±0.02	187.32^{e}±0.02	637.12^{e}±0.02	8.61^{e}±0.01	3.61^{e}±0.02
0:100	18.41^{e}±0.03	20.02^{d}±0.02	2014.10^{b}±0.02	117.15^{c}±0.01	314.83^{d}±0.02	206.03^{d}±0.12	1041.10^{d}±0.02	14.11^{a}±0.01	6.02^{c}±0.01
60:40	36.49^{b}±0.02	73.92^{e}±0.01	1049.10^{d}±0.02	109.84^{d}±0.01	317.65^{c}±0.02	210.42^{c}±0.02	1100.20^{c}±0.02	9.51^{d}±0.01	4.17^{d}±0.01
50:50	44.22^{a}±0.02	91.72^{b}±0.02	2117.10^{a}±0.03	146.02^{a}±0.02	362.03^{a}±0.02	241.25^{a}±0.02	1207.20^{a}±0.02	12.83^{b}±0.02	7.13^{a}±0.01
40:60	30.12^{c}±0.02	61.65^{c}±0.02	1634.2^{c}±0.02	121.03^{b}±0.02	346.12^{b}±0.02	229.72^{b}±0.01	1184.00^{b}±0.02	11.33^{c}±0.02	6.32^{b}±0.01

Data are means of triplicate (n=3) analysis ± standard deviation. Means with the same superscripts within each column are not significantly different (p >.05). means with different superscript within each column are significantly different (p<.05).

Table 3: Chemical composition of soursop:moringa tea extract

Soursop:moringa tea blends	pH	Total solids (mg/l)	Total sugars (%)	Tannin(%)	Phytate(%)	Alkaloid(%)	Flavonoid(%)	Saponin(%)	Cyanide(%)
100:0	7.28^{e}±0.01	3.82^{a}±0.02	3.07^{e}±0.02	8.95^{e}±0.02	2.52^{e}±0.02	1.93^{e}±0.01	7.34^{a}±0.02	0.25^{e}±0.01	0.22^{c}±0.01
0:100	7.81^{a}±0.01	3.55^{d}±0.02	1.12^{e}±0.01	9.36^{c}±0.02	7.67^{a}±0.03	4.64^{a}±0.02	3.61^{e}±0.12	1.63^{a}±0.02	0.30^{a}±0.01
60:40	7.49^{d}±0.00	3.66^{c}±0.02	2.25^{c}±0.01	9.12^{d}±0.01	4.27^{d}±0.02	2.85^{d}±0.02	6.57^{c}±0.02	0.67^{d}±0.01	0.17^{d}±0.01
50:50	7.73^{b}±0.01	3.72^{b}±0.02	2.36^{b}±0.01	9.84^{a}±0.01	6.17^{c}±0.02	3.93^{c}±0.02	6.83^{b}±0.02	1.31^{b} ±0.02	0.27^{b}±0.01
40:60	7.63^{c}±0.01	3.47^{e}±0.02	2.04^{b}±0.01	9.45^{b}±0.02	6.32^{b}±0.02	4.24^{b}±0.02	4.31^{d}±0.01	0.98^{c}±0.01	0.22^{c}±0.01

Data are means of triplicate (n=3) analysis ± standard deviation. Means with the same superscripts within each column are not significantly different (p<.05). Means with different superscript within each column are significantly different (p<.05)

These values vary from the range of values reported by [18] for fresh moringa leaf (213 mg), moringa leaf powder (16.55 mg), green tea (8.25 mg) and black tea (76.40 mg). This variation could be attributed to the processing methods such as steaming of the leaves as used in the present study which gave slightly higher value of 20.20 mg for 100% moringa tea compared to 16.55 mg reported for the tea powder by the above researchers. Soursop:moringa tea (50:50%) showed the highest level of vitamin C (91.72 mg/100 ml). vitamin C is an important nutrient possessing antioxidant ability and provides protection against free radicals [19]. Teas with high content of vitamin C as observed in this study have the potential of meeting the recommended daily intake of 60 mg [20] and protecting the body against free radicals.

The composition of all the minerals tested in the tea samples were significantly different ($p<0.05$). The 100% moringa tea showed significantly higher levels of the minerals than 100% soursop tea. However, the highest level of calcium, sodium, magnesium, phosphorous, zinc and potassium was observed with the soursop-moringa 50:50% tea blend while the 100% soursop tea had the least values for all the minerals evaluated. Interestingly, calcium and potassium were mostly abundant in all the tea blends and ranged from approximately 608-2,117 mg/110 ml and 637-1,207 mg/100 ml, respectively. Availability of calcium in human nutrition has been associated with reduced risk of osteoporosis, hypertension, colon/breast cancer, kidney stones, and obesity/over-weight [21]. Calcium plays an important role in blood clotting, in muscles contraction and in enzyme metabolic processes [22]. Lower values of calcium (which ranged from 1.39–6.87mg/100 ml) in moringa tea infusions were reported by [23] than observed in this study. Gabriel and Nkemakonam [18] reported 465.50 - 2057.50 mg/100 ml of calcium in moringa leaves and the tea samples which compares favorably to the values obtained in this study. Interestingly, the amount of calcium detected in this study suggests that the tea blends are suitable to meet the recommended daily allowance (RDA) of calcium (800–1100 mg/day) in human.

Potassium is an important element which helps in maintenance of acid-base balance in the body and normal functioning of nervous system [24]. Potassium levels of the tea blends obtained from this study are not surprising since moringa tea leaves have previously been reported to contain appreciable amount of potassium such as 1349.7 mg/100g [23] and 1845 mg/100g [25]. However, the recommended daily allowance of 4000 – 4700 mg/day for potassium as reported by [21] could be supplied to the body by drinking up to 400 ml of soursop-moringa tea per day.

The amount of sodium recorded for soursop:moringa tea blends ranged from 101.63 -146.02 mg/100g. Lower values which ranged from 0.63 – 7.86 mg/100mL and 8.13 mg/100g were reported for moringa leaf powder [23][25]. These differences could be attributed to the cultivation practices and processing conditions. Sodium plays a variety of important roles in the body such as controlling blood pressure and regulating the function of muscles and nerves, maintaining healthy fluid balance and contributing to proper muscle contraction and nerve impulse conduction [26]. The recommended daily allowance for sodium in the human body is between 1000 mg/day and 1500 mg/day. However, drinking 700-1000 ml of 50:50 soursop:moringa tea per day could help to meet the recommended daily intake of sodium. Magnesium in the tea samples ranged from 157.32 mg/100mL to 362.03 mg/100mL). This is higher than the level (1.30 – 12.63 mg/100mL) reported for moringa tea infusion and lower than 449.69 mg/100g reported for moringa leaf powder by [23. Moringa (100%) tea gave significantly ($p<0.05$) higher level of magnesium than 100% soursop tea. The levels of magnesium recorded in the tea blends suggest a synergistic effect in release of magnesium in the products as the level of magnesium in the tea samples increased with the increase in the amount of moringa tea powder. Magnesium helps to activate the enzymatic systems responsible for calcium metabolism in bones [29] and forms an essential constituent for reproduction and normal functioning of the nervous system [27][28]. The amount of magnesium recorded in this study suggest the potential of the soursop:moringa tea to supply the recommended daily allowance of magnesium (110 – 300 mg/day) in the body when consumed.

The level of phosphorus observed in soursop:moringa tea followed a similar trend with magnesium and increased with the increase in the amount of moringa tea powder which reflects the levels present in the individual tea powders. The values of phosphorus (187-241 mg/100ml) obtained in this study are within the range of values (74.80 – 225.00 mg/100ml) reported by [18] for moringa tea leaves suggesting high solubility and minimal loss of the mineral after brewing. In this study, the addition of equal amount of moringa and soursop tea powder gave the highest level of phosphorous. Phosphorus is the second most abundant mineral in the human body and is needed to perform many functions such as assisting in muscle contraction and facilitating nerve conduction [30]. Therefore, the high amount of phosphorus in the soursop-moringa tea products would be very beneficial to health.

Moringa tea leaves are richer in iron compared to soursop as revealed in this study with highest value obtained for 100% moringa tea. Iron serves as an oxygen carrier in the blood heamoglobin and muscle myoglobin of animals and facilitates the oxidation of carbohydrates, proteins and fats [32]. It contributes significantly to the prevention of widespread of anemia in developing countries like Nigeria. Soursop:moringa tea samples in this study showed good amount of iron (8.61 – 14.11 mg/100 ml) and could serve as a good sources of non-haem iron to meet the dietary requirement in the body.

Zinc plays important roles in the human body such as the synthesis of protein and DNA and boosting of the immune system [32]. It was observed that 100% moringa tea (6.02 mg/100 ml) is richer in zinc compared to 100% soursop tea (3.61 mg/100ml). Higher values have been reported for moringa leaf powder 70.70 mg/100g [23] 148 mg [33] and 858 mg [34]. The low level of zinc reported for the moringa tea extract compared to the leaf powder could be attributed the effect of processing. Zinc is not stored in the human body and needs to be obtained daily. Interestingly, the value (7.13 mg/100ml) obtained for zinc in 50:50 soursop:moringa tea in this study makes it a good source of zinc for women with recommended daily allowance of 8 mg/day [33].

3.1.2 Hydrogen ion concentration (pH)

The pH of the tea samples ranged from 7.28 – 7.81. This result is within the range of pH (7-10) as reported by [35] for green tea. Soursop-moringa (100%:0%) tea had the least pH value of 7.28, while moringa (100%) tea had the highest value (7.81). The differences in the pH values can be attributed to the difference in the formulation. Hydrogen ion concentration has been reported to be one of the important quality characteristics that describe the stability of bioactive compounds in tea products [36]. Thus high pH values observed in the tea samples suggests positive effect on the stability of the tea products during storage. Acidic tea such as the black tea has erosive potentials and has been implicated with dental problems [37][35]. Interestingly, soursop:moringa tea blends as observed in this study are not acidic making them suitable for individuals with sensitive teeth.

3.1.3 Total solids

Total solid were significantly ($p<0.05$) different among the tea samples and ranged from 3.47mg/L to 3.82mg/L (Table 3). Total solid is a reflection of solute present in liquid foods. It is inversely proportional to the amount of water present in a liquid food sample. The strength, taste, appearance and aroma of the tea depend on the amount of total solids [38]. Soursop tea (100%) recorded the highest value of 3.82 mg/L while soursop:moringa tea (40:60) recorded the least value (3.47 mg/L). The results obtained in this study showed that the total solid of the tea blends seem to have been affected more by the soursop than the moringa and increased with the increase in soursop leaf powder.

3.2.4 Total sugars

Total sugar content of the tea samples are presented in Table 3. Values obtained for total sugar in soursop:moringa tea blends were significantly different ($p<0.05$) and ranged from

1.12 – 3.07%. Soursop-moringa tea (100:0%) recorded the highest value (3.07%) while soursop-moringa tea (0:100%) recorded the least value (1.12%). Given the low sugar level in moringa, total sugar decreased with increase in the amount of moringa leaf powder added to the tea blends. The values obtained in this study are considerably low suggesting that soursop-moringa tea products contain less carbohydrate and could be suitable for persons desiring weight loss.

3.2.5 Antinutrients

Antinutrients of tea brewed from blends of dried soursop and moringa leaf powders are presented in Table 3. The result showed significant differences ($p<.05$) in the levels of all the antinutrients among the tea products. Previous studies reported that tea leaves contain anti-nutrients such as saponins, tannins and phytates [39][40]. However the concentration of antinutrients could be reduced or eliminated to tolerable level through processing methods.

The tannin content of the tea blends ranged from 8.95 – 9.84% with soursop:moringa tea (50%:50%) having the highest value and 100%soursop tea having the least value. The differences observed among the tea products could be linked to the composition of the blends. Astringent flavour is characteristic of tea leaf steeped in hot water due to the presence of catechins and other flavonoids [41]. Tannins can provoke an astringent reaction in the mouth and make the food unpalatable. Tannins also form complexes with proteins in the gut, reducing the digestibility or inhibiting digesting enzymes and microorganisms [12]. The values obtained in this study are above the toxic level reported by [43] for animals (5%) and poultry (0.5 – 7%). To reduce the effect of tannin effect on mineral absorption such as iron, tea could be taken between meals rich in vitamin C or with milk or lemon. However, tea with high level of tannin has been reported to benefit people with iron overload reducing the need for blood removal. Tannins are good antioxidants and catechin a type of tannin mostly present in tea, has been found to decrease total cholesterol, lower blood pressure and minimize the risk of cancer [43].

Phytic acid forms insoluble salts with essential minerals like calcium, iron, magnesium and zinc in food, thereby hindering their absorption into the blood stream [44]. About half the phytic acid phosphorus absorbed into the body is excreted unchanged and are unavailable for utilization [39]. Phytic acid detected in the tea products differed significantly among the blends, with 100% moringa tea having the highest level of phytic acid and 100% soursop tea showing the least level. It was observed that the amount of phytic acid in the tea blends increased as the quantity of moringa tea powder increased in the blends.

Flavonoids are one of major polyphenols present in tea [4] and are strong antioxidants, also found to be effective antimicrobial substances. They have been reported to possess substantial anti-carcinogenic and anti-mutagenic activities due to their antioxidant and anti-inflammatory properties [46]. Result from this study showed significant differences ($p<.05$) in the level of flavonoid among the tea blends. Soursop tea (100%) had the highest level of flavonoid (7.34%) while the 100% moringa tea had the least amount (3.6%). Addition of soursop tea powder increased the level of flavonoid in the tea blends. However, values obtained from this study (3.61-7.34%) are lower than those (1.62-57.64%) reported for moringa tea infusion by [23]. The variations in the results of the present study could be due to the methods of extraction of polyphenolic compounds, degree of polarity of the solvents and geographical locations of the plants. Apart from the 100% soursop tea, equal amount of soursop and moringa tea powders gave appreciable level of flavonoid suggesting a higher antioxidant potential than the other blends.

The result of saponin ranged from 0.25% to 1.63% and differed significantly ($p<0.05$) among the samples. Moringa tea (100%) had the highest value while 100% soursop tea had the least value. High level of saponin in moringa tea leaves seem responsible for the high levels detected in the tea blends. According to [47], saponins have immune modulation activities and are able to regulate cell proliferation as well as health benefits such as anticarcinogenic effect and cholesterol lowering activity.

Alkaloids are natural compounds, known to possess antimicrobial properties, due to their ability to intercalate with DNA of microorganisms [48]. Moringa tea (100%) contains the highest level of alkaloids (4.64%) content while 100% soursop tea had the least (1.93%) alkaloid content. Alkaloids in soursop-moringa tea samples showed significantly different (p<.05) levels and ranged from 1.93 – 4.64%. Some alkaloids exert a stimulating role of the central nervous system such as caffeine. It excites the nervous system, increases heart rate and promotes the elimination of urine. Other alkaloids like theophylline which usually exist in small quantities, aid blood circulation [48]. The alkaloid content of soursop-moringa tea with prolonged consumption in large quantities may generally increase the metabolic activity in the body.

Cyanogenic glucosides are secondary metabolites in foods that contain nitrogen and are capable of releasing toxic hydrogen cyanide when hydrolyzed by enzyme. It hinders cellular respiration. Toxicity in humans is possible at doses up to 0.5 mg – 3.5 mg per kilogram body weight [49]. The amount of cyanogenic glucoside recorded in this study ranged from 0.17 – 0.30% and there was no significant difference between 100% soursop tea and soursop:moringa tea (40:60%). The level of cyanogenic glycoside decreased with increase in the amount of soursop leaf powder added to the tea blends. However detoxification of this compound could be achieved by processing methods such as boiling, drying or fermentation [49]. Thus processing of soursop-moringa leaves to black tea through fermentation would further reduce the level of cyanogenic glycoside in the tea blends.

3.3 Total Phenol and Antioxidant Activity

The total phenolic content in soursop-moringa tea blends ranged from 139.66 – 214.04 mg GAE/L (Fig.1). The determination of the level of total phenolics based on their chemical reducing capacity relative to gallic acid [13]. Tea leaves are good sources of antioxidant compounds which act as free radical scavengers.

Positive relationship between antioxidant activity potential and amount of phenolic compounds of the crude tea extracts was reported by [50]. The phenol content obtained in this study (139.6 - 214.04 mg/100mL) suggests the potential of the tea products having good antioxidant activity. The highest level of total phenol was observed in 100% moringa tea.

Antioxidant capacity of the tea blends in this study was tested using the ferric reducing antioxidant power assay. This measures the reducing ability of antioxidants against oxidative effects of reactive oxygen species The reducing effect was mostly evident with 50% inclusion of both soursop and moringa leaves with FRAP value of 531.44 µM/L (Fig. 1).

When tested with Diphenol-2-2-picrylhydroxyl (DPPH), similar effect was observed with soursop:moringa tea (50:50%) which showed the highest DPPH value while soursop-moringa tea (100:0%) had the least. This result revealed that tea brewed from moringa leaves has good free radical scavenging activity compared to soursop tea and has the potential of reducing oxidative stress and preventing the onset of diseases.

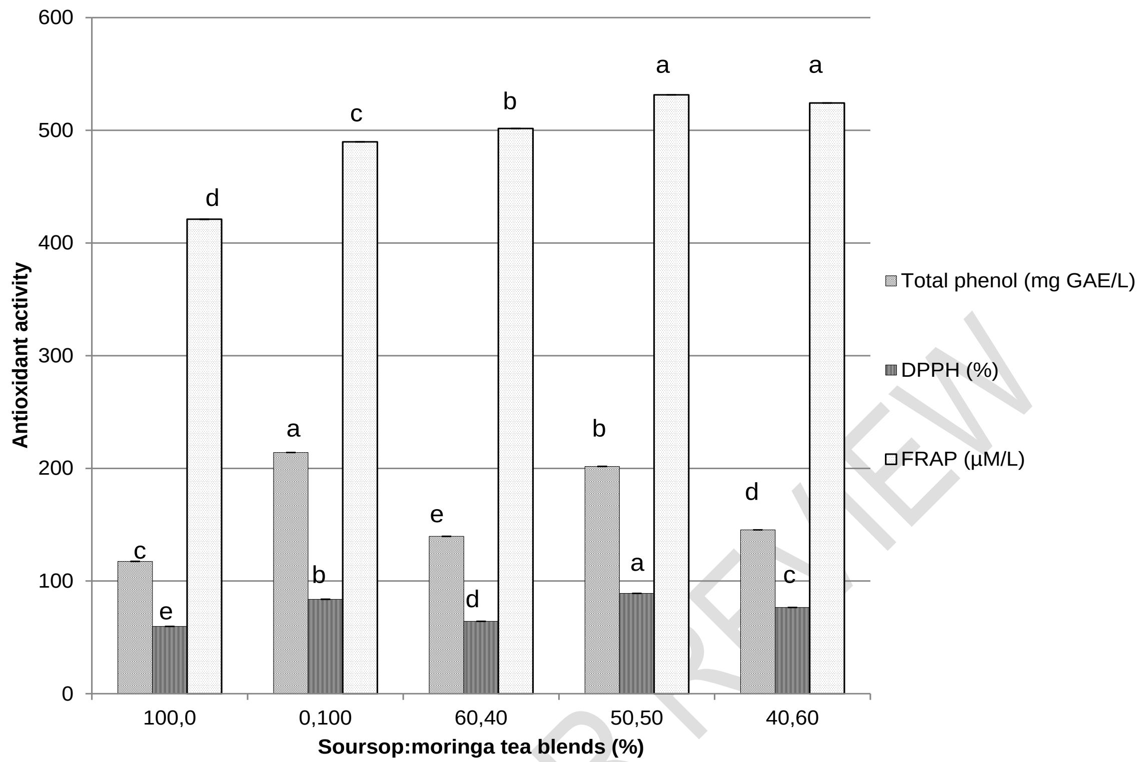

Fig.1: Total phenol and antioxidant activity of soursop-moringa tea extracts
Data are means of triplicate (n=3) analysis ± standard deviation. Means with the same superscripts on similar bars are not significantly different ($p > .05$) and means with different superscript on similar bars are significantly different ($p < .05$).

4. CONCLUSION

The chemical composition and antioxidant activity of tea made from blends of dried moringa and soursop leaves were evaluated. Vitamins C and A were analyzed and highest values obtained for soursop:moringa tea (50:50%) suggest the potential of this tea to supply recommended daily intake for both vitamins and protect the body against free radicals as antioxidants. Seven minerals analyzed in this study showed significant differences ($p<0.05$) among the tea samples. Calcium and potassium were dominant in all the tea blends. Although the 100% moringa tea showed higher levels of the minerals than 100% soursop tea, the highest levels of calcium, sodium, magnesium, phosphorous, zinc and potassium were observed with the soursop-moringa 50:50%. Basic pH was recorded for all the tea samples. This property makes soursop:moringa tea suitable for individuals with sensitive teeth against the acidic tea. Antinutrients were present in the tea blends with the highest level found in 100% moringa tea. High tannin content observed in the tea blends could benefit people with iron overload reducing the need for blood removal. The values obtained for all the antinutrients tested were within the acceptable limits. The level of total phenol obtained in this study suggests the potential of the tea products having good antioxidant activity. Antioxidant effect was mostly evident with 50% inclusion of both soursop and moringa leaves as revealed by the high values of FRAP and DPPH. Overall soursop:moringa tea blend (50:50%) emerged the best in all the quality parameters evaluated and demonstrated the potentials of soursop and moringa leaves in the production of tea.

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