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SOME PROPERTIES OF BEVERAGE OBTAINED FROM ROSELLE (*Hibiscus sabdariffa*) CALYCES AND ALLIGATOR PEPPER (*Aframomum melegueata*)

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ABSTRACT

This study investigated the effect of inclusion of alligator pepper powder on some properties of roselle beverage. Roselle beverages containing 0-5% ground alligator pepper were prepared. The pH, colour, radical scavenging ability and sensory properties of the beverages were determined. Data were subjected to analysis of variance and the means separated using Duncan's multiple range test at 5% level. The pH and DPPH scavenging ability of the extracts ranged from 2.52 - 2.59 and 14.03 - 40.11% respectively. Range of values for L*, a* and b* were 23.22 - 24.53, 1.34 - 2.09 and 0.71 - 0.99 respectively. The aroma, taste and overall acceptability ranged, on a 9-point scale, from 5.28 - 6.14, 4.88 - 5.82 and 4.90 - 6.20 respectively. Roselle beverage containing 2% alligator pepper was the most preferred. Inclusion of 2% alligator pepper improved the antioxidant and sensory properties of beverages from roselle calyces.

Keywords : *Hibiscus sabdariffa*, Alligator pepper, Roselle, Sensory Antioxidant properties,

INTRODUCTION

There is a growing demand for pure natural plant foods (i.e. those without addition of chemicals), especially those rich in antioxidant substances (Cid-ortega and Guerrero-Beltran, 2015). These substances have been reported to improve physical and mental well-being of man, as well as reduce the risk of certain debilitating diseases (Cid-ortega and Guerrero-Beltran, 2015).

Roselle (*Hibiscus sabdariffa*) belongs to the super order Malvaceae and it is grown in Central and West Africa, South, East Asia, and elsewhere in parts of West Indias, Jamaica and Central America (Ilondu and Iloh, 2007). It is cultivated for leaf, fleshy calyx, seed or fibre (Burkill, 2004). It is used in folk medicine against many complaints that include high blood pressure, liver diseases and fever (Burkill, 2004; Wang *et al*., 2000; Odigie *et al*., 2003). The thick red and fleshy cup-shaped calyces of the flower are consumed worldwide as a cold or hot beverage (Morton, 1987). Roselle calyces contain flavonoids, and the extract possesses antihypertensive, antimicrobial, anti-inflammatory, anticancer, antispasmodic and antioxidant properties (Vargas-Alvarez *et al*., 2018). Roselle calyces extracts contain high amounts of protein and other nutrients required for good health (Adanlawo and Ajibade, 2006).

Alligator pepper (*Aframomum melegueata*) is a member of the family *Zingiberaceae*, to which ginger (*Zingiber officinale*) belongs. The

indigenous names include "atare" in Yoruba, "ose-oji" in Igbo and "citta" in Hausa. It is eaten in Nigeria and some parts of West Africa as a spice during entertainment. It has a wide range of folkloric uses in traditional medicine, such as remedy for treating stomach ache, diarrhea and snake bite (Umukoro, 2007; Ilic *et al.,* 2010). The seed extracts have been reported to possess antinociceptive, anti-ulcer, antimicrobial, anti-inflammatory and antioxidant properties (Umukoro, 2007; Onoja *et al.,* 2014). The inclusion of ethanolic extracts of alligator pepper in roselle beverage has been reported (Nwokocha *et al*., 2012). However, it is a fact that consumers are wary of foods containing chemicals.

Beverages have been produced from roselle calyces either alone or in combination with fruits or plant extracts (Fasoyiro *et al*., 2005; Oyetade *et al*., 2012; Paul and Ghosh, 2012; Awe *et al.*, 2013; Adelekan *et al*., 2014; Cid-ortega and Guerrero-Beltran, 2015; Gbadegesin and Gbadamosi, 2017; Ogundele *et al*., 2017). However, information is scanty on the use of alligator pepper powder in roselle beverage. This is expected to reduce the complexity of preparing plant extracts, and thus provide a simplified method for a healthful roselle beverage manufacture.

The objective of the study was to evaluate the chemical and sensory properties of beverages from roselle calyces and alligator pepper.

MATERIALS AND METHODS

Materials

Dry calyces of *Hibiscus sabdariffa* and alligator pepper were purchased from Osiele market in Abeokuta, Nigeria. 1,1-Diphenyl-2-picrylhydrazyl (DPPH) reagent was purchased from a reputable supplier in Abeokuta, Nigeria.

Preparation of Hibiscus sabdariffa Calyces flour

Hibiscus sabdariffa was obtained and the dirt was sorted out by winnowing. Calyces were dried in the oven at 60 ºC (Babalola *et al.*2001) for 24 h. The dried calyces were milled (Phillips -model HR-1702) into flour of mesh size 425 micron and sieved. The dried calyces flour was packed and sealed in polyethylene bags until further analysis.

Preparation of Alligator Pepper Flour

The alligator pepper pods was opened and the seeds was removed and separated from the lint-like material in the pod. The seed was crushed using a clean laboratory blender (Phillips -model HR-1702), and sieved with a sieve of 250 micron mesh size.

Formulation of Hibiscus sabdariffa Calyces and Alligator pepper

The blends of *Hibiscus sabdariffa* Calyces and alligator pepper powder were mixed together using a laboratory blender (Phillips -model HR-1702). The blends were prepared by substituting *Hibiscus sabdariffa* calyces with alligator pepper at different ratios of 99:1, 98:2, 97:3, 96:4, 95:5 respectively while 100% dried calyces flour served as controls.

Preparation of Roselle Beverages

Roselle beverage was prepared according to the method reported by Cid-ortega and Guerrero-Beltran (2015). The ratio of roselle-pepper blend to hot water was 1:62 (w/v). The extraction temperature was kept constant at 100 ^{o}C for 30 min. The extract was sweetened with 13% sucrose. Roselle beverage was sieved in a double-layered muslin cloth.

Determination of pH

The pH meter was standardized using buffer solutions of acidic and basic values. Calibration was done by dipping the electrode in the acidic buffer solution, adjusting the pH, cleaning the electrode, dipping it into the basic buffer solution and again adjusting the meter. The electrode was rinsed with distilled water before taking measurements. The roselle beverages were homogenized by stirring before measurements of pH were taken to achieve uniformity. The pH

readings were made by dipping the electrode in roselle beverage and letting it display stability. Measurements were taken from the display screen when the readings were stable.

Determination of Colour

Tri-stimulus colorimeter was used to take colour measurements (Duangmal *et al.*, 2004). The instrument expresses colour measurement in the CIELAB (L*, a*, b*) form. The instrument was first calibrated using standard black and white plates (with transparent papers placed on the standard plates). After calibration, roselle beverages were analyzed by placing them on the petri dish, and then the image was captured on the samples. The colour attributes such as lightness (L*), redness (a*) and yellowness (b*) were recorded

Determination of antioxidant activity with 2, 2-diphenyl-1-picrylhydrazyl (DPPH) radical scavenging method

The antioxidant activity of the samples was measured in terms of hydrogen donating or radical scavenging ability, using the stable radical, DPPH (Brand-Williams *et al*., 1995). About 1 mL of DPPH was added to 4 mL sample and incubated at room temperature for 30 min. The absorbance was determined at 517 nm using a spectrophotometer (CECIL CE7200). The percentage inhibition was calculated using the following formula:

Reduction of absorbance (%) = [(AB - AA) / AB] x 100

AB = Absorbance of blank sample (t = 0 min)

AA = Absorbance of tested extract solution (t = 30 min)

Sensory Attributes of Roselle Beverage

The method described by Iwe (2002) was used. The sensory panel consists of 50 members who were familiar with the product and were asked to score the roselle beverage using a nine-point hedonic scale based on their degree of likeness where 9= like extremely; 5= neither like nor dislike; 1= dislike extremely. Attributes evaluated were: aroma, taste and overall acceptability.

Data Analysis

Data obtained were subjected to statistical analysis. Means, Analysis of variance (ANOVA) were determined using SPSS Version 21.0 and the differences between the mean values were evaluated at $p<0.05$ using Duncan's multiple range test.

RESULTS

Table 1 shows the effect of alligator pepper on the pH and colour of roselle beverage. Significant ($p<0.05$) differences were observed in the pH of roselle beverages. The pH of the samples were in the acidic region in which roselle beverage treated with 3% alligator pepper had the lowest value of 2.52 and roselle beverage treated with 2% alligator pepper had the highest value of 2.59. Significant ($p<0.05$) differences existed in the lightness (L*), redness (a*) and yellowness (b*) of the samples. The L* values ranged from 23.22 to 24.84, with roselle beverage treated with 5% alligator pepper recording the lowest value while roselle beverage treated with 1% alligator pepper had the highest. There a* values which ranged from 1.34 to 1.98 increased as the quantity of alligator pepper increased. The yellowness of the samples ranged from 0.71 to 1.02 with roselle beverage treated with 1% alligator pepper having the highest value while the control beverage had the lowest value.

Table 1: Effect of Alligator Pepper on pH and Colour of Roselle Beverages

HSC:AP	pH	L*	a*	b*
100:0	2.57^{ab}	24.53 ± 0.03^{ab}	1.34 ± 0.17^{c}	0.71 ± 0.03^{b}
99:1	2.54^{ab}	24.84 ± 0.06^{a}	1.37 ± 0.10^{c}	1.02 ± 0.05^{b}
98:2	2.59^{a}	24.38 ± 0.81^{a}	1.55 ± 0.40^{c}	0.70 ± 0.05^{b}
97:3	2.52^{b}	23.90 ± 0.04^{bc}	1.67 ± 0.01^{bc}	0.96 ± 0.04^{a}
96:4	2.56^{ab}	23.39 ± 0.02^{cd}	1.98 ± 0.02^{ab}	0.95 ± 0.04^{a}
95:5	2.53^{ab}	23.22 ± 0.06^{d}	2.09 ± 0.06^{a}	0.99 ± 0.03^{a}

Mean values with different superscripts within the same column are significantly different ($p<0.05$); HSC- *Hibiscus sabdariffa* Calyces, AP –Alligator pepper, L*- Lightness, a*- redness, b*- yellowness

Table 2 shows the effect of alligator pepper on the scavenging ability of roselle beverage. The antioxidant activity of the the beverges which increased as the quantity of alligator increased ranged roselle 14.03 to 40.11%. Table 3 shows the effect of alligator pepper on sensory attributes of roselle beverages. There were significant ($p<0.05$) differences in the taste and overall acceptability of the beverages. The addition of alligator pepper did not significantly ($p>0.05$) affect the taste of the beverages. The effect of alligator pepper inclusion on roselle beverage did not follow a definite pattern. Roselle beverage spiced with 2% alligator pepper was the most acceptable in terms of all the sensory attributes.

Table 2: Effect of Alligator Pepper on the Scavenging Ability of Roselle Beverages

HSC:AP	Antioxidant activity (%)
100:0	14.03 ± 1.00^{e}
99:1	23.00 ± 2.00^{d}
98:2	25.53 ± 0.40^{cd}
97:3	27.70 ± 1.01^{c}
96:4	35.62 ± 2.00^{b}
95:5	40.11 ± 5.10^{a}

Mean values with different superscripts within the same row are significantly different ($p<0.05$); HSC- *Hibiscus sabdariffa* Calyces, AP –Alligator pepper, DPPH- 2, 2-diphenyl-2-picrylhydrazyl

Table 3: Effect of Alligator Pepper on the Sensory Attributes of Roselle Beverages

HSC:AP	Aroma	Taste	Overall acceptability
100:0	5.40 ± 2.07^{ab}	5.02 ± 2.22^{a}	5.52 ± 2.16^{ab}
99:1	5.28 ± 1.93^{b}	4.88 ± 2.05^{a}	4.90 ± 2.04^{b}
98:2	6.14 ± 2.00^{a}	5.82 ± 2.31^{a}	6.20 ± 2.22^{a}
97:3	5.68 ± 1.88^{ab}	5.60 ± 2.03^{a}	5.56 ± 2.05^{a}
96:4	5.30 ± 1.84^{ab}	5.34 ± 2.10^{a}	5.38 ± 2.04^{ab}
95:5	5.58 ± 1.77^{ab}	5.22 ± 2.14^{a}	5.56 ± 1.90^{ab}

Mean values with different superscripts within the same column are significantly different ($p<0.05$); HSC- *Hibiscus sabdariffa* Calyces, AP –Alligator pepper

DISCUSSION

The fact that the beverages were acidic conforms to the findings of Fasoyiro *et al.* (2005), Olayemi *et al.* (2011) Nwokocha (2012) and Ogundele *et al.* (2016). pH is an important physiochemical parameter that tends to ensure good shelf stability of food samples since high acid confers more antimicrobial effects on contaminating organisms. Colour is an essential quality attribute of foods, which influences consumers' choice and preferences (Pathare *et al*., 2013). The appearance of a product as judged by its colour can often be used to determine the pigment content of a product, which in turn is often an index of quality (Francis, 1995). The decrease in the L* value of the beverages may be due to the dilution effect of the alligator pepper powder since it has been reported that anthocyanin in roselle beverage is principally responsible for the colour intensity of the beverage (Ishola *et al*., 2015).

The increase in the antioxidant property of the roselle beverage as the quantity of alligator pepper powder increased could be attributed to the presence of phytochemicals in alligator pepper (Nwokocha *et al*., 2012). The significant effect of alligator pepper powder on some sensory attributes of roselle beverage agrees with the findings of Nwokocha *et al*. (2012) and Ishola *et al*. (2015).

CONCLUSION

The result obtained from this study has shown that Roselle calyx with alligator pepper spiced at 2% level gave the most effective roselle beverage in terms of sensory acceptability. Addition of alligator pepper increases the antioxidant properties of the roselle beverages. However, roselle beverages treated with alligator pepper, if well prepared and packaged will compete

favourably with most of the imported non-alcoholic beverage available in the country.

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