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# Suitability of Local Sudanese Guava (*Psidium guajava* L.) Cultivars for concentrates production

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**ABSTRACT**

This study was conducted to investigate the suitability of white and red pulp guava fruits grown in Sudan for production of concentrates. The two cultivars were processed to concentrates by evaporation under normal atmospheric pressure. The two concentrates were evaluated physicochemically against an Indian commercial concentrate control. White pulp guava is characterized by high level of vitamin C (250 mg/100g), and similar levels of sugars compared to the red pulp guava. The pulping process significantly ($P \leq 0.05$) reduced the levels of vitamin C and sugars. Concentration of the juice to 17.00 and 19.00% total soluble solids in white and red guavas, respectively, resulted in further loss in vitamin C (134.9; 125.4 mg/100g, respectively), and increase in total sugars from 3.17 to 15.32% in the white one, and from 3.34 to 16.14% in the red one

***Keywords:*** *white and red guava, concentrate, processing characteristics.*


## INTRODUCTION

The guava tree (*Psidium guajava* L.) which belongs to the family Myrtaceae is considered as one of the most important tropical fruit trees in the world, enriching the diet of hundreds of millions of people with its special characteristic odour and high nutritive value (Morton, 1987; El- Bulk, 1997). In India, guava is known as ‘a poor man apple’ because of its high nutritional value and low price (Poovaiah, 1988). However, the tree is widely distributed in all warm areas of tropical America, Africa and Asia since 1526 (Morton, 1987; Krishna and HariBabu, 2002). In Sudan, guava fruit is considered as one of the most popular and major fruits of the country coming after dates, citrus, mango and banana. The most popular guava cultivars are the pear and apple shaped fruit types which may be either with pink or white pulp. Both types are easily grown in any part of the country with high productivity (7.0 tons/feddan) and could be harvested 2-3 times in one year. The chemical and physical properties of both red and white guava were studied by Ali . (2013).

The whole fruit is edible, from seeds to rind, but many people choose to remove the middle part that contains hard seeds embedded in the surrounding pulp. The pulp is sweetest and most delicious in the center, with the outer layer being sour and gritty like young pears, while the peel (fruit) is sour in taste but richest in phytochemicals ((Jiménez-Escrig, 2001). In fact, the raw guava fruits have a short shelf-life and highly perishable at room temperature or under arid ambient conditions. Therefore, the ripe fruits are usually eaten fresh or otherwise should be processed into juice, jam, concentrate or other similar products (Salunkhe and Desai, 1984). However, increase guava production and consumption as fresh or in a product form could effectively improve not only guava farmers’ income, but also, the industries that based on guava concentrate especially that large quantities of guava concentrates are now improted from outside the country.

The aim of this study was to study the suitability of local Sudanese guava cultivars for production of guava concentrate with high nutritional value and good processing qualities.

## MATERIALS AND METHODS

Guava fruit (*Psidium guajava* L.) of white and red pulp were obtained from Alkadaro (Khartoum North) and Aljeraf farms, respectively

Tin containers (No. 3) used in packaging fruit concentrates were kindly donated by Abu Eltayeb Factory (Khartoum North, Sudan).

### *Sampling of the fruits*

The guava fruits were washed, sorted and some were graded, and stored (8± 3° C) until needed for physical and chemical analyses. The fully rippened fruits were immediately manufactured into guava concentrate, packed into tin containers and stored at room temperature (25±5° C) until needed for testing.

### *Chemical attributes of the fruits*

The moisture , ash , protein , crude fiber, sugars and mineral content in the raw materials were estimated according to the method of the Association of Official Analytical Chemists ( AOAC, 1990), while ascorbic acid content was determined as described by pearson (1976).

### *Processing of guava to concentrates*

The cleaned graded guava fruits were weighed and manually peeled and sliced. Then the fruits were blanched and the juice was extracted using a fruit pulpier (MDX-207823-HR, Reeves, U.S.A). The juice obtained from each sample (red and white pulp) was transfered in a steam jacketed kettle, 50 liter capacity (No. 1044-19-66, Gebrs-H.J Scheffers), heated to 100° C for 30 min, 20 min for red and white juice, respectively until the total soluble solid (T.S.S) reached 17 Brix for the white sample and 19Brix for the red one. Then the steam was put off. Sodium benzaoate (ATE) (CDH, England) at 0.05% was immediately added as a preservative. Finally, the concentrates of the two samples were kept in clean tin containers, tightly closed, heated in water to (100° C) for 30 min., cooled (30± 3° C) and stored at room temperature (25± 5° C) until used for analysis.

### *Physicochemical attributes of guava pulp and concentrate*

The total soluble solids ( T.s.s ) and the pH of guava pulp and guava concentrates were measured following the method of the Association of Official Analytical chemists (AOAC, 1990 ) while the titrable acidity , the non – enzymatic browning were determined according to Ranganna (2001 )

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## RESULTS AND DISCUSSION

The physicochemical features of guava fruit pulp are shown in Table1. Significant ($P \leq 0.05$) differences were observed in the total soluble solids (TSS) for white and red pulp (5.00 and 5.50%), respectively. These values are lower compared to those obtained by Pagano . (2000) who reported 13.82 Brix in guava pulp. Muralikrishna . (1969) reported an increase in Brix during processing, which indicates that concentration is accompanied by release of sugars and acids from maltodextrin. Sabato . (2009) reported that the TSS of mango fruits are usually associated with metabolism and are significantly ($P \leq 0.05$) affected by the ripening process, therefore, dependent on maturity stage of the fruit.

The pH and acidity values (4.26, 4.20), (0.20, 0.28%) show insignificant differences between the white and red, respectively. However, a study in fresh guava pulp by Pagano . (2000) gave values of acidity and pH as 2.48 and 4.10, respectively, which showed significant variation in acidity compared to the value obtained in the study.

Pagano . (2000) reported higher total and reducing sugars values in guava pulp (11.00 and 5.70%), respectively compared to the values obtained in this study, 3.17 and 2.31% for the white pulp and 3.34 and 2.72% for the red pulp, respectively.

Table 1. Physico-chemical features of guava fruit pulp

| Constituent | Guava fruit pulp | | $Lsd_{0.05}$ | SE± |
|---|---|---|---|---|
| | White | Red | | |
| Total soluble solids (° Brix) | $5.00±1.06^{a}$ | $5.50±1.05^{b}$ | $0.4528^{*}$ | 0.0524 |
| pH | $4.26±1.05^{a}$ | $4.20±0.67^{a}$ | $0.0677^{ns}$ | 0.0345 |
| Acidity (%) | $0.20±0.00^{a}$ | $0.28±0.00^{a}$ | $0.0753^{ns}$ | 0.0026 |
| Total sugars (%) | $3.17±1.03^{b}$ | $3.34±1.03^{a}$ | $0.1568^{*}$ | 0.0196 |
| Reducing sugars (%) | $2.31±1.02^{b}$ | $2.72±1.03^{a}$ | $0.4098^{*}$ | 0.0588 |
| Non-reducing sugars (%) | $0.85±0.00^{a}$ | $0.62±0.00^{b}$ | $0.2155^{*}$ | 0.0241 |
| Ascorbic acid (mg/100 g) | $200.12±5.74^{a}$ | $142.51±4.51^{b}$ | $56.8451^{*}$ | 6.5121 |
| Non-enzymatic browning | $0.154±0.01^{a}$ | $0.261±0.01^{a}$ | $0.3207^{ns}$ | 0.3378 |

Mean±S.D value(s) bearing same superscript letter(s) within each row are insignificantly (P≤0.05) different., n.s = insignificant; * = significant at P≤0.05

The results of ascorbic acid level indicated significant (P≤0.05) difference between the white and red pulp (200.12, 142.51 mg/100g), respectively. The values of ascorbic acid in the pulp were lower compared to the values of ascorbic acid in the fruits before the processing which reflected the effect of heating and processing on level of ascorbic acid. El Faki and saeed (1975)found that, the maximum content of ascorbic acid has been determined by several workers and found to be influenced by variety, season and location of fruits. Askar . (1992) reported that, processing of guava juice at higher temperatures for a longer time showed loss in ascorbic acid content from 30.00-60.00%. Pagano . (1998) recorded ascorbic acid in some guava pulp as 3.05 mg/100 gm, which is very low compared to the values in this study. Vikram . (2005) pointedout that, both heating method and temperature have significant (P≤0.05) effect on the destruction of vitamin C in fruit juice.

Data regarding non-enzymatic browning indicated significant (P≤0.05) differences between the two pulps (0.154, 0.261) for white and red pulp, respectively. The browning in white variety was higher compared to the red one, therefore, the transmission of light was lower. Bayindirli, (1995) reported that, when clean apple juices were heated at 70-80 or 90° C for 30-180 minutes, the browning of juice dependant on the soluble solids content as well as on the temperature and time.

The physicochemical features of white and red guava concentrates are presented in Table (2). The T.S.S varied significantly (P≤0.05) in the two concentrates (17.00, 19.00) white and red, respectively, the T.S.S were higher than the pulps, mainly due to thermal process that reduce water content (Khan, 1987) as well as variation between the concentrates is due to pectin concentration in the fruit (Bose ., 1999 and Jiménez-Escrig, ., 2001). Results of pH-measurements and acidity values showed insignificant (P≤0.05) differences (4.60, 4.53); (0.30, 0.30) for white and red concentrates, respectively. In term of ascorbic acid, significant (P≤0.05) differences were observed between the two concentrates (134.90, 124.0 mg/100g) for the white and red guava concentrates, respectively. It is worth mentioning that there was degradation in vitamin C of white and red juices during processing to concentrate. Imungi . (1980) pointed that, increasing exposure time elevates yield but also causes a reduction in ascorbic acid content of guava juice due to oxidation. Pasteurization at 80° C for 27 sec. resulted in a loss of 2.6% of the ascorbic acid content in black current nectar (Inversen, 1999), while Vikram . (2005) found that, the degradation of vitamin C in orange juice was influenced by the method of heating and process temperature. Regarding to total, reducing and non-reducing sugars showed significant (P≤0.05) differences, the red concentrate recorded 16.14% total sugar and 10.95% reducing sugars, while the white one lower values (15.32%) total sugars and (9.09%) reducing sugars. However, the values of both total and reducing sugars in the two concentrates were higher compared to the values of the juices, which is due to the thermal process that increases the T.S.S of the juices. Khan(1987) and Sabato . (2009) justified that the variation in sugar content between different guava varieties mainly due to the thermal process that reduced water content, onto the physiological changes and polysaccharides metabolism during ripening process that contribute to accumulation of sugars The observation about non-enzymatic browning indicated that insignificant (P≤0.05) differences between white and red concentrates (0.13, 0.14), respectively. O'Beirne (1986).

Table 2. Physico-chemical properties of white and red pulp guava concentrates

| Parameter | Guava concentrate | | $Lsd_{0.05}$ | SE± |
|---|---|---|---|---|
| | White | Red | | |
| T.S.S (%) | $17.00±1.38^{b}$ | $19.00±2.09^{a}$ | $1.7253^{*}$ | 0.063 |
| pH-value | $4.60±0.07^{a}$ | $4.53±0.06^{a}$ | $0.036^{n.s}$ | 0.009 |
| Acidity (%) | $0.30±0.01^{a}$ | $0.30±0.01^{a}$ | $0.007^{n.s}$ | 0.001 |
| Ascorbic acid (mg/100gm) | $134.90±0.03^{a}$ | $125.40±0.01^{b}$ | $8.541^{**}$ | 0.064 |
| Total sugars (%) | $15.32±0.01^{b}$ | $16.14±0.07^{a}$ | $1.539^{*}$ | 0.009 |
| Reducing sugars (%) | $9.09±0.02^{b}$ | $10.95±0.05^{a}$ | $1.632^{*}$ | 0.087 |
| Non-reducing sugars (%) | $6.23±0.04^{a}$ | $5.19±0.03^{b}$ | $0.854^{*}$ | 0.065 |
| Non-enzymatic browning | $0.13±0.00^{a}$ | $0.14±0.00^{a}$ | $0.008^{n.s}$ | 0.002 |

Mean±S.D value(s) bearing same superscript letter(s) within each row are insignificantly (P≤0.05) different.
n.s = insignificant;
* = significant at P≤0.05
** = highly significant at P≤0.01

Table 3. shows the physicochemical features of white and red guava concentrates compared to a commercial guava concentrate. The T.S.S varied significantly (P≤0.05) in the three concentrates (17.00, 19.00, 20.00) for the white, red and the commercial concentrates, respectively. The highest value was recorded by the commercial concentrate followed by the red and then white concentrate (Bose ., 1999 and Jiménez-Escrig ., 2001) found that the variation among the concentrates in T.S.S is due to the pectin concentration in the fruit. The pH measurements and acidity values of the three concentrates indicated significant (P≤0.05) differences in pH values (4.60, 4.53, 4.24) for the white, red and commercial concentrates, respectively, whereas the acidity showed insignificant (P≤0.05) differences among the three concentrates. Regarding to ascorbic acid, the three concentrates showed significant (P≤0.05) differences as well as the white one recorded 134.090 mg/100g, followed by red 125.40 mg/100g and the lowest value recorded by the commercial concentrate 111.43 mg/100g. Vikram . (2005) found that the degradation of vitamin C in orange juice was influenced by the method of heating and process temperature. Significant (P≤0.05) differences were observed among the three concentrates in sugars, the commercial concentrate contains the maximum amount of total and reducing sugars (17.26 and 16.87%), respectively, followed by the red one (16.14 and 10.95%), then the white concentrate (15.32, 9.09%) for total and reducing sugars, respectively.

Noor . (2011) indicated the variation in total and reducing sugars of three mango cultivars processed to jam, the total sugar were 57.14, 66.13%, and 68.80% for Abusamaka, Gulbaltour and Magloba, respectively, whereas reducing sugars were 21.94, 32.33 and 33.62% for the three varieties, respectively.

With regard to non-enzymatic browning, the imported concentrate was significantly (P≤0.05) lower in browning compared to 0.33 the white and red concentrates the transmission of light translate the browning in the concentrate, the higher value means higher transmission and so lower browing. O'Beirne (1986) justified the browning in concentrate of Bramlay's seedling apple juice to high rates of Millard browning reaction.

Table 3. Physico-chemical properties of white and red pulp guava concentrates compared to the commercial one

| Parameter | Guava concentrate | | | $Lsd_{0.05}$ | SE± |
|---|---|---|---|---|---|
| | White pulp | Red pulp | Commercial*** | | |
| T.S.S (%) | 17.00±1.00$^c$ | 19.00±1.01$^b$ | 20.00±1.03$^a$ | 1.083* | 0.061 |
| pH-value | 4.60±0.07$^a$ | 4.53±0.06$^b$ | 4.24±0.07$^c$ | 0.047* | 0.013 |
| Acidity (mg/100gm) | 0.30±0.01$^a$ | 0.30±0.01$^a$ | 0.40±0.01$^a$ | 0.153$^{n.s}$ | 0.001 |
| Ascorbic acid (mg/100gm) | 134.90±0.03$^a$ | 125.40±0.01$^b$ | 111.43±0.03$^c$ | 6.891** | 0.021 |
| Total sugars (%) | 15.32±0.02$^c$ | 16.14±0.04$^b$ | 17.26±0.01$^a$ | 0.765* | 0.038 |
| Reducing sugars (%) | 9.09±0.03$^c$ | 10.95±0.04$^b$ | 16.87±0.07$^a$ | 1.842** | 0.056 |
| Non-reducing sugars (%) | 6.23±0.05$^a$ | 5.19±0.04$^b$ | 0.39±0.01$^c$ | 0.731* | 0.023 |
| Non-enzymatic browning | 0.13±0.00$^b$ | 0.14±0.00$^b$ | 0.33±0.00$^a$ | 0.012* | 0.016 |

Mean±S.D value(s) bearing same superscript letter(s) within rows are differ significantly (P≤0.05).
n.s = insignificant;
* = significant at P≤0.05
** = highly significant at P≤0.01
*** Source Premier Food Products

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