



# Development, Quality Evaluation and Acceptability of Green Tea from pawpaw, Utazi and moringa leaves

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**Abstract:** Green tea was developed using pawpaw, utazi and moringa leaves blends. Samples were blended in the following ratios pawpaw-utazi-moringa: 100:0:0, 0:100:0, 0:0:100, 50:25:25, 25:50:25, 25:25:50 designated as APA, BUB, CMC, PUM, UPM and MPU respectively. Proximate, mineral and phytochemical composition as well as sensory properties of the formulated green were investigated. The result showed that the moisture content ranged from 6.0 to 14.0% ash 9.11 to 11.30%, fat 2.70 to 3.41%, protein 22.36 to 39.45%, fibre 9.50 to 18.00% and carbohydrate 35.37 to 43.32%. The result revealed that a significant difference existed among the samples. The calcium, iron and sodium contents of green tea samples varied from 22.04 to 84.16mg/100g, 18.00 to 90.83mg/100g and 17.55 to 31.00mg/100g, 18.00 to 90.83mg/100g and 17.55 to 31.00mg/100g respectively. Flavonoid ranged from 3.80 to 6.30% while tannin ranged from 0.25 to 1.25%. The result of the sensory evaluation showed that sample CMC (100% moringa tea) was most accepted by the panelists when compared to the other green tea samples. It was concluded that satisfactory adult tea can be produced from the leaf blends of pawpaw, utazi and moringa leaves.

**Keywords:** Green tea, pawpaw, utazi, Moringa leaves, quality evaluation

## INTRODUCTION

Tea is an aromatic beverage commonly prepared pouring water over leaves of the plant (*Camellia sinensis*) (Martin, 2007). After water, tea is the most widely consumed beverage in the world (Macfarlane, 2004) it has a cooling, slightly bitter, and astringent flavor that many people enjoy (Ody, 2002). Tea has a variety of positive health benefits and recent human studies suggest that green tea may help reduce the risk of cardiovascular disease and some form of cancer (Peters *et al.*, 2001). Tea have been traditionally categorized into green, oolong and black teas according to the processing conditions employed during manufacturing (Kirk and Sawyer, 1997). Processing of green tea involves little or no fermentation and the tea leaf often remains reasonably green, oolong tea undergoes partial fermentation while black tea undergoes complete fermentation (Taylor and McDowell, 1993; Rinzler, 2001). Green tea is the healthiest beverage on the planet

Tea is an ancient beverage derived from the leaves of the plant, *Camellia sinensis* but tea can be produced from other plants by infusing their leaves, stem, barks, seeds and in boiling water are known as herbal tea to avoid confusion with beverages made from the actual tea plant (Anon, 2003).

It is an excellent profile of nutrients and antioxidants. Moringa leaf is rich in minerals, amino acids, vitamins and B-carotene. It also contains a rare combination of health promoting antioxidants such as zeatin, quercetins sitosterol, caffeoylquinic acid and kamepferol (Anwar et al, 2007). *Gongronema Latifolium* (Amarantha globe) is a tropical rain forest plant which belongs to the family *Asclepiadaceae* and genus *Gongronema* (Okafor et al., 1996). It is commonly grown in west Africa and is locally called “Utazi” by Ibibios, Quas and Efik, “utazi” by the Igbos in South East and “Arokeke by the Yoruba in south Western part of Nigeria. *G. latifolium* is widely believed to have strong nutritional and medicinal values. The leaf is rich in fats, proteins, vitamins, minerals and essential amino acids (Eleyinmi, 2007). *Carica papaya* Linnaeus (pawpaw), belongs to the family of *caricaceae*. According to Kirshna and Paridhari (2008) papaya is low in calories and rich in natural vitamins and minerals such as vitamin C, vitamin A, riboflavin, folate, calcium, thiamine, iron, niacin, potassium and fibre. Therefore processing *Gongronema Latifolium*, *moringa oleifera* and *carica papaya* into green tea is a way of making it available all the time, create variety and broadening its use as a green tea a functional beverage. It against this background that this study seeks develops and evaluates the green tea from *Gongronema Latifolium*, *Carica papaya* and *Moringa oleifera*

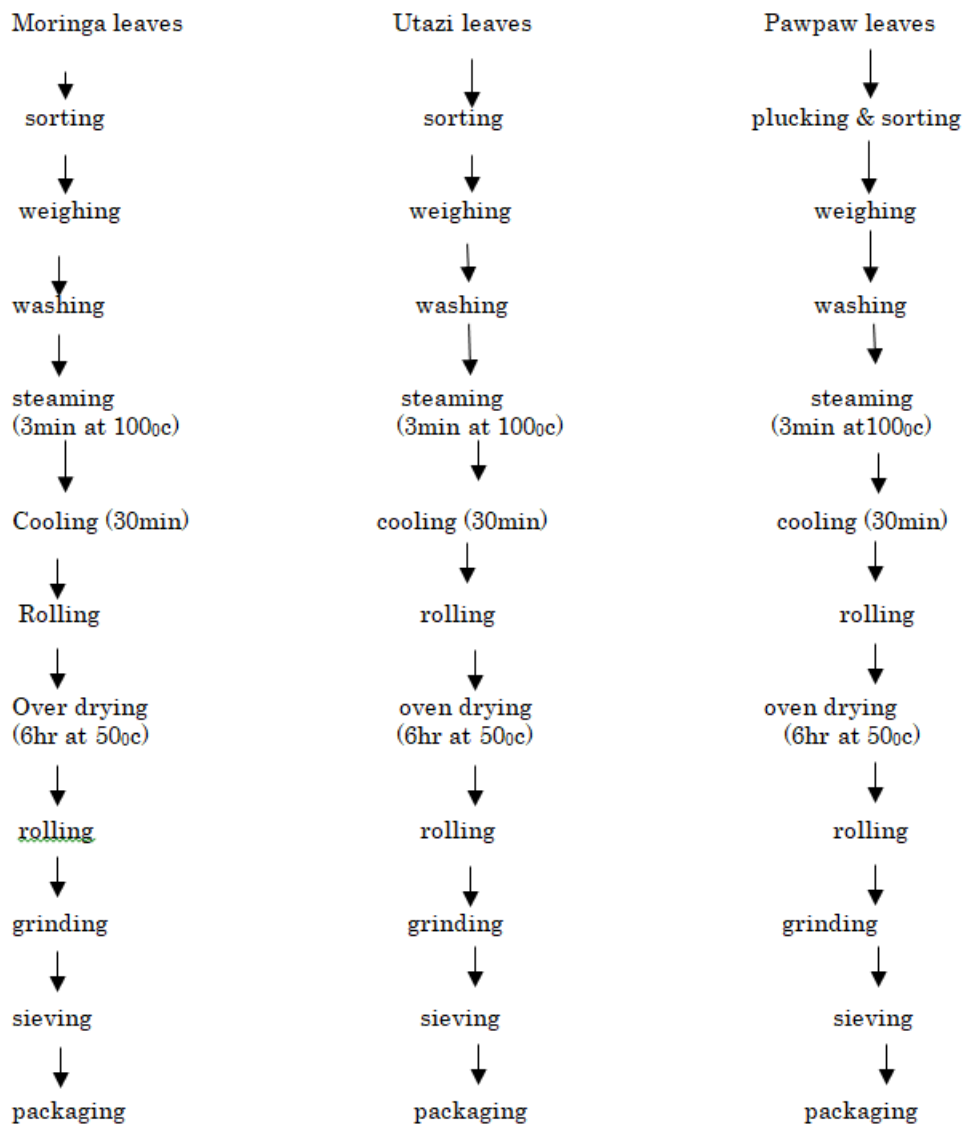
## Materials and Methods

### Procurement of raw materials

Moringa leaves and pawpaw leaves were obtained from a farm in Oko, Orumba North local government of Anambra State. Utazi leaves and coffee filters were purchased from Ekwulobia market.

### Processing of green tea from *moringa oleifera* leaf, papaya and utazi leaves

One thousand gram (1000g) *moringa oleifera*, Papaya leaves and Freshly green utazi leaves (*Gongronema latifolium*) were weighed, washed with distilled water. A pot was filled 10 ¼ of its volume with water and heated to 100°C in order to produce steam. Wire mesh was put above the water and the washed leaves were spread on the mesh and steamed for 3 min. After steaming, the leaves were allowed to cool at room temperature for 30 min prior to rolling which was done manually using the hand to disrupt the leaf cells and increase their surface area, to enhance the drying rate. The rolled leaves were spread on trays and dried immediately in a hot air oven for 6 hours at 50°C till the product became crispy. After drying, the product were rolled again manually using the palms of the hand to obtain a coarse product which was served and packaged in airtight container and stored in room temperature for further use.



**Figure 1:** flowchart for production of green tea from *moringa oleifera*, papaya and *Grongronema latifolium* (utazi).

**Formulation**

**Table 1:** Formulation of tea from blends of moringa oleifera, papaya and utazi

Sample	Papaya	Utazi	Mornga oleifera
	100		
APA			
		100	
BUB			
CMC			100
PUM	50	25	25
UPM	25	50	25
MPU	25	25	50

### Packaging of Green Tea

The blended samples were packaged in tea bags using coffee filter;

Cut the coffee filter to get a rectangular shape. Two gram (2g) of the blended green tea was placed at the centre of the coffee filter. Coffee tea was folded to overlap with two edges and folded part at top was stapled.

### Proximate composition

The moisture, protein, fat, ash, fibre and carbohydrate content determined on green tea samples using the method described by AOAC (2010).

### Mineral composition

The calcium, sodium and iron content of green tea samples from blends of pawpaw leaf, utazzi leaf and moringa leaf were determined by methods of AOAC (2010). Vitamin C content of the samples was determined by titrimetric method of AOAC (2010).

### Phytochemical Analysis

Tannin was determined using the method of Price *et al.* (1980) and flavonid was determine using the method of AOAC (2010)

### Sensory Evaluation

The green tea samples were made into infusion by subjecting the tea to hot water treatment in a clean container for 6mins. 2g of each blended sample was used. After 6mins, the teas were served to 10 panelists to evaluate for colour, flavor, taste, aftertaste and overall acceptability using a point Hedonic scale (with the ratings of: 1= Dislike extremely to 9= like extremely. The scores given by the panelists were analyzed by statistical software.

### Statistical Analysis

Data from chemical composition and sensory evaluation were subjected to analysis of variance (ANOVA) and difference between means were assessed by least significant different test at  $p < 0.05$ , using SPSS version 21.0.

## Result and Discussion

**Table 2:** Proximate composition of green tea formulated from pawpaw, utazi and moringa leaves blends.

SAMPLES	MOISTURE	ASH	FAT	PROTEIN	FIBRE	CARBONHYDRATE
%	%	%	%	%	%	%
APA	6.00 <sup>d</sup> ±0.00	11.30 <sup>a</sup> ±0.30	2.70 <sup>c</sup> ±0.20	27.37 <sup>d</sup> ±0.00	11.00 <sup>b</sup> ±0.00	41.63 <sup>b</sup> ±0.10
BUB	14.00 <sup>a</sup> ±0.00	9.11 <sup>c</sup> ±0.01	3.41 <sup>a</sup> ±0.010	33.36 <sup>b</sup> ±0.05	4.23 <sup>d</sup> ±0.00	35.89 <sup>d</sup> ±0.06
CMC	6.00 <sup>d</sup> ±0.50	9.45 <sup>d</sup> ±0.05	2.80 <sup>bc</sup> ±0.00	22.36 <sup>c</sup> ±0.02	18.00 <sup>a</sup> ±0.00	41.39 <sup>b</sup> ±0.10
PUM	12.00 <sup>b</sup> ±0.00	10.29 <sup>b</sup> ±0.00	2.80 <sup>bc</sup> ±0.10	28.33 <sup>c</sup> ±0.76	11.00 <sup>b</sup> ±0.00	35.37 <sup>d</sup> ±1.15
UPM	12.00 <sup>b</sup> ±0.00	9.74 <sup>c</sup> ±0.00	2.70 <sup>c</sup> ±0.00	28.88 <sup>c</sup> ±0.01	9.50 <sup>c</sup> ±0.50	37.11 <sup>c</sup> ±0.59
MPU	8.00 <sup>c</sup> ±0.00	9.83 <sup>c</sup> ±0.30	2.90 <sup>b</sup> ±0.00	39.45 <sup>a</sup> ±0.00	9.50 <sup>c</sup> ±0.00	43.32 <sup>a</sup> ±0.07

Values are mean of triplicate ± standard deviation.

Means with the same superscript in the same column are not significantly different at 5% probability.

APA =100% Pawpaw leaf, BUB =100% Utazi leaf, CMC=100% Moringa leaf, PUM= 50% Pawpaw; 25% utazi; 25% Moringa, UPM= 25% pawpaw; 50% utazi; 25% moringa, MPU=25% Pawpaw; 25% utazi; 50% moringa

The moisture content of the green tea samples were significantly ( $P < 0.05$ ) from each other. Moisture contents ranged from 6.00% - 14.00%. Sample BUB (green tea from 100% utazi) had the highest moisture content of 14.00% while sample APA and CMC (100% green tea from pawpaw and moringa

leaves respectively) had the least value of 6.0%. Similar result of moisture contents ranged from 3.64 – 15.19% was obtained by Uzodinma and Amie (2016) in green tea produced from bushbuck leaves. Moisture content is indication of shelf stability of a food product which implies lower the moisture content, the higher the shelf stability and vice versa (Fennema, 1996). Kirk and Sawyer (1997) reported that tea in excess of 11% moisture is susceptible to mould infestation and musty infusion.

The ash content of the green tea samples ranged from 9.11% - 11.30%. The tea developed from 100% utazi leaves had the lowest ash content while the highest percentage of ash was observed in 100% pawpaw leaves tea. The values of ash obtained in this study were within the range (10.41 – 12.31%) reported by Uzodinma and Amie (2016) and 11.30% ash contents of pawpaw leaf tea reported by Dev and Igbal (2015). Alakali et al (2016) reported a lower range (1.67% - 1.95%) of ash contents for herbal tea developed from ginger and *pavetta crassipes*. The high ash content observed in the green tea samples in this study shows that they contain an appreciable quantity of mineral elements.

The fat contents ranged from 2.79 to 3.4%. There were significantly ( $P < 0.05$ ) difference in the fat content of all the samples except for samples CMC and PUM which were not significantly ( $P > 0.05$ ) different from each other. The result revealed that fat contents of samples BUB was significantly ( $P > 0.05$ ) higher than other samples. The value obtained in this study was lower than the value of fat content of 6.07% reported by Eleyinmi, (2007) for dried utazi leaves. The variation observed in this result could be as a result of the processing methods used which reduced the fat content. Fat helps the body maintains the core temperature, absorbs nutrients and provides human with energy (Alakali et al 2016). The percentage of fat observed in this study implied that consumption of the teas from pawpaw, moringa and utazi leaves as functional beverage could be of advantage in terms of calorie management.

The protein content of the tea samples ranged from 22.36 – 39.45%. Significant ( $P < 0.05$ ) difference were observed in protein contents of green tea. The results obtained in this study is quite higher than the protein content (10.41 – 13.73%) reported by Uzodinma and Amie (2016) but similar to the values (26.2 and 27.5) reported by Dev and Igbal (2015) for fresh and dried pawpaw leaf tea. Alobi et al., (2012) and Zaku et al (2015) also reported a similar value (33.2% and 27.2%) for fresh and dried utazi leaves and 27.1% for dried moringa leaf tea respectively. The protein contents had an indirect relationship to the sensory character of tea. This may be as result of amino acids which are the building blocks of proteins, have shown to be responsible of off flavours in tea (Kinugasa et al. 1997). Sample CMC (100% moringa tea) had the highest value of fibre contents 18.00% while the lowest value 9.5% were recorded for samples UPM and MPU. The decrease in the fibre content of these samples was as a result of the increased proportions of pawpaw and utazi leaves teas which are lower in fibre content. The range in this study were within the range reported by Uzodinma and Amie (2016) (5.12 – 11.00%) for utazi tea and moringa leaf tea (19.2). in diet. Crude fibre serves to enhance the efficiency of digestion by stimulating peristaltic action and thereby enhancing the movement of food through the alimentary canal. It is also known to prevent colon cancer (BeMiller and Whistler, 1999). crude fibre in tea improves the sensory appeal of the beverage by providing a filter system to prevent the leaching of plant material from the tea bag into the infusion (Waldron et al., 2003).

There were significant ( $P < 0.05$ ) in carbohydrate contents of all the samples (35.37 – 43.33%) obtained in this study were significantly lower ( $P < 0.0$ ) than the values (48.28 – 51.45%) reported by Uzodinma and Amie (2016) for tea samples prepared from Utazi leaf tea; 58.4% reported by Dev and Igbal, (2015) for pawpaw leaf tea but similar with the value (38.2%) reported by Zaku et al (2015) for moringa leaf tea. Carbohydrate are needed for the central nervous system, kidneys, brain, muscles and including the heart to function properly and as source of energy for the body. (Alakali; et al; 2016).

**Table 3:** Mineral composition of green tea formulated from pawpaw, utazi, moringa leaves and their blends.

Samples	Calcium Mg/100g	Iron Mg/100g	Sodium Mg/100g
APA	84.16 <sup>a</sup> ±0.010	90.83 <sup>a</sup> ±0.289	17.55 <sup>d</sup> ±0.445
BUB	69.40 <sup>b</sup> ±0.00	18.00 <sup>f</sup> ±0.173	31.00 <sup>a</sup> ±0.00
CMC	22.04 <sup>f</sup> ±0.00	30.30 <sup>e</sup> ±0.300	22.00 <sup>c</sup> ±0.00
PUM	65.33 <sup>c</sup> ±0.000	55.00 <sup>b</sup> ±0.00	22.00 <sup>c</sup> ±0.00
UPM	60.72 <sup>d</sup> ±0.020	39.00 <sup>d</sup> ±0.000	22.40 <sup>c</sup> ±0.00
MPU	49.09 <sup>e</sup> ±0.00	42.25 <sup>c</sup> ±0.050	23.00 <sup>b</sup> ±0.00

Values are mean of triplicate ± standard deviation

Means with the same superscript in the same column are not significantly different at (P<0.05).

APA	100% Pawpaw leaf
BUB	100% Utazi leaf
CMC	100% Moringa leaf
PUM	50% Pawpaw; 25% utazi; 25% Moringa
UPM	25% pawpaw; 50% utazi; 25% moringa
MPU	25% Pawpaw; 25% utazi; 50% moringa

Mineral composition of green tea produced from pawpaw, Utazi and moringa leaf is presented in table 2. There were significant (P<0.05) difference in mineral composition of samples. Calcium (84.16mg/100g) and iron (90.83mg/100g) contents were significantly higher in sample APA (100% pawpaw leaf) and significantly lower in sample CMC (100% moringa leaf) and BUB (100% Utazi leaf) respectively. Sodium contents ranged from 17.55 and 31.00 mg/100g. Sample BUB had the highest value (31.00mg/100g) of sodium while sample APA had lowest value (17.55mg/100g). Ayoola and Adeyeye (2010) reported a similar value (90.50mg/100g) of iron for pawpaw leaf tea. Zaku et al (2015) reported a lower (28.2g) iron content for moringa leaf tea while Balogun et al (2016) reported a much lower value (7.8mg/100g) for utazi. The result of the mineral composition clearly showed that the green tea samples contain rich source of mineral elements. The presence of these minerals in the green tea indicates the usefulness of this tea in the coagulation of blood, the proper functioning of the heart, nervous system and the normal contraction of muscles. Calcium, assists in the formation of bones and teeth as well as cartilages. The presence of iron signifies that the leaves can be used against anemia, tuberculosis and growth disorder. Iron is an energizer but excess can cause fatigue although excess intake of iron is from natural source is hardly observed (Gbolahan, 2001). Sodium is involved with the regulation of plasma volume, acid – base balance, nerve and muscle contraction, among others.

Since these green tea samples contains these elements in different concentrations, the quality and the type of leaf to be taken will depend on the therapeutic need of the individual and they can also be combined for an effective result in such cases as diabetes, cancer, fibroid and tuberculosis (Ayoola and Adeyeye, 2010).

**Table 4 :**Phytochemical composition of green tea samples formulated from pawpaw, utazi, moringa and their blends

Sample	Flavonoid	Tannin
APA	2.50 <sup>d</sup> ±0.00	1.03 <sup>b</sup> ±0.058
BUB	3.97 <sup>c</sup> ±0.551	0.25 <sup>f</sup> ±0.00

CMC	6.30 <sup>a</sup> ±0.00	1.25 <sup>a</sup> ±0.00
PUM	3.80 <sup>c</sup> ±0.265	0.85 <sup>d</sup> ±0.00
UPM	4.00 <sup>c</sup> ±0.00	0.65 <sup>e</sup> ±0.00
MPU	4.70 <sup>b</sup> ±0.00	0.95 <sup>c</sup> ±0.00

Values are mean of triplicate ± standard deviation.

Means with the same superscript in the same column are not significantly different at 5% probability.

APA =100% Pawpaw leaf, BUB =100% Utazi leaf, CMC=100% Moringa leaf, PUM= 50% Pawpaw; 25% utazi; 25% Moringa, UPM= 25% pawpaw; 50% utazi; 25% moringa, MPU=25% Pawpaw; 25% utazi; 50% moringa

Table 4 shows the phytochemical composition of green tea formulated from pawpaw, utazi and moringa blends significant ( $P<0.05$ ) difference were observed in phytochemical content of green tea. Flavonoid and tannin were significant ( $P<0.05$ ) higher in sample CMC (100% moringa leaf) than other samples. Flavonoid contents ranged from 2.50 to 6.30% while tannin contents range from 0.25 to 1.25% phytochemicals composition are known to be non-nutritive but have been linked to the reduction of risk of some degenerative diseases in man (Liu, 2004).

flavonoid have been reported to exert various biological effects such as antibacterial, antitoxic, antiviral and anti-inflammatory activities (Cook and Samman, 1996). They are also strong antioxidants, free radical scavengers and metal chelators. The low tannin contents of green tea produced from pawpaw, utazi and moringa would make it serve as a health functional drink.

**Table 5:** Mean score for sensory evaluation of green tea developed from pawpaw, utazi, and moringa leaves.

SAMPLE	COLOUR	FLAVOR	AFTERTASTE	TASTE	OVERALL ACCEPTABILITY
APA	6.58 <sup>bc</sup> ±0.568	6.60 <sup>ab</sup> ±0.843	6.30 <sup>b</sup> ±0.483	6.40 <sup>ab</sup> ±1.430	6.80 <sup>bc</sup> ±0.422
BUB	8.20 <sup>a</sup> ±0.422	7.10 <sup>a</sup> ±1.524	6.60 <sup>b</sup> ±1.174	6.50 <sup>ab</sup> ±1.650	7.30 <sup>ab</sup> ±1.567
CMC	7.80 <sup>ab</sup> ±0.919	7.50 <sup>a</sup> ±1.434	7.70 <sup>a</sup> ±1.252	7.70 <sup>a</sup> ±1.494	8.10 <sup>a</sup> ±1.449
PUM	5.60 <sup>d</sup> ±0.966	6.00 <sup>b</sup> ±0.943	5.80 <sup>b</sup> ±1.317	5.80 <sup>b</sup> ±0.919	6.00 <sup>c</sup> ±0.942
UPM	7.30 <sup>abc</sup> ±0.823	7.30 <sup>a</sup> ±0.483	6.50 <sup>b</sup> ±0.971	6.90 <sup>ab</sup> ±1.287	7.00 <sup>bc</sup> ±1.155
MPU	6.50 <sup>c</sup> ±1.650	6.70 <sup>ab</sup> ±1.055	6.60 <sup>b</sup> ±1.265	7.20 <sup>b</sup> ±1.033	7.70 <sup>ab</sup> ±0.675

Values are mean of triplicate ± standard deviation.

Means with the same superscript in the same column are not significantly different at 5% probability.

APA =100% Pawpaw leaf, BUB =100% Utazi leaf, CMC=100% Moringa leaf, PUM= 50% Pawpaw; 25% utazi; 25% Moringa, UPM= 25% pawpaw; 50% utazi; 25% moringa, MPU=25% Pawpaw; 25% utazi; 50% moringa

The mean score for the sensory evaluation of green tea samples is shown in table 4. There were significant ( $P<0.05$ ) difference in all the sensory attributes such as colour, flavor, after taste, taste and overall acceptability. Sample BUB (100% Utazi) had the highest mean scores (8.20) in colour of green tea samples. Sample CMC (100%) moringa had the higher mean scores in flavor (7.50), after taste (7.70), taste (7.70) and overall acceptability (8.10). Finally, it was observed that sample CMC mostly preferred all the attributes tested except for colour which had the highest rating in sample BUB.

## Conclusion

This study has shown that green tea can be developed from blends of pawpaw, utazi and moringa leaves. Samples MPU (52% moringa, 25% pawpaw, 25% utazi leaves) had the highest protein

contents while sample BUB had the highest value in ash and fat contents. Calcium and iron content were significantly ( $P < 0.05$ ) higher in sample APA (100% pawpaw) than other samples. All green tea samples were good source of ash, protein, fibre and carbohydrate but relatively lower in fat content. Flavonoid and tannin were significantly ( $p < 0.05$ ) higher in 100% moringa green tea than green teas developed from utazi and pawpaw leaves blends. The green tea produced from 100% moringa leaves was most accepted in terms of flavor, taste, after taste and overall acceptability.

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