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Changes in quality attributes of mixed roselle, water melon and grape juice using *Aframomum danielli* as a preservative

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Roselle, water melon and grape juice are excellent sources of vitamin C. The shelf life of most fresh fruit juices stored under room temperature is very short. The use of *Aframomum danielli* (*A. danielli*) as a preservative is not known. Roselle juices processed at 1:1 and 1:2 with or without *A. danielli* of 15% concentration were stored for two weeks at room temperature and evaluated for chemical properties and sensory attributes. Sensory evaluation of the juices were done by a 10 membered panel randomly selected from male and female adults. At zero day of storage, roselle grape juice of 1:2 ratio with *A. danielli* was significantly higher in total solids (0.637%) and ash content (0.072%). The vitamin C content of roselle-water melon juice of 1:2 ratio with *A. danielli* was higher at p<0.01. At one week of storage, there was a decrease in ash, specific gravity and vitamin C content of the juice. Roselle grape juice of 1:2 ratio with *A. danielli* was higher in ash (0.0675%). The vitamin C content of roselle-water melon of ratio 1:2 with *A. danielli* (17.125%) was significantly higher. At two weeks of storage, there was a drop in ash, specific gravity and vitamin C content of the juices. Higher sensory scores were given to roselle based sample with *A. danielli* at 0, one and two weeks of storage. Roselle grape juice of ratio 1:2 with *A. danielli* was rated high in general acceptability at zero and one week of storage. In summary roselle grape juice of ratio 1:2 with *A. danielli* had acceptable nutrient and sensory qualities at one week of storage. Beyond one week, the preservative potential of *Aframomum danielli* at 15% concentration was low.

Key words: Roselle juice, *A. danielli*, preservation, water melon juice, grape juice.

INTRODUCTION

Roselle (*Hibiscus sabdariffa* L.) is a member of the family Malvaceae to which okra, cotton and kenaf belong. The flowers of roselle are generally small. Both the leaves and the fleshy base of the flower (the calyx) are employed in the preparation of soups and sauces. The vegetable is a popular diet during the raining season. Roselle calyx is a cheap source of vegetable protein, fat and minerals. Roselle is also very rich in vitamins and minerals and an excellent source of anti oxidant which helps to reduce blood pressure (Peng-Kong et al., 2002, Fasoyiro et al., 2005). Regular consumption of roselle may reduce nutritional deficiency problems such as night blindness, scurvy and rickets (Ashaye and Adeleke, 2009, Babalola et al., 2001).

Roselle calyces are popularly used in Nigeria in the production of zobo drink. It is also used in the production

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of tea and jams. Water melon is a fruit rich in vitamin C and some essentials nutrient such as beta - carotene (Strandhagen et al., 2000), Grape contains polyphenols called flavonoids which lowers the risk of clogged arteries and it potentially lowers blood pressure. It is also rich in vitamin C and mineral such as calcium and potassium. *A. danielli* also known as alligator pepper can be used as flavouring in soups. *A. danielli* species has antibacterial effects and has been used in food preservation studies (Ashaye et al., 2006).

This research work on changes in quality attributes of mixed roselle, water melon and grape using using *A. danielli* as preservative is not well known. Hence this study aimed at assessing the chemical and sensory attributes of stored roselle - water melon and roselle grape juice using *A. danielli* as a preservative.

MATERIALS AND METHODS

Raw materials

Roselle calyces (*Hibiscus sabdariffa*) used for this research study were obtained from the experimental farm of Institute of Agricultural Research and Training, I.A.R.& T., Ibadan, while water melon and grape fruits were purchased from the local market.

Preparation of *Aframomum danielli* flour

Dry *A. danielli* pods was shelled and the seeds was grounded into powder and packed.

Preparation of roselle, water melon and grape juice

200 g of a dried roselle was weighed and washed in the water, it was poured inside a clean pot and three liters of water was added to it. It was boiled for ten minutes after; it was allowed to cool and sieved to obtain the juice.

Grape and water-melon juice were prepared by first peeling the grape and water-melon fruit, they were then chopped, crushed, blended and sieved. Roselle watermelon and roselle grape juices were prepared at ratios 1:1 and 1:2 with and without the addition of grounded seed flour of *Aframomum danielli* at 15% concentration.

Chemical analysis

Determination of titratable acidity (TTA)

1 ml of each sample was diluted to 100 ml, 10 ml aliquot of the diluents was pipette into a 100 ml volumetric flask and one drop of 1% phenolphthalein was added and mixed properly to give a pink colour. The mixture was titrated against 0.1N NaOH until the pink colour was discharged to a clear colourless solution at the equivalent point. The % TTA was calculated using the formula:

$$\%TTA = \frac{\text{Titre value} \times 0.1\text{N NaOH} \times \text{acid equivalent} \times DF}{\text{Volume of aliquot taken.}}$$

Where, DF = dilution factor; acid equivalent = respective acid to which the % TTA is expressed (A.O.A.C 1984).

Determination of specific gravity

10 ml of juice was measured using a 50 ml measuring cylinder into a previously weighed 10 ml beaker and weight W_1 was taken. 10 ml of water was also measured into the same 10 ml beaker of weighed W_0 and the overall weight W_2 taken on the analytical weighing balance. Specific gravity of the juice was obtained by using the formula:

$$\text{Specific gravity} = \frac{\text{Weight of 10 ml of juice } (W_1 - W_0)}{\text{Weight of equal volume of water } (W_2 - W_0)}$$

Determination of total solids

2 ml of the sample was weighed into a previously weighed crucible. The crucible plus sample taken was then transferred into the oven set at 100°C to dry to a constant weight for 24 h overnight. At the end of the 24 h, the crucible plus sample was removed from the oven for ten minutes and weighed.

If the weight of empty crucible plus sample is W_O, weight of crucible plus sample is W_1, weight of crucible plus oven dried sample is $W_{2.}$

$$\%\text{ Total solids} = \frac{W_2 - W_0}{W_1 - W_0} \times \frac{100}{1}$$

Determination of ash

20 ml of the sample were measured into a porcelain crucible. Then transferred into the muffle furnace at 550°C and left for about four hours until it has turned to white ash. The crucible and its content were cooled off to about 100°C in air, then room temperature in a desiccator and weighed. This was done in duplicate. The percentage ash was determined or calculated from the formula below:

$$\%\text{ Ash content} = \frac{\text{Weight of ash} \times 100}{\text{Original weight of sample}}$$

(A.O.A.C, 1989)

Determination of vitamin C

50 ml of the juice extract was pipette into a phosphoric acid as stabilizing agent was added and made up to the mark in water. 10ml of the solution was pipette into a 50 ml volume flask, 2.5 ml acetone was added and titrated with 5×10^{-5}g/l 2,6-dichlorophenol solution control, a faint pink colour which persist for 15 s was obtained (A.O.A.C, 1984).

Sensory evaluation

Sensory evaluation was carried out on the juice samples as described by Larmond (1977) using 10 panelists to assess the quality of the juices with regard to their colour, flavour, taste, texture and overall acceptability. The sensory scores were subjected to analysis of variance using completely randomized block design and their means were separated by Duncan multiple range test (Duncan 1955).

Table 1. Chemical Composition of Roselle based juice at zero day of storage

Sample	Titrable acidity (%)	Total solids (%)	Ash (%)	Vitamin c (mg/100 g)	Specific gravity
RJ	0.324[b]	0.567[g]	0.060[f]	13.240[j]	1.053[b]
RW 1:1	0.314[c]	0.538[f]	0.050[h]	17.060[d]	1.062[a]
RW 1:2	0.307[d]	0.603[d]	0.062[e]	17.230[b]	1.045[c]
RG 1:1	0.303[e]	0.603[d]	0.060[f]	14.086[h]	1.015[g]
RG 1:2	0.250[h]	0.623[b]	0.068[b]	14.250[f]	1.016[f]
RJ AD	0.327[a]	0.563[h]	0.063[de]	13.465[i]	1.062[a]
RW1:1 AD	0.284[g]	0.694[e]	0.057[g]	17.140[c]	1.053[b]
RW1:2 AD	0.283[g]	0.612[c]	0.066[g]	17.365[a]	1.045[c]
RG1:1 AD	0.297[f]	0.614[c]	0.064[cd]	14.240[g]	1.025[e]
RG1:2 AD	0.220[i]	0.637[a]	0.072[a]	14.365[e]	1.027[d]

Means in the same columns followed by the same letter are not significantly different from each other at P<0.01. RJ, Roselle juice (control); RW (1:1), roselle and water melon juice of ratio (1:1); RW (1:2), roselle and water melon juice of ratio (1:2); RG (1:1), roselle and grape juice of ratio (1:1); RG (1:2), roselle and grape juice of ratio (1:2); RJ AD, roselle juice preserved with *Aframomum danielli*; RW AD (1:1), roselle and water melon preserved with *Aframomum danielli* of ratio (1:1); RW AD (1:2), roselle and water melon preserved with *Aframomum danielli* of ratio (1:2); RG AD (1:1), roselle and grape juice preserved with *Aframomum danielli* of ratio (1:1); RG AD (1:2), roselle and grape juice preserved with *Aframomum danielli* of ratio (1:2).

Table 2. Chemical composition of roselle based juice at one week of storage.

Sample	Titrable acidity (%)	Total solids (%)	Ash (%)	Vitamin c (mg/100 g)	Specific gravity
RJ	0.352[a]	0.560[d]	0.056[e]	12.575[i]	0.999[b]
RW 1:1	0.317[c]	0.581[f]	0.046[g]	15.485[d]	0.957[e]
RW 1:2	0.290[c]	0.592[bc]	0.058[d]	16.925[b]	0.983[d]
RG 1:1	0.307[d]	0.596[bc]	0.052[f]	13.700[h]	0.999[b]
RG 1:2	0.254[f]	0.617[a]	0.063[b]	13.915[f]	0.999[b]
RJ AD	0.331[b]	0.557[d]	0.060[c]	12.125[j]	0.991[c]
RW1:1 AD	0.304[d]	0.590[bc]	0.053[f]	16.855[c]	1.00[a]
RW1:2 AD	0.286[c]	0.605[cb]	0.062[b]	17.125[a]	0.991[c]
RG1:1 AD	0.302[d]	0.604[ab]	0.058[d]	13.850[g]	0.999[b]
RG1:2 AD	0.232[g]	0.615[a]	0.068[a]	14.075[e]	1.008[a]

Means in the same columns followed by the same letter are not significantly different from each other at P<0.01. RJ, Roselle juice (control); RW (1:1), roselle and water melon juice of ratio (1:1); RW (1:2), roselle and water melon juice of ratio (1:2); RG (1:1), roselle and grape juice of ratio (1:1); RG (1:2), roselle and grape juice of ratio (1:2); RJ AD, roselle juice preserved with *Aframomum danielli*; RW AD (1:1), roselle and water melon preserved with *Aframomum danielli* of ratio (1:1); RW AD (1:2), roselle and water melon preserved with *Aframomum danielli* of ratio (1:2); RG AD (1:1), roselle and grape juice preserved with *Aframomum danielli* of ratio (1:1); RG AD (1:2), roselle and grape juice preserved with *Aframomum danielli* of ratio (1:2).

Statistical analysis

Data was subjected to analysis of variance and their means were separated by Duncan multiple range test Duncan 1955.

RESULTS AND DISCUSSION

Table 1 shows that roselle grape juice of ratio 1:2 with *A. danielle* at zero day of storage was significantly higher in total solids (0.639%) and ash content (0.072%). The higher content of total solids and ash may be due to presence of higher molar mass compounds such as pectin and starch. (Katia et al., 2013).

The vitamin C content of roselle water melon juice of 1:2 ratio with *A. danielle* was higher at p<0.01 when compared with others. This variation may be due to time of harvest, maturation degree and varietal differences (Katia et al., 2013). However, these values are within the range reported for most juices (Aina and Shodipe, 2006, Peng-Kong et al., 2002).

At one week of storage (Table 2), there was a decrease in ash, specific gravity and vitamin C contents of the

Table 3. Chemical composition of roselle based juice at two weeks of storage.

Sample	Titrable acidity (%)	Total solids (%)	Ash (%)	Vitamin c (mg/100 g)	Specific gravity
RJ	0.463[e]	0.345[d]	0.051[ab]	12.265[i]	0.989[a]
RW 1:1	0.568[d]	0.338[d]	0.037[c]	14.840[d]	0.955[a]
RW 1:2	0.578[c]	0.306[g]	0.047[b]	16.220[b]	0.987[a]
RG 1:1	0.314[h]	0.577[c]	0.046[c]	13.285[h]	0.985[a]
RG 1:2	0.317[g]	0.590[b]	0.056[a]	13.740[f]	0.978[a]
RJ AD	0.457[f]	0.326[c]	0.053[ab]	12.025[j]	0.985[a]
RW1:1 AD	0.584[b]	0.321[ef]	0.044[bc]	16.100[c]	0.958[a]
RW1:2 AD	0.597[a]	0.313[fg]	0.056[a]	16.655[a]	0.988[a]
RG1:1 AD	0.295[j]	0.582[bc]	0.050[b]	13.565[g]	0.987[a]
RG1:2 AD	0.308[i]	0.600[a]	0.059[a]	14.005[e]	0.987[a]

Means in the same columns followed by the same letter are not significantly different from each other at P<0.01. RJ, Roselle juice (control); RW (1:1), roselle and water melon juice of ratio (1:1); RW (1:2), roselle and water melon juice of ratio (1:2); RG (1:1), roselle and grape juice of ratio (1:1); RG (1:2), roselle and grape juice of ratio (1:2); RJ AD, roselle juice preserved with *Aframomum danielli*; RW AD (1:1), roselle and water melon preserved with *Aframomum danielli* of ratio (1:1); RW AD (1:2), roselle and water melon preserved with *Aframomum danielli* of ratio (1:2); RG AD (1:1), roselle and grape juice preserved with *Aframomum danielli* of ratio (1:1); RG AD (1:2), roselle and grape juice preserved with *Aframomum danielli* of ratio (1:2).

Table 4. Sensory evaluation of roselle based juice at zero day of storage.

Sample	Titrable acidity (%)	Total solids (%)	Ash (%)	Vitamin c (mg/100 g)	Specific gravity
RJ	6.400[bc]	4.000[a]	3.700[b]	4.100[d]	5.200[c]
RW 1:1	5.500[cd]	4.300[b]	4.400[b]	4.300[d]	5.000[c]
RW 1:2	4.600[d]	3.900[b]	4.100[b]	3.800[d]	4.400[c]
RG 1:1	5.000[cd]	4.300[b]	4.200[b]	5.000[cd]	5.100[c]
RG 1:2	4.500[d]	4.300[b]	4.300[b]	5.200[abc]	5.400[bc]
RJ AD	8.000[a]	7.000[a]	7.100[a]	6.800[a]	7.400[a]
RW1:1 AD	7.100[ab]	7.100[a]	6.900[a]	6.700[a]	7.000[a]
RW1:2 AD	6.400[bc]	6.800[a]	6.900[a]	6.500[ab]	6.600[ab]
RG1:1 AD	7.500[ab]	7.200[a]	7.300[a]	6.100[ab]	7.700[a]
RG1:2 AD	7.100[ab]	7.200[a]	7.700[a]	6.100[ab]	7.200[a]

Means in the same columns followed by the same letter are not significantly different from each other at P<0.01. RJ, Roselle juice (control); RW (1:1), roselle and water melon juice of ratio (1:1); RW (1:2), roselle and water melon juice of ratio (1:2); RG (1:1), roselle and grape juice of ratio (1:1); RG (1:2), roselle and grape juice of ratio (1:2); RJ AD, roselle juice preserved with *Aframomum danielli*; RW AD (1:1), roselle and water melon preserved with *Aframomum danielli* of ratio (1:1); RW AD (1:2), roselle and water melon preserved with *Aframomum danielli* of ratio (1:2); RG AD (1:1), roselle and grape juice preserved with *Aframomum danielli* of ratio (1:1); RG AD (1:2), roselle and grape juice preserved with *Aframomum danielli* of ratio (1:2).

juices with concomitant increase in their titratable acidity. This observation may be due to utilization of soluble solids by yeast cells during fermentation (Idolo et al., 2012; Omemu et al., 2006, Doughari et al., 2007; Braide et al., 2012).

Roselle-grape juice of 1:2 ratio with *A. danielle* was higher in ash (0.0675%). However there was no significant difference in the total solids of roselle -grape juice of ratio 1:2 with *A. danielli.* This finding may be due to antibacterial property of *A. danielli.*(Ashaye, 2006). The vitamin C content of Roselle -water melon of ratio 1:2 with *A. danielli* was significantly higher with a value of (17.125%). At two weeks of storage (Table 3), there was a further drop in ash, specific gravity and vitamin C contents of the juices. Also, titratable acidity content increased in all the juice samples. Increase in titratable acidity may be due to the increased activities of micro-organisms resulting in production of organic acids (Ojokoh et al., 2002).

The ash contents of roselle -grape juice of 1:2 with *A. danielle* and roselle water melon juice of 1:2 ratio were not significantly different from each other at p<0.01. The vitamin C content of roselle -water melon of ratio 1:2 with *A. danielli* was the highest. At zero day of storage, roselle-grape juice of ratio 1:2 with *A. danielli* was also rated high in general acceptability (7.20) (Table 4).

Table 5. Sensory evaluation of roselle based juice at one week of storage.

Sample	Titrable acidity (%)	Total solids (%)	Ash (%)	Vitamin c (mg/100 g)	Specific gravity
RJ	6.900[a]	4.300[b]	3.800[cd]	4.800[b]	4.400[c]
RW 1:1	5.800[a]	4.800[b]	3.700[cd]	5.200[b]	4.400[bc]
RW 1:2	5.800[a]	4.400[b]	3.900[bcd]	4.800[b]	5.600[ab]
RG 1:1	3.700[b]	2.600[c]	2.500[de]	3.300[c]	3.800[c]
RG 1:2	3.300[b]	2.100[c]	2.000[e]	2.500[c]	2.400[d]
RJ AD	7.100[a]	5.400[ab]	5.500[ab]	6.100[ab]	6.700[a]
RW1:1 AD	6.800[a]	5.400[ab]	5.300[abc]	6.000[ab]	6.100[a]
RW1:2 AD	6.000[a]	5.800[ab]	5.300[abc]	5.600[b]	6.400[a]
RG1:1 AD	6.900[a]	6.500[a]	6.700[a]	7.100[a]	6.900[a]
RG1:2 AD	6.000[a]	5.700[ab]	6.200[a]	6.200[ab]	5.900[a]

Means in the same columns followed by the same letter are not significantly different from each other at P<0.01. RJ, Roselle juice (control); RW (1:1), roselle and water melon juice of ratio (1:1); RW (1:2), roselle and water melon juice of ratio (1:2); RG (1:1), roselle and grape juice of ratio (1:1); RG (1:2), roselle and grape juice of ratio (1:2); RJ AD, roselle juice preserved with *Aframomum danielli*; RW AD (1:1), roselle and water melon preserved with *Aframomum danielli* of ratio (1:1); RW AD (1:2), roselle and water melon preserved with *Aframomum danielli* of ratio (1:2); RG AD (1:1), roselle and grape juice preserved with *Aframomum danielli* of ratio (1:1); RG AD (1:2), roselle and grape juice preserved with *Aframomum danielli* of ratio (1:2).

Table 6. Sensory evaluation of roselle based juice at two weeks of storage.

Sample	Titrable acidity (%)	Total solids (%)	Ash (%)	Vitamin c (mg/100 g)	Specific gravity
RJ	4.900[c]	3.600[ab]	3.700[a]	4.000[c]	3.200[cd]
RW 1:1	5.000[bc]	2.700[bcd]	2.200[cd]	2.500[bcd]	2.200[d]
RW 1:2	5.000[bc]	2.900[abcd]	2.400[bcd]	2.900[abcd]	2.500[cd]
RG 1:1	1.800[e]	1.800[d]	1.800[d]	1.900[d]	2.100[d]
RG 1:2	1.500[e]	2.100[cd]	2.000[cd]	1.800[d]	2.700[cd]
RJ AD	5.900[abc]	4.200[a]	3.600[a]	3.700[a]	3.700[abc]
RW1:1 AD	6.000[ab]	3.200[abc]	3.400[ab]	3.500[abc]	4.800[a]
RW1:2 AD	6.700[a]	4.200[a]	3.600[a]	3.700[ab]	4.600[ab]
RG1:1 AD	3.200[d]	2.900[abcd]	2.600[abcd]	2.500[bcd]	3.500[bc]
RG1:2 AD	3.600[d]	3.000[abcd]	3.000[abc]	2.400[cd]	3.100[cd]

Means in the same columns followed by the same letter are not significantly different from each other at P<0.01. RJ, roselle juice (control); RW (1:1), roselle and water melon juice of ratio (1:1); RW (1:2), roselle and water melon juice of ratio (1:2); RG (1:1), roselle and grape juice of ratio (1:1); RG (1:2), roselle and grape juice of ratio (1:2); RJ AD, roselle juice preserved with *Aframomum danielli*; RW AD (1:1), roselle and water melon preserved with *Aframomum danielli* of ratio (1:1); RW AD (1:2), roselle and water melon preserved with *Aframomum danielli* of ratio (1:2); RG AD (1:1), roselle and grape juice preserved with *Aframomum danielli* of ratio (1:1); RG AD (1:2), roselle and grape juice preserved with *Aframomum danielli* of ratio (1:2).

However, higher sensory scores were given to roselle based sample with *A. danielli*. *A. danielli* is known to have a good flavor (Fasoyiro et al., 2005).

At one week of storage (table 5) roselle base juice with *A. danielle* was also rated highest in sensory parameters. This could be due to preservative potential of *A. danielle* (Ashaye et al., 2006). At two weeks (Table 6) acceptability decreased markedly with roselle based juice without *A. danielli* having the least. The colour of roselle-water melon of ratio 1:2 with *A. danielli* was significantly higher than the rest.

Conclusion

Roselle-grape juice of ratio 1:2 with *A. danielli* had acceptable nutrient and sensory qualities at one week of storage. Beyond one week, the preservative potential of *A. danielli* at 15% concentration was low.

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