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CHEMICAL AND SENSORY STABILITY OF STORED HOMEMADE ROSELLE JUICE

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Abstract: Roselle juice is rich in nutrients and is one of the most widely consumed drinks in Africa, Asia and South America. The total carotenoid content, antinutritional and sensory stability of stored home-made roselle juice was investigated. Control (commercial roselle juice), and freshly prepared 10% 20%, 30%, 40% and 50% roselle juice were stored at cold temperature (8±2^{o}C) for two weeks. The juice was evaluated for 2 weeks for chemical properties (total carotenoid content, vitamin C, titratable acidity, pH, specific gravity, total solids and ash) antinutritional factors (saponins, tannins, phytate and oxalate). Sensory evaluation was done by a 10-member panel made of male and female adults. Fifty percent (50%) roselle juice at 0 day was significantly higher than other roselle juice in titratable acidity (0.097%), specific gravity (0.962%), ash (0.062%), Vitamin C, (8.700mg/100g), total carotenoid content (461.05µg/100g), tannin (0.037%) and oxalate (1.705%). There was a decrease in some chemical properties and antinutritional factors with increase in storage time. In sensory attributes and nutritional quality, roselle juice from 10%-30% was preferred. Generally, fifty percent roselle juice received lower sensory scores after two weeks of storage

Keywords: Roselle, antinutritional, carotenoid, sensory, vitamin C

Introduction

Roselle (*Hibiscus sabdariffa*) belongs to the family *Malvaceae* which consists of more than three hundred (300) species around the globe. It is cultivated for the leaves, stem, seeds and calyces (Ajala *et al.*, 2021; Ashaye and Adeleke, 2009). Roselle is well-known to be rich in nutrients, its calyces are frequently used in the production of juices, jam, ice-cream, refreshing-beverages and other deserts and flavours. For instance, in Australia it is popularly- called Roselle or rosella fruit.

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It is also called Wonjo in Gambia, Zobo in Nigeria and the Yorubas in Nigeria call it the white variety Isapa. Roselle is known to be a highly acidic-fruit with low sugar content. Previous research discovered that succinic acid and oxalic acid were quantified as two predominant organic acids in Roselle (Ashaye and Adeleke, 2009; Salami and Afolayan 2021; Ajala *et al*., 2021). Roselle contains a higher amount of ascorbic acid compared to orange and mango. It also contains a higher amount of vitamin C and small quantity pro-vitamin A. It is rich in riboflavin, calcium and iron. It also contains anti-oxidants which include flavonoids (Omoarukhe *et al* 2023; Villalobus-vega *et al*., 2023). Many parts of Roselle are valuable; its fruits can be prepared and added to fruit salads. In tropical and subtropical regions, they are frequently used for culinary and cosmetic purposes (Emir *et al*., 2023).

In Nigeria, the dried Roselle calyces are prepared into a refreshing drink called “Zobo”. Its preparation involves: boiling the dried calyces in water for eight to ten minutes or until the water becomes brick-red, the brick-red solution is allowed to pass through a sieve and sugar is added to the juice. This is one of the most popular-drinks and inexpensive-beverages commonly consumed (Ashaye *et al* 2008., Ajala *et al* 2021; Hernandez-Nava *et al*., 2023). Nutritionists have found Roselle calyces to be high in calcium, niacin, riboflavin and iron. At present, there are little information about changes in vitamin C, anti-nutritional factors, total carotenoid content and sensory properties of Roselle juice stored at cold refrigerated temperature conditions. Hence, this work is aimed at evaluating the changes in chemical and sensory properties of Roselle juice during cold storage (8 ± 2^0C).

Materials and Methods

Materials

Fresh samples of Roselle calyces, sugar and bottles were all purchased from the local market.

Preparation of Roselle juice

Fresh Roselle calyces of 10 g, 20 g, 30 g, 40 g, and 50 g were weighed separately. Each of them was washed and boiled separately with 100 mL of water for eight minutes. It was sieved to collect

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the extracted juice after which 27 g of sugar was added to each sample for taste. The roselle juice was poured into sterile bottles and kept in the refrigerator at (8 ± 2^0C) for 2 weeks.

Chemical analysis of samples

The following analysis such as pH (AOAC official method 945.10), total soluble solids (AOAC official method 970.59), Titratable acidity (AOAC official method 950.06), specific gravity (AOAC official method 935.18), total carotenoid (AOAC official method 970.59), oxalate (AOAC official method 974.24) and ash (AOAC official method 925.51) were done using A.O.A.C, (2000).

Vitamin C

Ten milliliters (10 mL) of the juice was measured into a 100 mL volumetric flask and was made-up to 100 mL with 3% meta-phosphoric acid solution (0.0033M EDTA). The resulting juice solutions were filtered through a Whatman Filter Paper (of size No.3). Exactly 10 mL of the filtrate was pipetted into a small conical-flask and titrated immediately against the standardized-solution of 2, 6-dichlorophenolindephenol to a faint-pink endpoint. (Kirk and Sawyer, 1991) The ascorbic-acid contained in the juice was calculated using the equation 1.

$$\text{Acid ascorbic} = \frac{V \cdot T}{W} \cdot 100, \ \text{mg/100 g sample} \quad (1)$$

Where, V = mL of 2,6-dichlorophenolindephenol (dye) used for titration of aliquot of diluted sample, T = ascorbic-acid equivalent of dye-solution expressed as milligram (mg) per milliliter (mL) of dye, W = quantity of sample (measured in grams) in titrated-aliquot.

Phytic Acid

The method of Maga, (1982) was used. Two grammes (2 g) of each juice sample were measured into 250 mL conical flask. One hundred milliliters of (100 mL) of 2% (Molar-concentration) hydrogen chloride-acid were added to soak each juice-sample in the conical-flask for 3 hours. This was filtered through a double-layer of hardened filter-paper. About 50 mL of each juice-filtrate was poured into a 250 mL conical-flask and 107 mL distilled-water was added to each sample as

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to get the right acidity. 10 mL of 0.3% (w/v) Ammonium thiocyanate (NH_4SCM) solution was added into each juice-solution described above. This was titrated with the standard solution of ferric-chloride ($FeCl_3$) containing 0.00195g iron per milliliter. A brownish-yellow end-point was obtained which lasted for 5 minutes. The % phytic-acid was determined as shown in equation 2

$$\text{Phytic acid} = \frac{\text{titre value} \cdot 0.00195 \cdot 1.19 \cdot 100 \cdot 3.55}{\text{weight of sample}}, \% \qquad (2)$$

Saponins

The Spectrophotometric method of Brunner, (1984) was used for saponins evaluation. One mL of each juice-sample was measured into a 250 mL Beaker and one hundred mL of iso-butyl alcohol was added. The resulting-mixture was shaken on a UDY shaker (Laboratory devices Inc., Marlborough road, Lancing Business Park Lancing West Sussex England) for 5 hours to ensure uniform mixing Thereafter the resulting-mixture passed through a Whatman filter paper (Size: No.1) into a 100 mL capacity-beaker and 20 mL of 40% (w/v) saturated-solution of maganesium trioxo-carbonate (IV) ($MgCO_3$) was added. The resultant-mixture with saturated $MgCO_3$ was again filtered through a Whatman No1 filter paper to obtain a clear colorless solution. One mL of the colorless solution was pipetted into 50mL volumetric-flask and 2mL of 5% (w/v) ferric-chloride ($FeCl_3$) solution was added and made-up to mark with distilled water. It was allowed to stand for 30min for blood red color to develop. 0-10 ppm standard Saponin solutions were prepared from saponin stock solution (Sigma-Aldrich chemicals St Louis, M063178, USA, CAS No 8047-15-2). The standard solutions were treated similarly with 2 mL of 5% $FeCl_3$ solution as done for 1mL of sample above. The spectrophotometric-absorbance of the samples and that of the standard saponin-solution were taken after color development in a Jenway V6300, Spectrophotometer at a wave-length of 380 nm.

$$\text{Saponins} = \frac{\text{absorbance of sample} \cdot \text{gradinet factor} \cdot \text{dilution factor}}{\text{weight of sample} \cdot 10000}, \% \qquad (3)$$

Tannins

About 0.20 mL of juice sample was measured into a 50 mL beaker, followed by addition of 20 mL of 50% methanol, covered with para-film and was incubated in a water bath at 77-80^{o}C for one hour. It was shaken thoroughly to ensure a uniform mixture. The extract was quantitatively filtered

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through a double-layered Whatman filter paper (of size No. 41) into a 100 mL volumetric-flask, followed by the addition of 20 mL water, 2.5 mL Folin-Dennis' reagent and 10 mL of 17% sodium tri-oxocarbonate (IV), Na_2CO_3 and was thoroughly mixed. The Folin-mixture was made-up to mark with water, and allow to stand for 20min until the formation of bluish –green coloration at the end of the range 0-10 ppm were treated similarly as 1 mL sample above.

The spectrophotometric-absorbance of the Tannic-acid standard solutions together with that of the juice-samples were read after a colour formation on the Spectronic-spectrophotometer (Spectronic- 21D) at a wave-length of 760 nm. The percentage tannins was determined using the formulae stated in Equation 4 (Swain, 1979)

$$\text{Tannin} = \frac{\text{absorbance of sample} \cdot \text{average gradient factor} \cdot \text{dilution factor}}{\text{weight of sample} \cdot 10000}, \% \qquad (4)$$

Sensory evaluation was carried out on the juice samples on the basis of colour, taste, mouthfeel, flavour and general acceptability using the difference method described by Larmond, (1977). Ten panellists composed of male and female adults that are familiar with the product were used. The 9 point scale was used to determine the preference of panellists. Ratings were from (1-9), one corresponding with extreme dislike and nine with extreme likeness.

Statistical analysis of the data was done using Co-Stat Package. The data were subjected to analysis of variance at $P<0.01$ and Duncan Multiple Range Test (DMRT) was used for separation of means in triplicates (Duncan, 1955).

Results and discussion

Table 1 depicts the chemical composition of roselle juice at day zero, one week and two weeks of storage at cold temperature (8 ± 2^0C). At zero day of storage, the titratable acidity, specific gravity, ash, vitamin C and total carotenoid of 50% roselle juice was significantly higher than other roselle juice samples at $p<0.01$ due to higher concentration of roselle juice. The total solids of 40% and 50% roselle juice were not significantly different from each other. The high pH in the juice samples

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may be linked with the presence of naturally occurring organic acids such as malic, citric and oxalic acid. These observed values may inhibit microbial growth (Jiawei *et al.*, 2023).

After one week of storage, titratable acidity of 40% and 50% Roselle juice were not significantly different from each other, however the pH of 50% roselle juice was significantly lower with a value of 3.15. This observation may be due to higher rate of fermentation by microorganisms. Food microorganisms are very active in medium high in fermentable substances such as sugar. Sugar can easily be broken down to acids by these microorganisms. It was also observed that 50% roselle juice was higher in ash (0.061%) and total carotenoid (450.250 µg/100g). The high carotenoid content could mean a good source of pro-vitamin A. It was also seen that the carotenoid content of the juice samples dropped at one week of storage. This may be due to oxidative degradation caused by poor oxygen barrier in the bottle used for packaging (Mariam *et al.*, 2022). The decrease in vitamin C at one week of storage may be due to oxidation by both enzymatic and none enzymatic catalysts in the juice (Mariam *et al.*, 2022).

After two weeks of storage, 50% Roselle juice was significantly higher in titratable acidity (0.073%) and lower in pH (3.6). The higher titratable acidity may be due to the action of polymerase enzymes. These enzymes are responsible for the hydrolysis of complex pectic polysaccharides thereby increasing the release of inherent organic acids such as citric, malic and L-ascorbic-acid. In vitamin C, there was no significant difference in (10%-50%) roselle juice. However reduced values in vitamin C content of the samples may be due to oxidation resulting from the utilization of amino acids, lipids and collagen formation (Ajala *et al* 2021). The carotenoid value of 50% roselle juice was (439.400 µg/100g). The chemical composition values observed at two weeks were negligible when compared with zero day of storage. This result agreed with the finding of Omoarukhe *et al* (2023) who recorded minimal changes in chemical properties of processed citrus segments and juices during storage.

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Table 1. Chemical composition of Roselle juice samples at different storage periods under cold temperature**.**

PARAMETERS	DURATION	10% RJ	20% RJ	30% RJ	40% RJ	50% RJ	CRJ
TTA (%)	WEEK 2	0.048 ± 0.01^{c}	0.056 ± 0.01^{bc}	0.060 ± 0.01^{abc}	0.068 ± 0.01^{ab}	0.073 ± 0.01^{a}	0.056 ± 0.01^{bc}
	WEEK 1	0.061 ± 0.01^{c}	0.069 ± 0.10^{bc}	0.078 ± 0.10^{ab}	0.085 ± 0.10^{a}	0.088 ± 0.10^{a}	0.062 ± 0.01^{c}
	DAY 0	0.069 ± 0.01^{d}	0.075 ± 0.01^{c}	0.086 ± 0.10^{b}	0.089 ± 0.01^{b}	0.097 ± 0.10^{a}	0.066 ± 0.01^{d}
pH	WEEK 2	5.35 ± 0.10^{a}	5.10 ± 1.0^{a}	4.60 ± 0.01^{ab}	4.70 ± 0.01^{ab}	3.60 ± 0.01^{c}	4.10 ± 0.01^{bc}
	WEEK 1	4.30 ± 1.00^{a}	4.05 ± 1.00^{ab}	3.55 ± 0.10^{abc}	3.45 ± 0.10^{bc}	3.150 ± 0.10^{c}	3.95 ± 1.00^{abc}
	DAY 0	3.80 ± 0.10^{b}	3.50 ± 0.01^{c}	3.12 ± 0.01^{d}	2.72 ± 0.00^{e}	2.51 ± 0.00^{e}	4.20 ± 0.10^{a}
S.G.	WEEK 2	5.35 ± 1.0^{a}	5.10 ± 1.0^{a}	4.60 ± 0.5^{ab}	4.70 ± 0.5^{ab}	3.60 ± 0.2^{c}	4.10 ± 0.5^{bc}
	WEEK 1	0.917 ± 0.00^{d}	0.916 ± 0.00^{d}	0.944 ± 0.01^{b}	0.945 ± 0.01^{b}	0.950 ± 1.00^{a}	0.923 ± 0.00^{c}
	DAY 0	0.926 ± 0.00^{d}	0.927 ± 0.01^{d}	0.947 ± 0.01^{c}	0.951 ± 0.01^{b}	0.962 ± 0.01^{a}	0.924 ± 0.00^{e}
TSS	WEEK 2	0.364 ± 0.01^{b}	0.371 ± 0.01^{b}	0.383 ± 0.01^{a}	0.381 ± 0.01^{a}	0.391 ± 0.01^{a}	0.384 ± 0.01^{a}

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	WEEK 1	0.381±0.1^{a}	0.387±0.10^{a}	0.394±0.10^{a}	0.402±1.00^{a}	0.409±1.0^{a}	0.397±0.10^{d}
	DAY 0	0.402±0.00^{cd}	0.407±0.01^{bc}	0.412±0.01^{b}	0.431±0.10^{a}	0.435±0.10^{a}	0.397±0.10^{d}
Ash	WEEK 2	0.050±0.00^{d}	0.051±0.01^{cd}	0.052±0.01^{c}	0.057±0.10^{b}	0.059±0.10^{a}	0.048±0.00^{e}
	WEEK 1	0.051±0.01^{d}	0.052±0.01c^{d}	0.053±0.01^{c}	0.059±0.10^{b}	0.061±0.10^{a}	0.049±0.01^{e}
	DAY 0	0.052±0.01^{e}	0.053±0.01^{d}	0.053±0.01^{c}	0.060±0.01^{b}	0.0620±0.10^{a}	0.051±0.01^{e}
Vit.C (mg/100g	WEEK 2	8.305±1.0^{a}	8.215±1.0^{a}	8.415±1.00^{a}	8.320±1.0^{a}	8.375±1.0^{a}	6.425±0.20^{b}
	WEEK 1	8.475±0.10^{bc}	8.375±0.10^{d}	8.575±1.00^{a}	8.425±0.10^{cd}	8.530±1.00^{ab}	7.300±0.10^{e}
	DAY 0	8.66±1.0^{b}	8.54±0.10^{d}	8.66±1.0^{a}	8.61±1.0^{c}	8.70±1.1^{b}	7.82±0.10^{e}
TCT	WEEK 2	404.9±1.10^{d}	416.2±1.20^{c}	420.2±1.20^{bc}	427.1±1.50^{b}	439.4±1.50^{a}	386.3±1.0^{e}
(µg/100 g)	WEEK 1	415.00±1.0^{d}	427.55±1.00^{c}	429.60±1.10^{c}	440.05±1.10^{b}	450.25±1.10^{a}	4393.00±1.0^{e}
	DAY 0	424.25±1.10^{d}	433.60±1.10^{c}	436.95±1.20^{c}	454.35±1.50^{b}	461.05±1.50^{a}	405.90±1.00^{e}

Means ±SD in the same row with the same letter were not significantly different from each other at $P<0.01$; **Key:** TTA- Titratable Acidity, SG-Specific gravity, TSS-Total soluble solids, Vit. C-Vitamin C, TCT-Total carotenoid content, CRJ-Commercial roselle juice

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Table 2 shows the antinutritional factors of Roselle juice at zero-day, one week and two weeks of cold storage (8 ± 2^0C). Roselle juice of fifty percent concentration (50%) was significantly higher in tannin (0.012%), oxalate (1.210%) and phytate content (1.705%) at $p<0.01$. Commercial Roselle juice was higher in saponin (0.085%).

There was also a concomitant drop in the antinutritional factors at one week. Phytate has a high affinity to bind zinc and lower the ratio of plasma zinc to copper and therefore lowers the risk of cardiovascular diseases. Saponin on the other hand could reduce blood glucose and insulin responses to starchy foods and plasma cholesterol and triglycerides. High saponin may impact a bitter taste oxalate could reduce the risk of cancer at small proportions (Sinela *et al* 2017., Adeboyejo *et al* 2019., Adeboyejo *et al* 2022). Tannins on the other hand are aromatic compounds containing phenolic groups, important in foods for their sensory attributes such as colour, astringency and bitterness. Its astringent property helps in healing wounds and inflamed mucous membranes and can inhibit the formation of superoxide radicals due to its antioxidative property (Babarinde *et al* 2019).

Fifty percent roselle juice was still significantly higher in tannin, oxalate and phytate content.

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Table 2. Anti-nutritional factors of Roselle juice samples at different storage periods under cold temperature

PARAMETERS	DURATION	10% RJ	20% RJ	30% RJ	40% RJ	50% RJ	CRJ
% Saponin	WEEK 2	0.002±0.01^{b}	0.004±0.01^{b}	0.005±0.01^{b}	0.010±0.10^{ab}	0.012±0.10^{ab}	0.025±0.10^{a}
	WEEK 1	0.003±0.01^{b}	0.007±0.01^{b}	0.011±0.01^{b}	0.016±0.10^{b}	0.018±0.10^{b}	0.060±1.0^{a}
	DAY 0	0.008±0.00^{c}	0.012±0.01^{bc}	0.015±0.01^{bc}	0.022 ±0.01^{bc}	0.027±0.10^{b}	0.085±0.10^{a}
% Tannin	WEEK 2	0.005±0.01^{c}	0.009±0.01^{c}	0.011±0.1^{bc}	0.018±0.1^{ab}	0.021±0.10^{a}	0.007±0.1^{c}
	WEEK 1	0.010±0.01^{d}	0.014±0.01^{c}	0.017±0.10^{c}	0.026±0.10^{b}	0.029±0.10^{a}	0.010±0.00^{d}
	DAY 0	0.016±0.00^{e}	0.020±0.01^{d}	0.024±0.01^{c}	0.032±0.01^{b}	0.037±0.01^{a}	0.012 ±0.00^{f}
% Phytate	WEEK 2	0.550±0.10^{e}	0.685±0.10^{d}	0.795±0.10^{c}	0.875±0.10^{b}	0.975±1.00^{a}	0.380±0.00^{f}
	WEEK 1	0.640±0.10^{e}	0.760±0.11^{d}	0.895±0.11^{c}	1.015±1.00^{b}	1.125±1.00^{a}	0.420±0.10^{f}
	DAY 0	0.700±0.01^{d}	0.825 ±0.01^{c}	0.995±0.10^{b}	1.140±0.10^{a}	1.210±0.10^{a}	0.465±0.01^{e}
% Oxalate	WEEK 2	1.155±0.10^{e}	1.235±0.10^{d}	1.390±1.00^{c}	1.455±1.00^{b}	1.525±1.00^{a}	0.595±0.00^{f}
	WEEK 1	1.230±0.1^{e}	1.310±0.10^{d}	1.450±0.10^{c}	1.525±1.00^{b}	1.625±1.00^{a}	0.650±0.00^{f}

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DAY 0	1.310±0.1^{c}	1.395±0.11^{c}	1.525±1.00^{b}	1.605±1.00^{ab}	1.705±1.0^{a}	0.715±0.00^{d}

Means ±SD in the same row with the same letter were not significantly different from each other at P< 0.01. R.J.= Roselle juice, CRJ= Commercial Roselle Juice

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Tables 3 describes the sensory scores for roselle juice stored at cold temperature for zero, one and two weeks. There was a slight increase in taste of roselle juice at one week of storage when it was compared with zero day of storage. This may be due to fermentation by psychrophilic microorganisms. It was also observed that acceptable sensory scores were given to all sensory parameters for 10%, 20% and 30% roselle juice throughout the storage period. Low scores were however given to 40% roselle juice at two weeks of storage. Fifty percent roselle juice was unacceptable at two weeks of storage. This could be due to increased sour taste of the juice. Roselle juice at lower concentration is acceptable and compared favourably with commercial roselle juice

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Table 3. Sensory evaluation of Roselle juice at different storage periods under cold temperature

Attributes	DURATION	**10% RJ**	**20% RJ**	**30% RJ**	**40% RJ**	**50% RJ**	**CRJ**
Colour	WEEK 2	7.1±1.00^{a}	6.9±1.00^{a}	6.2±0.20^{b}	6.1±0.20^{b}	6.0±0.20^{b}	7.6±1.00^{a}
	WEEK 1	7.3±1.00^{ab}	8.7±1.00^{a}	6.9±1.00^{b}	6.6±1.00^{b}	6.7±1.00^{b}	6.0±1.00^{b}
	DAY 0	7.0±1.00^{b}	6.9±1.00^{b}	6.1±1.00^{c}	5.9 ±0.10^{cd}	5.3 ±0.10^{d}	8.0±1.00^{a}
Taste	WEEK 2	7.4±1.00^{a}`	7.3±1.00^{a}	6.0±1.00^{b}	5.7±0.20^{b}	5.6±0.20^{b}	8.0±1.00^{a}
	WEEK 1	7.4±1.00^{b}	8.9± 1.01^{a}	7.0±1.00^{b}	6.9±1.00^{b}	6.5±1.00^{b}	7.4±1.00^{b}
	DAY 0	7.6± 1.00^{a}	6.9±1.00^{a}	4.9±0.10^{b}	4.9±0.10^{b}	3.9±0.10^{b}	7.7±1.00^{a}
Mouth Feel	WEEK 2	6.0±0.20^{b}	6.0±0.20^{b}	4.7±0.10^{c}	4.6±0.10^{c}	3.6±0.10^{d}	7.1±1.00^{a}
	WEEK 1	7.3±1.00^{b}	8.5±1.10^{a}	6.5±0.20^{c}	6.6±0.20^{c}	6.5±0.20^{c}	7.2±1.00^{bc}
	DAY 0	6.3±1.00^{ab}	6.5±1.00^{a}	4.8±0.20^{bc}	4.5±0.20^{c}	3.3 ±0.10^{c}	7.1±1.00^{a}
Flavour	WEEK 2	6.8±1.00^{ab}	6.6±1.00^{b}	5.2±0.20^{c}	4.4±0.20^{cd}	3.5±0.10^{d}	7.6±1.00^{a}

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	WEEK 1	6.9±1.00^{bc}	8.4±1.01^{a}	6.5±1.00^{bc}	6.4±1.00^{bc}	6.3±0.30^{c}	7.1±1.00^{b}
	DAY 0	6.9±1.00^{b}	6.7±1.00^{b}	5.7±1.00^{c}	5.1±1.00^{c}	4.4±0.20^{d}	7.7±1.01^{a}
General	WEEK 2	6.6±1.00^{b}	6.7±1.00^{b}	5.5±1.00^{c}	5.0±01.00^{c}	4.1±0.20^{d}	8.2±1.10^{c}
Acceptability	WEEK 1	7.0±1.00^{b}	8.8±1.10^{a}	6.6±0.20^{bc}	6.0±0.20^{bc}	5.6±0.10^{c}	7.5±1.00^{ab}
	DAY 0	7.2±1.00^{b}	6.6±1.00^{a}	5.6±0.20^{c}	5.1±0.20^{c}	4.4±0.10^{d}	8.3±1.00^{a}

Means ±SD in the same row with the same letter were not significantly different from each other at $P<0.01$; R.J.= Roselle juice, CRJ= commercial Roselle juice

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Conclusions

Generally, fifty percent (50%) roselle juice at 0 day was significantly higher than other roselle juice in titratable acidity (0.097%), specific gravity (0.962%), ash (0.062%), Vitamin C, (8.700 mg/100 g), total carotenoid content (461.05 µg/100 g), tannin (0.037%) and oxalate (1.705%). There was a decrease in some chemical properties and antinutritional factors with increase in storage time. In sensory attributes and nutritional quality, roselle juices from 10%-30% were preferred. However, fifty percent roselle juice received lower sensory scores after two weeks of storage. It can be inferred that roselle juice at 10%-30% concentration kept under cold temperature (8 ± 2^0C) will still maintain its aesthetic appeal at two weeks unlike higher roselle juice concentration. This information will stand as a guide, especially for roselle processors at culinary level. It will help them to plan vis- a-vis in their production and marketing strategies for maximum profitability and reduced post-harvest losses.

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