Jher Vol. 30, No. 1, September 2023, pp. 61 - 71

Chemical and Sensory Properties of Herbal Tea Produced from Monkey Sugarcane *(Costus afer)* and Asthma Plant *(Euphorbia hirta)* Leaves

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Abstract

The study analysed the chemical and sensory properties of herbal tea made from blends of monkey sugarcane *(Costus afer)* and asthma plant *(Euphorbia hirta)* leaves. Specifically, it determined the mineral, vitamin, phytochemical, anti-nutrients and sensory compositions of the herbal tea blend. The herbal tea blend was processed into powder and were formulated at the ratios of 100 % *C. afer* and 0 % *E. hirta*; 60 % *C. afer* and 40 % *E. hirta*; 50 % *C. afer* and 50 % *E. hirta;* and 40 % *C. afer* and 60 % *E. hirta*. The herbal blends were evaluated using standard methods. The results of the mineral compositions are: calcium (24.30-33.20 mg/100g), magnesium (6.61-113.07 mg/100g); zinc (10.63-13.79 mg/100g); iron (9.32-21.24 mg/ml). Vitamin composition are; Vitamin C (1.78-2.44 mg/100g), Vitamin A (0.32-2.43 mg/100g) and Vitamin E (0.26-1.42 mg/100g). The results revealed the mineral and vitamin contents of the herbal tea were significantly different ($p < 0.05$) except for vitamin C. The phyto-nutrient compositions of the herbal tea blend are: alkaloid (1.30-2.40 %) and flavonoid (2.20-4.80 %). Anti-nutrient compositions of the herbal tea blend are; tannin (33.00-59.26 µg/ml) and oxalate (2.41-3.07 g/l). They were all significantly different ($p < 0.05$). The sensory characteristics of the herbal infusions for taste is (6.25-7.20), colour (6.45-7.22), appearance (6.10-7.30), aroma (6.30-7.30) and general acceptability (6.90-7.50). With the exception of general acceptability, the sensory characteristics of the herbal infusions were significantly different ($p < 0.05$). The herbal infusion with equal blends had the best organoleptic appeal. The study recommends that consumers could make up for nutrients such as calcium and magnesium from other sources to meet the Recommended Daily Allowance.

Keyword: Herbal, Tea, Chemical, Phyto-nutrients, Anti-nutrients, Sensory, Properties.

Introduction

Plants are essential for daily life requirements of human beings, as food, shelter, fiber, and therapeutic purposes (Radha *et al*., 2021; Alexieva *et al*., 2020). There is a significant increase in interest in botanical sources of natural pharmaceuticals, cosmetics, nutritional

supplements, herbal teas, and other health-promoting items (Kumar *et al*., 2021). Plants are often an excellent source of medicines, and many medicines are derived directly or indirectly from plant resources (Dagli *et al*., 2015).

Tea is an aqueous infusion of dried leaves of the plant *Camellia sinensis*. It is considered a pleasant, economical and socially accepted health beverage, due to its refreshing and mild stimulating effects (Abdel-Raheim *et al*., 2009). According to Ndife *et al*. (2019), it is consumed as health-drink or extracts because of the systemic health effects. The beneficial effect of tea on human health is primarily due to its high antioxidant activity, which results mainly from the presence of phenolic compounds, of which tannins and catechins, as well as their derivatives, are primarily found (Pinto *et al*., 2020). Significant components of tea also include important minerals such as copper, manganese, iron, zinc, magnesium, calcium, sodium, and potassium (Konieczynski *et al*., 2017). Available also are herbal teas; mixture of leaves, seeds and/ or roots of various plants. According to Ravikumar (2014), herbal teas, also called tisanes, are beverages made from the infusion or decoction of herbs, spices, or other plant material (seeds, roots, etc.), commonly consumed for its therapeutic and energizing properties.

Monkey sugarcane (*Costusafer*) is a plant commonly known as ginger lily or spiral ginger. It is a tall (4m), perennial, herbicious and unbranched tropical plant with a creeping rhizome. It is also called bush cane. (Fatokun et al, 2020). The major constituents of *Costusafer* for modern drug production are steroidal sapogenins, saponinsaferosides A-C and dioscin. A research by Boison*et al.* (2019) revealed that the stem and leaves of the plant contain substantial amounts of micronutrients and macronutrients. Experimental studies on various parts of the plant show bioactivities such as anti-hyperglycemic, cardioprotection, nephroprotection, central nervous system depressant, analgesic, antibacterial, and antioxidant (Boison *et al.,* 2019).

Asthma plant (*Euphorbia hirta*) is a small annual herb, frequently seen occupying open waste spaces, roadsides, grasslands, pathways, rice field and as a weed of cultivation. It is usually erect, grows up to a height of 40cm tall and it can also be seen lying down. Asthma plant is a pan tropical weed from the tropical regions of the Americans. The phytochemical screening of *Euphorbia hirta* revealed that the plant contains, terpenoids, alkaloids, steroids, tannins, proteins, mucilages, glycoside, saponin, coumarin, cardiac glycosides, anthroquinones, flavanoids and phenolic compounds (Onyeka *et al*., 2018). The previous pharmacological studies showed that *Euphorbia hirta* exerted anti-oxidant, anti-microbial, antiepileptic, anti-inflammatory. The plant also contains anti-asthmatic, anti-diabetic, anti-cancer, wound healing, gastrointestinal, diuretic, anti-parasitic, immunological and galactogenic, activities (Ali, 2017).

Study of the potential richness of tea from underutilized plants offers individual choice of alternative tea product as revealed by Schulze *et al.* (2018). Further clinical evidence indicates that individuals need to prioritize plant materials like fruit, vegetables, grain, nuts and oils to achieve a healthy diet. Acquiring sufficient knowledge on richness of

monkey sugarcane and asthma plant, and processing them into products will help to offer consumers more alternative sources of herbal tea.

Objectives of the study

The main objective of the study was to investigate chemical and sensory properties of herbal tea produced from monkey sugarcane *(Costus afer)* and asthma plant *(Euphorbia hirta)* leaves. Specifically, the study determined;

1. mineral composition of the tea blend
2. vitamin composition of the tea blend
3. phyto-chemical composition of the tea blend
4. anti-nutrient composition
5. sensory attributes of the tea blend.

Materials and Methods

***Design of the study*:** The study adopted experimental design.

***Materials*:** Monkey sugarcane *(Costus afer)* was sourced from Amokwe, Nkalaha in Ishielu Local Government Area (LGA) while Asthma plant *(Euphobia hirta)* was obtained from Azugwu Community, Abakaliki LGA both in Ebonyi State. Both samples were identified by the Department of Crop Science and Landscape Management, Ebonyi State University, Abakaliki.

***Sample Preparation*:** The samples were prepared using the method described by Essiet *et al*. (2013) with little modification. All wilting and disease visible plant materials were removed. The leaves were submerged in water for proper washing to remove dust, sand and other particles. The leaves of *Costus afer* were size reduced for efficient drying. Both leaves were dried in the sun for five days then ground using a hand corolla machine. The machine was washed before and after each grinding. The samples were stored differently in air tight plastic containers and properly labeled for formulation and analyses.

***Sample Formulation*:** The sample was formulated using the composition as presented below:

% *Costus afer*	% *Euphorbia hirta*
100	0
60	40
50	50
40	60

Preparation of herbal tea blend sample: 2g sample of different blends were infused in 250mls of water for two minutes. The samples were labeled A, B, C & D to separate them.

***Chemical Analysis*:** The samples were analyzed in triplicates. Parameters determined include minerals, vitamins, phyto-nutrients and anti-nutrients. The minerals and vitamins were determined using the Association of Official Analytical Chemist (AOAC) (2010). Phyto-nutrients were determined using Herbone (1973) method. Tannin was determined using colourimetric method as described by Kirk and Sayer (1998) and oxalate was determined using General Chemistry Laboratory Revision 2.1(CHEM121L) (2014).

***Sensory Evaluation*:** This involved the following procedures:

***Selection of Panelists*:** Twenty taste panelists were purposively drawn from students in the Department of Food Science and Technology and Home Economics and Hospitality Management Education, Ebonyi State University, Abakaliki.

***Instrument for Data Collection*:** A 9-point hedonic scale was used for data collection. The scale ranged from (9) representing "liked extremely" (1) representing "disliked extremely".

***Data Collection Method*:** The tea was served bland so as to get its natural taste.

Panelists rinsed their mouths with water to avoid bias. They recorded their responses in the 9-point hedonic scale.

***Data Analysis*:** Mean was used for data analysis. Duncan's multiple range test and Analysis of Variance to determine significant differences between samples at 5 % level of significance were also used.

Findings

Table 1: Mineral Composition of Herbal Tea made from Blends of *Costus afer* and *Euphorbia hirta* Leaves

Parameter	100%CA:0%EH	60%CA:40%EH	50%CA:50%EH	40%CA:60%EH
Calcium (mg/100g)	$31.31^{b} \pm 0.00$	$33.20^{a} \pm 0.13$	$24.30^{c} \pm 0.25$	$31.56^{b} \pm 0.50$
Magnesium (mg/100g)	$13.07^{a} \pm 0.16$	$8.81^{c} \pm 0.15$	$6.61^{d} \pm 0.08$	$10.56^{b} \pm 0.08$
Zinc (mg/100g)	$13.79^{a} \pm 0.10$	$11.65^{b} \pm 0.21$	$10.63^{c} \pm 0.21$	$13.59^{a} \pm 0.11$
Iron (mg/100g)	$111.3^{b} \pm 0.33$	$93.20^{c} \pm 0.17$	$212.40^{a} \pm 0.17$	$93.20^{c} \pm 0.17$

Values are means ± standard deviation. Means with different superscripts in a row were significantly different ($p < 0.05$). CA = Costu afer Leaf Powder, EH = Euhporbia hirta Leaf Powder.

Table 1 shows that calcium content of the herbal tea samples ranged from 24.30 – 33.20 mg/100g. The blend of 60% CA: 40% EH had the highest calcium content (33.20mg\100g) while the 50% CA and 50% EH blend had the lowest calcium content (24.30mg\100g). Magnesium composition ranged from (6.61- 13.07 mg\100g). The result revealed that all the herbal tea samples differed significantly ($p < 0.05$). The tea blend of 100% CA: 0% EH had the highest magnesium content (13.07mg\100g) while the blend of 50%: 50% had the least (6.61mg\100g). **Z**inc content of the herbal tea obtained from this study ranged from (10.63 to 13.79 mg/100g). The zinc content of the herbal tea blend revealed a significant difference ($p < 0.05$). The blend of 100% CA: 0% EH had the highest zinc value (13.79mg\100g) while the blend of 50%: CA: 50% EH had the least zinc content. The Iron composition of the herbal tea revealed significant difference ($p < 0.05$). The iron content ranged from 93.2 – 212.3 mg/ 100g. Herbal teas (50% CA:50 % EH had the highest iron content (212.40mg\100g), the blends of 60% CA and 40% EH and 40% CA: 60 % EH) had lowest and same iron scores (9.32 mg/ ml). Whole *C. afer* herbal tea (100 % CA:0 % EH) scored 111.3 mg/ 100g.

Table 2: Vitamin Composition of the Herbal Tea made from Blends of *Costus afer* and *Euphorbia hirta* Leaves

Parameter	100%CA:0%EH	60%CA:40%EH	50%CA:50%EH	40%CA:60%EH
Vitamin C (mg/100g)	$1.78^{a} \pm 0.45$	$2.22^{a} \pm 0.45$	$2.44^{a} \pm 0.67$	$2.00^{a} \pm 0.23$
Vitamin A (Retinoid) (mg/100g)	$0.32^{d} \pm 0.001$	$1.29^{b} \pm 0.03$	$2.43^{a} \pm 0.00$	$0.46^{c} \pm 0.01$
Vitamin E (mg/100g)	$1.42^{a} \pm 0.00$	$0.26^{d} \pm 0.00$	$0.46^{c} \pm 0.01$	$0.68^{b} \pm 0.00$

Values are means ± standard deviation. Means with different superscripts in a row were significantly different ($p < 0.05$). CA = Costu afer Leaf Powder, EH = Euhporbia hirta Leaf Powder.

Table 2 shows that the vitamin C contents of the herbal tea ranged from 1.78-2.24 mg/100g. The blend of 50% CA: 50% EH had the highest vitamin C content (2.44mg\100g) while the least is from the blend 100% CA: 0% EH (1.78mg\100g). The values are significantly different ($p < 0.05$). The vitamin A content of the herbal tea made from the blends of *C. afer* and *E. hirta* ranged from 0.32-2.43 mg/100g. The vitamin A content of the tea blends were significantly different ($p < 0.05$). The blend of 50%CA: 50% EH has the highest vitamin A content (2.43mg\100g) while the blend of 100% CA: 0% EH had the lowest (0.32mg\100g). The vitamin E content of the herbal teas of this study ranged from 0.26 – 1.42 mg/100g with 60 % CA: 40 % EH scoring lowest (0.26 mg/100g) and the blend of 100% CA: 0 % EH scored the highest.

Table 3: Phytonutrient Compositions of Herbal Tea made from Blends of *Costu safer* and *Euphorbia hirta* Leaves

Parameter	100%CA:0%EH	60%CA:40%EH	50%CA:50%EH	40%CA:60%EH
Alkaloid (%)	$1.40^{b} \pm 0.20$	$2.40^{a} \pm 0.40$	$1.30^{b} \pm 0.30$	$2.30^{a} \pm 0.10$
Flavonoid (%)	$2.20^{d} \pm 0.00$	$4.20^{b} \pm 0.20$	$2.70^{c} \pm 0.10$	$4.80^{a} \pm 0.20$

Values are means ± standard deviation. Means with different superscripts in a row were significantly different ($p < 0.05$). CA = Costu afer Leaf Powder, EH = Euhporbia hirta Leaf Powder

Table 3 shows that the alkaloid content of the herbal teas made from blends of *C. afer* and *E. hirta* ranged from 1.30-2.40 % with an average value of 2.00 %. The blend of 60% CA: 40% EH had the highest alkaloid content (2.40mg\100g) while the least is in the blend of 100% CA: 0% EH (1.40mg\100g). The alkaloid values were significantly different ($p < 0.05$). The flavonoid content of the herbal teas ranged from 2.20-4.80 %. The highest value found in the blend of 40% CA: 60% EH (4.80mg\100g) and the lowest in the blend of 100% CA: 0% EH (2.20mg/100g). The results are significantly different ($p< 0.05$).

Table 4: Anti-nutrient Composition of Herbal Tea made from Blends of *Costus afer* and *Euphorbia hirta* Leaves

Parameter	100%CA:0%EH	60%CA:40%EH	50%CA:50%EH	40%CA:60 %EH
Tannin (µg/ ml)	$33.00^{d} \pm 0.43$	$45.00^{c} \pm 0.43$	$57.45^{b} \pm 0.45$	$59.26^{a} \pm 0.45$
Oxalate (mg/100ml)	$0.28^{b} \pm 0.03$	$0.307^{a} \pm 0.06$	$0.305^{a} \pm 100$	$0.241^{c} \pm 0.1$

Values are means ± standard deviation. Means with different superscripts in a row were significantly different ($p < 0.05$). CA = Costu afer Leaf Powder, EH = Euhporbia hirta Leaf Powder

Table 4 reveals that the tannin contents ranged from 33.00-59.26 µg/ml. 100 % CA: 0 % EH herbal tea had the lowest tannin content (3.30mg/100g) and the highest in the herbal tea blend of 40% CA: 60% EH (5.926mg/100g). The oxalate content of the herbal teas blend ranged from 0.240-0.307 mg/100ml. The result revealed significant difference ($p < 0.05$). The herbal tea (40 % CA: 60 % EH) scored lowest (0.241 mg/100ml) and the highest from the blend of 60 % CA: 40 % EH herbal tea (0.307 mg/100ml).

Table 5: Sensory Composition of the Herbal Tea Infusion made from Blends of *Costus afer* and *Euphorbia hirta* Leaves

Parameter	100%CA:0%EH	60%CA:40%EH	50%CA:50%EH	40%CA:60%EH
Taste	$7.05^{a} \pm 1.00$	$6.25^{b} \pm 1.25$	$7.20^{a} \pm 0.95$	$7.05^{a} \pm 1.32$
Colour	$6.45^{b} \pm 1.43$	$6.55^{ab} \pm 0.94$	$7.25^{a} \pm 1.05$	$6.70^{ab} \pm 0.66$
Appearance	$6.10^{b} \pm 1.25$	$6.80^{a} \pm 1.06$	$7.30^{a} \pm 0.98$	$7.30^{a} \pm 1.03$
Aroma	$6.55^{b} \pm 0.94$	$7.20^{a} \pm 1.01$	$7.30^{a} \pm 1.22$	$6.30^{b} \pm 0.80$
GA	$6.90^{a} \pm 0.64$	$7.20^{a} \pm 1.20$	$7.50^{a} \pm 1.05$	$7.15^{a} \pm 0.93$

Values are means of twenty replicate determinations ± standard deviation. Means with different superscripts in a row are significantly different ($p < 0.05$). GA = General Acceptability, CA = Costu afer Leaf Powder, EH = Euhporbia hirta Leaf Powder

Table 5 reveals that taste scores of the herbal tea ranged from 6.25 to 7.20. The herbal tea at equal blends of *C. afer* and *E. hirta* (50 % CA: 50: EH) had the best taste appeal for the panelists with score of 7.20. The result of the colour of the herbal infusion made from blends of *C. afer* and *E. hirta* ranged from 6.45-7.25. The result revealed significant difference ($p < 0.05$). The panelists showed highest preference (7.05) for the colour of the herbal tea with equal blends of *C. afer* and *E. hirta* (50 CA: 50 % EH). The sensory characteristics of herbal tea made from blends of *C. afer* and *E. hirta* revealed that the infusions differed significantly ($p < 0.05$). The appearance scores of the herbal infusions ranged from 6.10-7.30. The result revealed that both 50 % CA: 50 % EH and 40 % CA: 60 % EH herbal infusions showed better and same appearance score by the panelists (7.30). The result of the aroma characteristics of the herbal infusions were significantly different ($p < 0.05$) among the herbal tea infusions as shown. The aroma scores ranged from 6.30-7.30. The panelist preferred the aroma of the tea blend 50% CA: 50% EH. The result of the sensory evaluation of the herbal infusions revealed no significant difference ($p > 0.05$) in the general acceptability. The scores ranged from 6.90-7.50. The 50% CA: 50%EH blend had the highest score while the 100%CA: 0% EH had the least score.

Discussion of findings

Table 1 presented the mineral composition of the herbal tea blend. The calcium content obtained in the study (24.30 – 33.20mg/100g) is higher than the range of value (1.87-2.47 mg/100g) reported by Ndife *et al*. (2019) for calcium content of black and green tea. The result did not meet the Recommended Daily Allowance (RDA) of 800-1000 mg/100g reported by Agrawal *et al*. (2020). The herbal tea consisting of 50:50 ratio Costus afer and *Euphorbia hirta* had the lowest calcium value (24.30 mg/100g). Also, the calcium content of 100 % *C. afer* (31.31 mg/100g) is lower than 418 mg/100g reported by Chukwu and Chukwu (2018) for green tea. From the result, the calcium contents of the herbal tea beverage were significantly different ($p < 0.05$). The result revealed an increase in the calcium content with increase in *E. hirta*, with the exception of herbal tea of 50% *C. afer* and 50%*E. hirta*.

The result of the zinc composition of the herbal tea blend ranged from10.63-13.07mg/100g. The tea blends of *C. afer* and *E. hirta* leaves revealed significant difference ($p < 0.05$). Herbal tea (50CA:50EH) had the lowest zinc content (10.63 mg/100g). Whole *C. afer* herbal tea (100 % CA: 0 % EH) had highest (13.79

mg/10g), which is higher than 0.028 mg/g (equivalent to 2.80 mg/100g) reported by Adam and Lawal (2020) and also had similar score with herbal tea at 40 % *C. afer* and 60 % *E. hirta* (13.59 mg/100g). The zinc scores of the herbal teas aligns with the 12 mg/100g Recommended Daily Allowance (RDA) as reported by Agrawal *et al*. (2020).

The result of the iron content ranged from 93.2 – 212.3mg/100g. The result obtained was higher than 50 mg/100g (equivalent to 0.050 mg/ ml) reported by Ekpe *et al*. (2018) and 1.35 mg/100g (equivalent to 0.0135 mg/ ml) reported by Chukwu and Chukwu (2018). The Recommended Daily Allowance (RDA) of iron as reported by Agrawal *et al*. (2020) is 17 mg/100g.

Table 2 presents the vitamin composition of the herbal tea blend. The vitamin C composition of the herbal blend ranged from 1.78- 2.24mg/100g. The herbal tea of whole *C. afer* leaves (100 % CA: 0 % EH) scored lowest (1.78 mg/100g) in vitamin C value, which is slightly lower than 3.27 mg/100g reported by Ekpe *et al*. (2018). The result revealed also that herbal tea (50 % CA: 50 % EH) had the highest vitamin C value (2.44 mg/100g).

The vitamin A content of the herbal tea blend ranged from 0.32 – 2.43mg/100g. The herbal tea blend of whole *C. afer* (100 % CA: 0 % EH) scored lowest (0.32 mg/100g) while herbal tea with equal blends (50 % CA 50 % EH) had the highest vitamin A content (2.43 mg/100g). The result is in line with 550 µg (0.5 mg/100g) Recommended Dietary Intake of WHO/FAO (2004).

The vitamin E content of the herbal tea blend ranged from 0.26 – 1.42mg/100g. The result revealed that 100 % CA: 0 % EH herbal tea scored highest (1.42 mg/100g) in the vitamin E content, followed by 40 %C CA: 60 % EH (0.68 mg/100g). However, with exception of whole *C. afer* herbal tea (100 % CA: 0 % EH), the vitamin E content increased gradually. This increase may be as a result of increase in level of *E. hirta* in the herbal teas. Vitamin E functions as an antioxidant, works as protector against oxidation and plays an important role in maintaining stability and integrity of cell membrane (Eze and Njoku, 2018). It is a strong.

Table 3 presents the phytonutrient content of the herbal tea blend. The alkaloid obtained in this study ranged from 1.30 – 2.40 %. This is higher (0.65 to 2.20 %) than that reported by Okafor and Ogbobe (2015) for green and black herbal teas from *Moringaoleifera* leaf. The result of the phytonutrient compositions of the herbal tea revealed that they were significantly different ($p < 0.05$). Alkaloids give strong radical scavenger power, so they can be used as natural and good sources of natural antioxidants (Ali, 2017).

The flavonoid obtained in this study ranged from 2.20 – 4.80%. The result is lower (6.00 and 6.50 %) than that reported by Okafor and Ogbobe (2015) for black and green herbal teas from *Moringaoleifera* leaf. The flavonoid compositions of herbal tea were significantly different ($p < 0.05$). The phytonutrient compositions revealed that the herbal teas could be an appreciable source of flavonoids, especially herbal tea at 60 % *E. hirta* substitution.

Table 4 presents the anti-nutrient composition of the herbal tea blend. The tannin content ranged from 3.3 – 5.9mg/100g.Herbal tea blend 100 % CA: 0 % EH had the least (33.00 µg/ml is equivalent to 3.30 mg/100g) tannin content. The result is higher than 0.05

mg/100g reported by Chukwu and Chukwu (2018) on the tannin content of *C. afer* leaves. Herbal tea (40 % CA: 60 EH) had the highest tannin content (59.26 µg/ml equivalent to 5.9 mg/100g). The tannin contents of herbal tea samples were significantly different ($p < 0.05$).

The oxalate content as obtained from the study ranged from 0.24 – 0.307mg/100ml. The result revealed that both herbal teas (60 % CA:40 % EH and 50 % CA:50 % EH) had close oxalate scores (0.307 and 0.305 mg/l100ml respectively). However, with the exception of herbal tea (40 % CA:60 % EH), other blends had higher oxalate content when compared to *C. afer* herbal tea without *E. hirta* substitution. The anti-nutrient oxalic acid has been shown to impair the absorption of magnesium, zinc, iron and calcium in the intestine by compellation. (Sonmez *et al.,* 2018). The value recorded is very tolerable.

The sensory attributes of the herbal tea blend revealed that both 100 % CA: 0 % EH and 40 % CA: 60 % EH had same taste score (7.05) while 60 % CA: 40 % EH recorded least taste appeal (6.25) as reported by the panelists. Taste is considered the most important attribute regarding the quality of any food product. It is the major component of the flavour detected by the taste buds of the tongue, mouth membrane and influenced by the texture, flavour, and composite of food products (Majeed *et al*., 2017).

The colour test revealed that all the blended herbal infusions recorded significant colour appeal by the panelists except for whole *C. afer* herbal tea (100 % CA: 0 % EH). The colour appeal increases with increase in *E. hirta* with the exception of herbal infusion of (40 % CA: 60 % EH). Consumer's appetite for food is stimulated or dampened by its colour (Anesi De-Heer, 2011).

The result of the aroma revealed that herbal infusion of 40 % CA: 60 % EH had the least aroma appeal (6.30) while the infusion with equal blends of both *C. afer* and *E. hirta* (50 % CA: 50 % EH) had best aroma appeal (7.30) as reported by the panelists. The aroma appeal of the infusion revealed an increasing preference trend associated with decrease in *C. afer* with exception of *C. afer* herbal infusion of 60 % *E. hirta*. Aroma is a strong driver of food choice and a close association occurs between taste and aroma and this is closely related to memory (Youssef, 2015).

The general acceptability of the herbal tea blend revealed that herbal infusion of whole *C. afer* (100 % CA: 0 % EH) had the least acceptability score (6.90) while herbal infusion with equal blend of *C. afer* and *E. hirta* (50 % CA: 50 % EH) had the highest acceptance (7.50) followed by herbal infusion of 60 % CA: 40 % EH scoring (7.20). However, the general acceptability scores of the herbal infusions increased gradually which may be associated with increase in *E. hirta* substitution.

Conclusion

The present study highlighted nutritive potentials as well as the organoleptic appeals of herbal tea blends made from *Costus afer* and *Euphorbia hirta*. The result in exception of vitamin C content showed that the micronutrient composition of the herbal teas was significant. The result revealed that the herbal blends could be a cheap and good source of micronutrients with calcium and vitamin C been predominant mineral and vitamin. Similarly, the study revealed significant difference in the phytochemical compositions of the

herbal tea blend. All the herbal blends contained appreciable number of alkaloids and flavonoids while the oxalate and tannin anti-nutrients in the blends were in low concentration (oxalic acid limits 0.5mg/100ml and tannin is 15mg/100g). The study revealed that with the exception of general acceptability, the sensory characteristics of the herbal tea infusions were significant. Thus, the herbal blends from *Costus afer* and *E. hirta* could be a cheap and good source of nutrients.

Recommendations

Based on the result the following are recommended:

1. Other calcium and magnesium source may be incorporated into the herbal teas to meet up the Recommended Daily Allowance.
2. Further research should be carried on the antioxidant compositions of the blended herbal beverage as well as detailed anti-nutrient composition.

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