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Effect of Storage on the Quality Attributes of Concentrates of Two Mango (*Mangifera indica*) Varieties Grown in Sudan

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Authors' contributions

This work was carried out in collaboration between all authors. Author AOKE designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript and managed literature searches. Authors AEAMN and AEOE managed the analyses of the study and literature searches. All authors read and approved the final manuscript.

Original Research Article

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ABSTRACT

Aims: To produce concentrates at remote areas of production, where fruits are expected to be cheaper and hence compete with imported concentrates.
Study Design: Factorial Experimental design.
Place and Duration of Study: Department of Food Science and Technology, Faculty of Agriculture, University of Khartoum, Sudan and Food Research Center, Shambat, Sudan, between September 2009 and May 2010
Methodology: Two mango (*Mangifera indica*) varieties Abu Samaka and Baladi were used to produce concentrate and the concentrate was stored at ambient temperature and a refrigerator at 4ºC for 6 months. The concentrates were prepared by using open kettle boiler (100ºC) and they were packed in cans using double seam machine.
Results: The Baladi variety gave higher total soluble solids (TSS) than Abu Samaka. Abu Samaka exhibited an excellent percentage (29.7%) of total sugars during storage and the total titrable acidity of mango concentrate in the two varieties reported a slightly increase. The reducing sugars increased gradually with storage time. The two varieties showed

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retention of ascorbic acid content during storage. There was no growth of *E. coli*, yeast and molds in the concentrates of the two varieties tell the end of the storage period (6 months). The concentrates from the two varieties at both temperatures were acceptable by the panelists.
Conclusion: The two varieties showed suitability in processing to give mango concentrate.

Keywords: Mango concentrate; storage period; quality attributes; sensory attributes.

1. INTRODUCTION

The mango (*Mangifera indica* L.) fruits belong to the family *Anacardiaceae*, the origin of mango is Indo – Burma and Thailand region; India leads the worldwide production [1]. UNEP [2] reported that mango is perishable fruit grown widely in the Sudan. Mangoes are available in small quantities almost throughout the year and their peaks of production extend from May to September. In Sudan there are more than 30 varieties and the Baladi variety is the most abundant. In Abu Jebeha and Rashad (in Southern Kordofan state in the Sudan) there are about 3.000.000 trees. The non common varieties that cover most production areas are Alphonso, Abu Samaka, Galbatour and White Zebda [3].

Mango is an excellent source of vitamin A and C. It is rich source of beta carotene which is precursor of vitamin A. Vitamin A is essential nutrient required for normal growth, vision and immune health, knowing that low fat diet rich in fruits and vegetable may reduce the risk of cancer [4]. Sudanese mango chemical composition reported as follows: 79 kcal food energy, 79.7 % moisture, 18.6% of total carbohydrates, 1.2 % protein, 0.0 % fat, 0.4 % crude fiber, 0.5 ash. Ash contains 50 mg/100g Ca, 2.6 mg/100g iron and 2 mg/100g phosphorus [5].

Mangoes are processed at two stages of maturity. Green fruit is used in chutney, pickles, curries and dehydrated products. The green fruit should be freshly picked from the tree. Ripe mangoes are processed as canned and frozen slices, puree, juices, nectar and vacuum dried product for home use and cottage industry [6]. In the developing countries especially in Africa, Asia and the Middle East, where the food is short in supply and the refrigeration facilities are limited or do not exist, dried, concentrated and dehydrated foods would be the most likely method of preservation of foods.

The conventional method to prevent the spoilage of mango pulp is the applying a heat treatment to the fruit juices during manufacturing and by the natural low pH of the juices [7]. Spoilage of fruit juices and fruit juice products by thermophilic bacteria has become a major concern as spoilage cases of acidic vegetables, fruit juices and fruit juice products *Alicyclobacillus* spp. has been reported [8]. Most of these spoilage bacteria has the fatty acids as the major components of the cellular membrane, and they can be grown at 40-60ºC [9]. Apart from this spoilage bacterial group some of the other microbial populations were also present in the mango fruit juices, and they must be protecting the fruit juices from the spoilage microbial population.

In addition, to its food value, the mango has also been used for medicinal values, in Samoa, a brake infusion has been a traditional remedy for mouth infection in children and also mango stone is useful as substitute for maize in finishing broiler diets. The Kernel is also used for medicinal purposes in moderation of anti- bacterial and anti- fungal activities [10].

In the Sudan, mango concentrates are imported from Asian countries, they are imported in cans or barrels for further processing. Mango canneries are located in Khartoum State where mango fruits are expensive. The objective of this project is to produce concentrates at remote areas of production, where fruits are expected to be cheaper and hence compete with imported concentrates.

2. MATERIALS AND METHODS

2.1 Plant Material

Two mango varieties, namely, Baladi, known also as Kitchener, and Abu Samaka which are commonly cultivated and consumed in Sudan, were chosen in this study. Twenty five samples from each variety were obtained from Abu Jebeha, purchased from the local market of Khartoum State. Only fully ripe and sound fruits sample were selected. These fruits were cleaned and kept refrigerated prior to further treatment and analysis.

2.2 Physical Properties of Mango Fruits

The percentage of peel, stone and mango pulp were calculated as mentioned by Saeed and Khattab [11].

2.3 Preparation of the Mango Pulp

Mango fruits were first weighed, sorted, graded and then thoroughly washed under running water. Cleaned fruits were peeled, sliced by a sharp clean stainless steel knife. The slices were pulped using an electric blender; and the weight of the peel, stone and pulp was recorded.

2.4 Processing of Mango Pulp Concentrate

The processing was carried out in The Food Research Centre (FRC), Khartoum North, Sudan. Mango pulp was concentrated at atmospheric pressure in open steam jacketed kettle (Modele: OSK 1602). Its capacity was about 60 liters, heated surface area was 0.1964 m^2 and its evaporation rate was 0.143 k / min.

The pan was heated by steam pressure (1kg f/ cm). The concentration time was recorded when the concentration of mango pulp reached 22 Brix for the Baladi variety and 17 Brix for Abu Samaka variety. A 0.3 gm of sodium metabisuphite was added per 1kg pulp to preserve the product. The concentrate was filled hot in a clean sterilized No. 9 lacquered tin plate cans, they were cleaned and sterilized. The cans were sealed using a double seam machine.

The filled cans were divided into two groups; some were stored at room temperature and the others in refrigerator 4ºC for 6 months, cans were then drawn after every two months for further analysis and assessment of cans condition and the quality of the product.

2.5 Chemical Analysis

The total soluble solids and refractive index were measured at 20ºC using an Abbe refractometer (Model 1T) according to AOAC [12]. Total titratable acidity was determined

according to Nielsen [13] expressed as citric acid percentage. The pH values were measured using a Consort Model P107 pH meter. Ascorbic acid was determined using the 2, 6-dichlorophenol indophenol dye titration method described by AOAC [12]. Total sugars and reducing sugars were determined by the method described in AOAC [12].

2.5.1 Determination of non-enzymatic browning

Two grams of mango concentrate were placed in a 250 ml volumetric flask containing 100 ml of 50 % ethanol solution. The flask was then covered with a paraffin film and was left at room temperature for 24 hours with occasional shaking. The solution was then filtered through Whatman No. 2 filter paper.

The optical density was determined using colorimeter (Analyser-9) at 445 nm wavelength using 0.5 cm diameter tube, the differences between the optical density of the sample before and after storage was considered as a measure of the degree of browning during storage [14].

2.6 Microbial Load Determination: Total Viable Count

Total viable count was carried out using the pour plate count method described by compendium of methods for the microbial examination of foods [15]. One ml of aliquots from suitable dilution was transferred aseptically into sterile Petri dishes to each dilution 10- 15 ml melted and cooled 42ºC plate count agar was added. The inoculums were mixed with media and allowed to solidify; the plate was then incubated at 37ºC for 48 hours. A Quebec colony counter (Model 3045-00, Reichert Instruments GmbH, Seefeld, Germany) was used for viable bacteria.

2.6.1 Yeast and mold enumeration

Yeasts were enumerated by surface plating on malt extract agar (Oxoid) with 0.01% chloramphenicol as bacterial inhibitor and incubated aerobically at 25ºC for 2-3 days [15]

2.6.2 Enumeration of total spore forming bacteria

From suitable dilution of sample, 0.1 gm cholraphenicol per one liter of medium to inhibit bacteria growth on samples was spread all over the plate using sterile bent glass rod. Plates were then incubated at 25-28ºC for 48 hours as described by APHA [15]. Colony results were presented as CFU/g. The colony count method to determine the total spore forming bacteria was followed as described by APHA [15]. A test tube of suitable dilution was heated in water bath at 80ºC for 10 minutes. The tube was cooled and 0.1 ml from this dilution was aseptically transferred into sterile Petri dishes. To each plate melted starch milk agar was added. The inoculums were mixed with medium and allowed to solidify. The plates were incubated at 37ºC for 2 days.

2.6.3 Total coliform bacteria

One ml from the first three dilutions was inoculated in tubes. The tubes were incubated at 37ºC for 48 hours; the most probable number was then recorded [15].

2.7 Organoleptic Evaluation

Organoleptic evaluation was done for mango concentrate, using the Hedonic Scoring Test method [16]. Ten panelists from the students of the Faculty of Agriculture, University of Khartoum, Sudan; were provided with coded mango concentrate samples in plastic cups and were asked to evaluate: color, flavor, taste and over all acceptability.

2.8 Statistical Analysis

Factorial experimental design was used. The results were subjected to statistical analysis using the Statistical Package for Social Science (SPSS), triplicate samples were analyzed for each determination and the figures were then averaged using the analysis of variance program (ANOVA). A probability of 5% was used to indicate the differences between the samples according to Duncan Multiple Range Test (DMRT) [17].

3. RESULTS AND DISCUSSION

3.1 Physical and Chemical Properties of the Two Mango Varieties

Table 1 shows the percent of peel, stone and pulp of mango varieties in relation to the whole fruit weight. The results are similar to those reported by Saeed and Khattab [11]. Abu Samaka had higher pulp content (60%) less peel weight (14.8%); while Baladi variety had a quite high stone weight (41.9%).

Table 1. Relative weight of stone, peel and pulp of the mango varieties

Varieties	Peel %	Stone %	Pulp %
Abu Samaka	14.8(±0.28)^{b}	10.9(±0.08)^{b}	60.0(±0.05)^{a}
Baladi	16.8(±0.50)^{a}	41.9(±0.21)^{a}	41.3(±0.35)^{b}

Values are means of three replicates (n=3) ± SD. Means in a column not sharing a common superscript letter are significantly (P = .05) different as assessed by Duncan's Multiple Range Test (DMRT)

3.2 Effect of Storage Time on Physicochemical Properties of Mango Concentrate

Total sugars, reducing sugars and total soluble solids are of high content after 6 months. There is a slight decrease in ascorbic acid at the end of storage period (Table 2). The pH value increased after two months of storage this agree with results obtained by Mustafa [18]. Total acidity decreased after two months, then it increased during the remaining period of storage, this could be due to partial hydrolysis of organic acid [18].

The total sugars of Abu Samaka concentrate stored in the refrigerator decreased after 2 months but it increased after six months, to a higher level 29.7% compared to Baladi 24.6%. This could be due to inversion of sucrose to glucose and fructose sugar during storage time. The same variety when it stored at room temperature showed a decrease in total sugars after two months of storage but an increase after four months was observed (Table 3).

Table 2. Changes in chemical composition of mango concentrate during storage at refrigerator (4ºC)

Variety/ Storage time (month)	Total sugars (%)	Reducing sugars (%)	Total soluble solids (Birx)	Titrable acidity (mg/100g)	pH	Non -enzymatic browning (OD)	Ascorbic acid (mg/100g)
Abu Samka 0	15.83(±0.11)^{d}	8.75(±0.01)^{d}	14.83(±0.28)^{c}	0.89(±0.05)^{a}	2.61(±0.10)^{b}	0.05(±0.00)^{d}	25.13(±0.15)^{c}
Abu Samka 2	12.22(±0.02)^{d}	10.64(±0.00)^{c}	16.83(±0.28)^{c}	0.05(±0.00)^{d}	4.56(±0.00)^{a}	0.22(±0.00)^{c}	23.03(±0.01)^{d}
Abu Samka 4	16.83(±0.03)^{d}	10.12(±0.01)^{c}	18.50(±0.50)^{c}	0.44(±0.01)^{b}	1.84(±0.00)^{d}	1.25(±0.03)^{a}	22.33(±0.17)^{c}
Abu Samka 6	29.70(±0.00)^{a}	14.12(±0.00)^{b}	19.00(±0.00)^{b}	0.44(±0.00)^{b}	2.56(±0.00)^{c}	1.27(±0.00)^{d}	22.03(±0.01)^{c}
Baladi 0	19.30(±0.11)^{b}	9.69(±0.10)^{d}	21.83(±0.28)^{a}	1.34(±0.02)^{a}	2.02(±0.00)^{c}	0.28(±0.00)^{c}	38.42(±0.15)^{a}
Baladi 2	23.76(±0.03)^{a}	16.68(±0.28)^{a}	22.90(±0.17)^{a}	0.06(±0.04)^{d}	4.46(±0.00)^{a}	0.20(±0.35)^{c}	38.24(±0.00)^{a}
Baladi 4	23.34(±0.35)^{a}	11.46(±0.05)c	22.90(±0.28)^{ab}	0.23(±0.00)^{c}	1.85(±0.00)^{d}	1.49(±0.27)^{a}	27.23(±0.13)^{b}
Baladi 6	24.66(±0.10)^{a}	9.143(±0.00)^{d}	23.83(±0.28)^{a}	0.30(±0.00)^{b}	2.56(±0.00)^{b}	1.52(±0.00)^{b}	27.16(±0.16)^{b}

Values are means of three replicates (n=3) ± SD. Means in a column (of the same variety) not sharing a common superscript letter are significantly (P=.05) different as assessed by Duncan's Multiple Range Test (DMRT)

Table 3. Changes in chemical composition of mango concentrate during storage at room temperature (35ºC)

Variety/ Storage time (month)	Total sugars (%)	Reducing sugars (%)	Total soluble solids (Birx)	Titrable acidity (mg/100g)	pH	Non -enzymatic browning (OD)	Ascorbic acid (mg/100g)
Abu Samka 0	15.83(±0.10)^{d}	8.71(±0.00)^{d}	14.83(±0.28)^{c}	0.89(±0.01)^{a}	2.65(±0.00)^{b}	0.05(±0.00)^{d}	25.13(±0.00)^{c}
Abu Samka 2	12.64(±0.23)^{d}	11.53(±0.18)^{c}	16.83(±0.28)^{c}	0.33(±0.05)^{b}	4.03(±0.00)^{a}	0.88(±0.05)^{b}	19.38(±0.26)^{d}
Abu Samka 4	19.53(±1.50)^{b}	11.16(±0.15)^{c}	18.83(±0.28)^{c}	0.03(±0.03)^{d}	1.92(±0.03)^{d}	1.74(±0.01)^{a}	19.30(±0.00)^{d}
Abu Samka 6	20.2(±0.52)^{b}	17.30(±0.03)^{a}	20.00(±0.00)^{a}	0.23(±0.05)^{c}	3.14(±0.00)^{a}	1.75(±0.00)^{d}	18.08(±0.00)^{d}
Baladi 0	19.30(±0.00)^{b}	9.65(±0.00)^{d}	21.5(±0.50)^{a}	1.34(±0.00)^{a}	2.02(±0.00)^{c}	0.28(±0.00)^{c}	38.42(±0.01)^{a}
Baladi 2	25.10(±0.00)^{a}	18.20(±0.00)^{a}	23.33(±0.57)^{a}	0.05(±0.01)^{d}	4.21(±0.00)^{a}	0.44(±0.00)^{b}	38.19(±0.17)^{a}
Baladi 4	18.34(±0.00)^{c}	14.23(±0.02)^{b}	23.50(±0.50)^{a}	0.04(±0.01)^{d}	1.92(±0.00)^{d}	1.22(±0.00)^{a}	38.01(±0.01)^{a}
Baladi 6	25.76(±0.05)^{a}	23.83(±0.02)^{a}	23.00(±0.28)^{a}	0.25(±0.11)^{c}	3.15(±0.00)^{a}	1.28(±0.03)^{c}	27.75(±0.32)^{b}

Values are means of three replicates (n=3) ± SD. Means in a column (of the same variety) not sharing a common superscript letter are significantly (P=.05) different as assessed by Duncan's Multiple Range Test (DMRT)

The reducing sugars content of the two varieties under investigation stored in the refrigerator increased after two months of storage and decreased then after (Table 2). Reducing sugars of Abu Samaka stored at room temperature increased gradually with storage periods; while Baladi is fluctuated during storage periods (Table 3). The total soluble solids increased during the storage period at both temperatures for the concentrate of the two varieties; Abu Samaka reported 19% TSS at the end of storage, while Baladi 23% TSS when stored in the refrigerator. This can be attributed to the hydrolysis of some insoluble solids during storage [19].

Changes in the acidity of mango concentrate of the two varieties, Abu Samaka and Baladi stored in refrigerator and room temperatures are shown in Tables 2 and 3. The results obtained showed slightly decrease during storage after 2 months and slightly increase after 4 and 6 months periods. This could be due to production of organic acids during storage [14]. The pH of the concentrate of the two varieties fluctuates during the storage period in the two temperatures (Tables 2 and 3). This result is agreed with results obtained by Mustafa [18].

Abu samaka and Baladi concentrates stored in the refrigerator reported a gradual increase in the non enzymatic browning (Table 2). For the same varieties stored at room temperature non enzymatic browning increased gradually after 6 months (Table 3) that's due to effect of storage temperature [20].

Abu Samaka and Baladi concentrates stored in the refrigerator and room temperature showed a slight decrease in the ascorbic acid content (Table 2 and 3), results also indicated that Abu Samaka had an excellent retention of ascorbic acid during storage in refrigerator temperature, while Baladi had an excellent retention of ascorbic acid during storage at room temperature as reported by Saeed and Khattab [11] and Purushottam et al. [21].

3.3 Microbial Load of the Two Mango Concentrate During Storage

It was found that the total viable count was nil at zero time of storage and started to increase after 2 months (Table 4). The growth of spore forming bacteria was nil at zero time but during the storage period it was less than the normal level; that is may be due to the heat treatment and subsequently, the possible reduction in water activity this result agree with that obtained by Mustafa [18]. The growth of spore forming bacteria for the variety Abu Samaka at refrigerator reported nil count at zero time, while it was less than the normal level during the six months of storage (Table 5). Abu Samaka has good attributes than Baladi when tested for microbial growth during the processing of mango concentrate. The yeasts and molds and E. coli, were reported nil count during storage.

3.4 Sensory Evaluation of Mango Concentrate

Tables 6 and 7 show the sensory evaluation of the mango concentrate stored at the different temperatures. There is a gradual decrease in the flavor, color, taste and acceptability of the two concentrates during the storage period in the refrigerator and at room temperature.

Abd Elrahman [22] reported that there are no changes in TSS, pH, viscosity and acidity of mango concentrate stored for six months, while there are slightly increase in reducing and total sugars in the mango concentrate, similar results were also reported by Tripath et al. [23]. Mango concentrate can be stored for periods ranging from one month to one year [21]. The storage temperature ranges from below zero to as high as 27ºC. The rate of

deterioration varies with each product; but in general is inversely proportional to storage temperature [24]. The changes in mango concentrate canned in good vacuum cans and in bottles, stored at 37ºC. After eight weeks, there was a slight reduction in ascorbic acid in the products packed in the bottles compared to canned product. The product acquired acceptable taste and flavor in the both containers [21].

Table 4. Total viable count (CFU/g) during storage time at different storage temperature of mango concentrates

Storage temperature	Varieties	0 Time	2 Months	4 Months	6 months
Refrigerator (4ºC)	Abu Samaka	- ve	2.54(±0.00)^{c}	2.73(±0.03)^{c}	3.73(±0.05)^{b}
	Baladi	0.07 (±0.01)^{d}	2.63(±0.00)^{c}	2.90(±0.02)^{c}	3.81(±0.01)^{b}
Room temperature (35ºC)	Abu Samaka	- ve	2.72(±0.05)^{c}	3.82(±0.00)^{b}	4.44(±0.50)^{a}
	Baladi	- ve	2.81(±0.07)^{c}	3.88(±0.00)^{b}	4.46(±0.00)^{a}

Values are means of three replicates (n=3) ± SD. Means in each raw not sharing a common superscript letter are significantly (P=.05) different as assessed by Duncan's Multiple Range Test (DMRT)

Table 5. Growth of spore forming bacteria (CFU/g) during storage time at different storage temperature of mango concentrates

Storage temperature	Varieties	0 Time	2 Months	4 Months	6 months
Refrigerator (4ºC)	Abu Samaka	- ve	- ve	2.64(±0.03)^{c}	2.93(±0.05)^{b}
	Baladi	- ve	2.64(±0.05)^{c}	2.80(±0.02)^{b}	3.77(±0.05)^{a}
Room temperature (35ºC)	Abu Samaka	- ve	2.54(±0.00)^{c}	2.93(±0.00)^{b}	4.66(±0.05)^{a}
	Baladi	- ve	2.27(±0.00)^{c}	3.62(±0.05)^{b}	3.84(±0.05)^{a}

Values are means of three replicates (n=3) ± SD. Means in each raw not sharing a common superscript letter are significantly (P=.05) different as assessed by Duncan's Multiple Range Test (DMRT)

Table 6. Sensory evaluation scores of mango concentrate during storage periods at refrigerator

Varieties	Storage periods	Flavor	Color	Taste	Acceptability
Abu Samka	Zero time	46.35(±1.15)^{a}	43.65 (±0.58)^{a}	41.05(±2.08)^{c}	36.65 (±0.53)^{a}
	2 month	44.65 (±0.11)^{b}	42.35 (±1.19)^{b}	40.65 (±0.03)^{c}	35.05 (±1.04)^{a}
	4 month	44.65 (±0.58)^{b}	40.05 (±1.53)^{a}	39.35 (±0.02)^{c}	34.05 (±0.04)^{b}
	6 month	43.65 (±1.00)^{b}	38.65 (±1.00)^{d}	37.35 (±0.04)^{d}	25.05 (±0.02)^{d}
Baldi	Zero time	46.65 (±0.84)^{a}	43.65 (±1.00)^{a}	47.65 (±0.03)^{a}	37.65 (±0.06)^{a}
	2 month	42.6(±2.79)^{b}	42.6(±1.17)^{b}	46.6(±0.30)^{a}	36.3(±0.04)^{a}
	4 month	38.0(±0.58)^{c}	42.0(±2.10)^{b}	45.3(±0.06)^{b}	35.0(±0.30)^{c}
	6 month	37.0(±0.84)^{d}	41.66(±1.14)^{c}	45.0(±0.05)^{b}	30.0(±0.06)^{d}

Values are means of three replicates (n=3) ± SD. Means in each raw not sharing a common superscript letter are significantly (P=.05) different as assessed by Duncan's Multiple Range Test (DMRT)

Table 7. Sensory evaluation scores of mango concentrate during storage periods at room temperature

Varieties	Storage periods	Flavor	Color	Taste	Acceptability
Abu Samka	Zero time	46.3(±0.84)[a]	43.6(±0.58)[a]	41.3(±0.04)[c]	37.3(±0.04)[a]
	2 month	39.6(±1.83)[b]	39.6(±0.58)[c]	40.6(±0.05)[c]	32.3(±0.03)[c]
	4 month	36.6(±1.03)[c]	35.6(±0.58)[d]	39.6(±0.04)[d]	29.6(±0.00)[d]
	6 month	35.0(±3.08)[d]	34.0(±0.52)[d]	37.0(±0.04)[d]	27.3(±0.03)[a]
Baldi	Zero time	46.3(±0.84)[a]	43.0(±1.55)[a]	46.6(±0.06)[a]	37.0(±0.05)[c]
	2 month	40.0(±0.63)[b]	41.0(±2.61)[b]	43.3(±0.15)[b]	33.3(±0.06)[c]
	4 month	36.6(±0.52)[c]	33.0(±2.25)[d]	35.0(±0.03)[c]	30.6(±0.05)[c]
	6 month	31.6(±2.16)[d]	32.0(±0.00)[d]	32.0(±0.04)[d]	30.0(±0.05)[d]

Values are means of three replicates (n=3) ± SD. Means in a column (of the same variety) not sharing a common superscript letter are significantly (P=.05) different as assessed by Duncan's Multiple Range Test (DMRT)

4. CONCLUSION

Mango varieties showed suitability for processing to give mango concentrate due to their low microbial load. For the two varieties there is retention of ascorbic acid content during the storage period. The sensory evaluations showed excellent results and gradually decrease during the storage period. As Baladi variety had low pulp content and developed a brown color during storage period and had more TSS than Abu Samaka; therefore, Abu Samaka variety is suitable for processing. As the concentrates which stored at refrigerator showed an excellent attributes than that which stored at room temperature; therefore, refrigerator is suitable for storage of the mango concentrate for up to six months.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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