International Journal of Advanced Research in Biological Sciences
ISSN: 2348-8069
www.ijarbs.com
DOI: 10.22192/ijarbs Coden: IJARQG(USA) Volume 4, Issue 1 - 2017

Research Article

DOI: http://dx.doi.org/10.22192/ijarbs.2017.04.01.020

Chemical and Sensory Characteristics of Jam and Nectar Processed from some Sudanese Guava Genotypes

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Abstract

This research is justified by the need of using different Guava genotypes, in the region of Singa and Khartoum city for the processing of jam and nectar. The experiments were conducted during 2009/10 and 2010/11. Selection of Guava genotypes was based on high yield and good fruit quality, that recognized by Guava growers and field survey. In the present study, various genotypes of guava fruits from Khartoum and Singa city were used in jam and nectar processing and evaluate their chemical analysis (pH, total soluble solids, total acidity and vitamin C) as well as the sensory analysis. The total soluble solids of jam that processed from both genotypes were in the range 66.8-68.8 brix. The acidity and pH of jam that processed from Singa and Khartoum were in the range of 19.6 – 23.9 and 3.3 – 5.0, respectively. Nectar-Vitamin C of both genotypes of Singa and Khartoum was in the range 12.0 – 197.3 mg\100g, while the total soluble solids were 1.8 – 5.4. Depend on the results of chemical and sensory analysis; it can be made of jam and nectar from these selected guava genotypes. Most panelists preferred the jam made using genotype Singa 2 and nectar processed form genotype Singa 4. Also most panelists preferred the jam processed from the genotypes Khartoum 3 and nectar processed from genotype Khartoum 7.

Keywords: Guava genotypes, fruit quality, acidity, TDS, vitamin C.

1. Introduction

Guava (*Psidium guajava* L.) has some importance in international trade and domestic economy of several countries in warmed climates due to its easy cultivation under variable soils and climates and its high vitamin C (Menzel, 1985). Guava can be successfully grown under tropical and subtropical climates (Layer and Kurian, 2006). In the Sudan Guava is grown successfully in the areas of Singa, Kassala, Abujebaeha, Rahad, Nile River and Jailli in Khartoum State and there are no authentic statistic information on areas and production amounts are available (Bedri, 1978; Abdelaziz *et al*., 2016). There are many clones of guava that are famous in the world. In Sudan, guava is generally propagated from seeds. Seedlings are variable in both plant and fruit characteristics, because heterozygosity. There are four genotypes of guava namely: Shendi (White pulp), Pakistani (White pulp), Gunib (Red pulp) and Singa (White pulp). Six thousand hectare produces 112000 tons annually are noted. Production per hectare area is estimated to be around 10-17 tons annually (Gassamalla *et al*., 2008). There are no released guava cultivars for jam and nectar processing in Sudan. This study aims to select superior guava trees for jam and nectar processing. This research study is a part of research project financed by the Ministry of higher Education and Scientific Research- Sudan, the project aiming at evaluation of selected guava genotypes grown in Khartoum and Singa city to the processing, accordingly a number of genotypes belong to the main groups of Singa and Khartoum were selected to evaluate the chemical analysis and sensory properties.

2. Materials and Methods

2.1 Materials

Guava fruits were collected from Khartoum and Singa City, in (2009/10 and 2010/11), Republic of Sudan, after harvesting on a several days and then transported to the Food Engineering and Technology laboratory in University of Gezira, Gezira State, Republic of Sudan.

2.2 Processing of guava jam

The jams and nectar were prepared at the Food Engineering and Technology Laboratory of the University of Gezira, Wad Medani, Sudan, following the Good Manufacturing Practices. A fully mature Guava fruits were peeled and sliced using a fruit and vegetable cutter machine (KG 40. Nihon Conk CO. LTD., Japan) after discarding the seeds. The slices were blanched. Guava puree was obtained by passing the blanched slices through narrow orifices of pulpier (PPT-180. Seikensha Co. LTD. Japan). Then total soluble solids (TSS) and pH of the puree were measured (Azhari *et al*., 2011). Addition of pectin to the jam was done according to the method used by Saeed and Elmubarak, (1974). Boiling is desirable in order to cause intimate mixing of the fruit pulp and the sugar and to partially concentrate the product by evaporation of excess moisture. Aluminum open-kettle was used. An abbe refractometer was used to determine the finishing point (68% soluble solids). Hot jam was poured in glass jars, tightly closed without delay, put upside down, and cooled.

2.3 Processing of Nectar

The various selected genotypes of Guava were used as the raw material. Fresh fruits were first processed into concentrated juice in the laboratory of Food Engineering and Technology, University of Gezira, Wad Medani, Sudan, for the production of pasteurized nectar. In order to monitor the process, 17 steps of nectar processing were identified and defined which resulted with a total of all samples for analysis, each with 5 independent replicates. Samples were snap frozen in liquid nitrogen and ground to a fine powder. These were subsequently transported on dry ice, where the samples were stored at −80 °C until analysis. All samples were then freeze dried at −80 °C, b1 mP pressure for 20 h using a freeze-dryer (Snijders Scientific, LY-5FM).

2.4 Chemical analysis

All chemical analysis was performed in triplicate, with results expressed as mean ± standard deviation. The following analysis were performed according to regulations of the AOAC (1998): pH using a digital pH meter, total soluble solids (°Brix) by refractometry using a ABBE refractometer, water activity (Aw) using Aw Sprint - Novasina TH-500 equipment, acidity (% citric acid) with solution NaOH (0.1M), ash by muffle, moisture by drying kiln.

2.5 Sensory analysis

Jam and nectar products were subjected to sensory evaluation using 10 panelists. The panelists were asked to assess each sample for texture, flavor, appearance, color, and over all acceptability using a questionnaire designed by the Department of Food Engineering and Technology, Faculty of Engineering and Technology, University of Gezira, Wad Medani, Sudan. A sensory acceptance test, 9-point Hedonic Scale Test, permitted the comparative evaluation of both formulations with regard to the aspects of appearance, aroma, flavor and texture. The scale ranged from 1-dislike extremely to 9-extremely like.

2.6 Statistical analysis

All experiments were conducted at least in triplicate and statistical analyses were performed using SPSS version 16.0 software for Windows (SPSS Inc., Chicago, IL, USA). One-way analysis of variance (ANOVA) was used to determine significant differences between means and Tukey's test was used to perform multiple comparisons between means. The significance level was defined as $p<0.05$.

3. Results and Discussion

3.1 Chemical analysis of jam

As shown in Table 1 and 2, the results of the acidity, TSS and pH of Singa and Khartoum genotypes jams were reported. The acidity of Singa genotypes was 22.6, 19.6, 23.9, 21.3, 22.2, 20.2 and 20.7 for Singa genotypes (Singa 1 to Singa 7), respectively, while was 21.3, 20.5, 21.3, 20.1, 20.9, 23.5, 19.6 and 20.9

for Khartoum genotypes (Khartoum 1 to Khartoum 8), respectively. The total soluble solid of Singa genotypes jam were in the range of 66.4 to 68.2 brix, while for Khartoum genotypes in the range of 66.8 to 68.2 brix (Table 1 and 2). The results of TSS of both genotypes was similar to that obtained by Fox and Cameron (1982) who pointed out that in Great Britain jam must contain not less than 68.5% soluble solids unless packed in hermetically sealed containers in which case, it must contain not less than 65%. The TSS of both genotypes also was found to be in the range to that obtained by Ahmed (2002) who recorded 66 brix for the total soluble solids of pectin jam extracted from grapefruit.

Table 1. Chemical analysis of jam processed from various genotypes of Guava from Singa state.

Samples	Acidity	TSS (brix)	pH
Singa 1	22.6 ±0.15	66.8 ±0.32	3.3 ±0.14
Singa 2	19.6 ±0.16	67.6 ±0.17	3.4 ±0.34
Singa 3	23.9 ±0.22	67.6 ±0.31	3.3 ±0.16
Singa 4	21.3 ±0.14	66.8 ±0.16	3.5 ±0.10
Singa 5	22.2 ±0.16	66.4 ±0.18	3.4 ±0.10
Singa 6	20.2 ±0.19	67.9 ±0.18	3.5 ±0.16
Singa 7	20.7 ±0.15	68.2 ±0.11	3.5 ±0.14

Table 2. Chemical analysis of jam processed from various genotypes of Guava from Khartoum state.

Samples	Acidity	TSS (brix)	pH
Khartoum 1	21.3 ±0.11	67.8 ±0.33	3.3 ±0.16
Khartoum 2	20.5 ±0.13	67.2 ±0.16	3.4 ±0.32
Khartoum 3	21.3 ±0.21	67.2 ±0.33	3.8 ±0.13
Khartoum 4	20.1 ±0.15	67.3 ±0.13	5.0 ±0.14
Khartoum 5	20.9 ±0.15	67.8 ±0.13	3.5 ±0.14
Khartoum 6	23.5 ±0.15	68.1 ±0.13	3.3 ±0.14
Khartoum 7	19.6 ±0.19	68.2 ±0.15	3.4 ±0.17
Khartoum 8	20.9 ±0.19	66.8 ±0.15	3.5 ±0.17

The pH of Singa genotypes jam was 3.3, 3.4, 3.3, 3.5, 3.4, 3.5 and 3.5 for Singa 1, Singa 2, Singa 3, Singa 4, Singa 5, Singa 6 and Singa 7, respectively (Table 1). These results are mainley similar to those required for quality control of jam. Saeed and Elmubarak (1974) stated that the pH of jam should be kept in the range of 3.2 to 3.4. On the other hand, the pH of Khartoum 3.3, 3.4, 3.8, 5.0, 3.5, 3.3, 3.4 and 3.5 for Khartoum 1, Khartoum 2, Khartoum 3, Khartoum 4, Khartoum 5, Khartoum 6, Khartoum 7 and Khartoum 8, respectively (Table 2). The results obtained in this study mainley fall within the range reported by Herschdoerfer (1972) who pointed out that the normal pH range is 3.1-3.2 with extreme values of 3.0 to 3.4.

3.2 Chemical analysis of nectar

As illustrated in Table 3 and 4, the results of vitamin C, acidity, TSS and pH of Singa and Khartoum genotypes nectar were recorded. Vitamin C content of Singa genotypes was 68.7, 42.0, 39.3, 21.3, 31.1, 30.0 and 38.7 mg/100g for Singa 1, Singa 2, Singa 3, Singa 4, Singa 5, Singa 6 and Singa 7, respectively (Table 3), while was 81.6, 28.3, 32.5, 12.0, 93.3, 197.3, 125.3 and 77.3 mg/100g for Khartoum 1, Khartoum 2, Khartoum 3, Khartoum 4, Khartoum 5, Khartoum 6, Khartoum 7 and Khartoum 8, respectively (Table 4). These results were more than those obtained by Ahmed (1999) who recorded a range of 0.03 – 0.04 mg/100g ascorbic acid for grapefruit pectin jam and orange pectin jam, respectively. Regular consumption of fruit is associated with reduced risks of cancer, cardiovascular disease, stroke, alzheimer disease, cataracts and some of the functional declines associated with aging (Sackman, 2005).

The acidity of Singa genotypes was 5.8, 13.2, 11.7, 13.3, 3.5, 19.0 and 18.6 for Singa genotypes (Singa 1 to Singa 7), respectively (Table 3), while was 10.7, 7.9, 18.1, 17.5, 10.5, 13.7, 11.1 and 13.0 for Khartoum genotypes (Khartoum 1 to Khartoum 8), respectively (Table 4). These results are similar to that obtained by Ibnoof, (2007). The TSS of Singa genotypes nectar were in the range of 1.8 to 5.4 brix, while for

Khartoum genotypes in the range of 2.4 to 4.4 brix. The pH of Singa genotypes nectar were in the range of 4.0 to 5.2, while for Khartoum genotypes in the range of 3.4 to 5.3 (Table 3 and 4). These results were within the range required for nectar manufacture. Buchanan and Durward (2006) reported that the resulting low pH value of nectar inhibits the growth of food spoiling bacteria, most of which are acid sensitive; in addition, other bacteria cannot successfully grow like *Staphylococci*, *Salmonella* and *E. coli*.

Generally, the chemical composition of nectar varieties and is shown to be variable even in the same variety depending upon locality and other environmental factors (Joslyn, 1970).

Table 3. Chemical analysis of nectar processed from various genotypes of Guava from Singa state.

Samples	Vit. C (mg/100g)	Acidity	TSS(brix)	pH
Singa 1	68.7 ±0.12	05.8 ±0.13	4.1 ±0.31	4.5 ±0.13
Singa 2	42.0 ±0.17	13.2 ±0.12	5.4 ±0.15	5.1 ±0.31
Singa 3	39.3 ±0.41	11.7 ±0.22	3.4 ±0.32	5.2 ±0.16
Singa 4	21.3 ±0.13	13.3 ±0.25	2.7 ±0.14	5.2 ±0.11
Singa 5	31.1 ±0.11	03.5 ±0.14	3.9 ±0.10	4.7 ±0.15
Singa 6	30.0 ±0.13	19.0 ±0.19	2.9 ±0.10	4.9 ±0.13
Singa 7	38.7 ±0.18	18.6 ±0.13	1.8 ±0.13	4.0 ±0.18

Table 4. Chemical analysis of nectar processed from various genotypes of Guava from Khartoum state.

Samples	Vit. C (mg/100g)	Acidity	TSS(brix)	pH
Khartoum 1	81.6 ±0.12	10.7 ±0.10	3.9 ±0.31	5.3 ±0.13
Khartoum 2	28.3 ±0.11	7.9 ±0.11	2.4 ±0.15	4.6 ±0.31
Khartoum 3	32.5 ±0.20	18.1 ±0.24	4.4 ±0.31	5.1 ±0.14
Khartoum 4	12.0 ±0.14	17.5 ±0.13	2.4 ±0.12	3.4 ±0.12
Khartoum 5	93.3 ±0.12	10.5 ±0.12	3.4 ±0.15	5.0 ±0.13
Khartoum 6	197.3 ±0.11	13.7 ±0.15	2.3 ±0.17	4.9 ±0.11
Khartoum 7	125.3 ±0.13	11.1 ±0.16	3.9 ±0.11	4.9 ±0.14
Khartoum 8	77.3 ±0.18	13.0 ±0.19	3.9 ±0.10	5.1 ±0.17

3.3 Sensory evaluation of jam and nectar of Singa genotypes

With respect to the sensory evaluation of the jam and nectar produced from guava of Singa City, the appearance, texture, color, flavor and overall acceptability are shown in Table 5 and 6. Sensory evaluation is carried out by the senses of taste, smell, touch, and hearing when food is eaten. The complex sensation that results from the interaction of the senses is used to measure food quality in programs for quality control and new product development (Abdelaziz *et al*., 2016).

As shown in Table 5, the results of sensory analysis of jam processed from Singa genotypes were recorded. The results indicated that panelists preferred the jam proceed from the control and the other samples in all sensory parameters, however there are no significance differences (p<0.005) between the genotypes Singa 1, Singa 2 and Singa 3 compared with the control in all the sensory characteristics evaluated. Thus, Singa 2 genotype has been selected for jam processing due to its good quality.

Most panelists preferred the nectar made using Singa genotypes more than the control due to its appealing appearance, texture, acceptable color and overall acceptability. Therefore, Singa 4 was found to be the best one to due to the quality (Table 6).

Table 5. Mean score for sensory attributes of jam processed from various genotypes of Guava from Singa State.

Sample	Appearance	Texture	Color	Flavor	Overall acceptability
Control	7.6 a	7.7 a	7.6 a	8.2 a	7.8 a
Singa 1	6.8 a	6.6 a	7.2 a	7.0 ab	7.2 ab
Singa 2	7.1 a	7.0 a	7.0 a	7.0 ab	7.1 ab
Singa 3	7.0 a	6.6 a	6.7 a	6.7 b	7.1 ab
Singa 4	6.7 a	6.8 a	7.0 a	7.0 ab	6.9 ab
Singa 5	4.4 b	4.4 b	4.6 b	4.6 c	4.2 c
Singa 6	6.8 a	6.8 a	6.7 a	6.7 b	6.6 ab
Singa 7	6.7 a	6.8 a	6.1 a	6.1 b	6.2 b

Table 6. Mean score for sensory attributes of nectar processed from various genotypes of Guava from Singa State.

Sample	Appearance	Texture	Color	Flavor	Overall acceptability
Control	5.6 c	4.7 b	4.3 d	6.2 bc	5.3 bc
Singa 1	6.7 b	6.7 a	6.8 b	7.2 ab	7.1 a
Singa 2	7.0 ab	7.4 a	7.2 b	6.8 ab	6.8 a
Singa 3	6.4 ab	6.8 a	6.5 bc	5.1 c	6.6 ab
Singa 4	7.5 a	7.1 a	8.4 a	7.6 a	8.0 a
Singa 5	6.8 ab	6.7 a	6.9 b	6.7 ab	6.8 a
Singa 6	6.2 b	7.0 a	4.5 d	3.1 d	4.7 c
Singa 7	6.5 ab	6.9 a	5.8 c	5.5 c	5.3 c

3.4 Sensory evaluation of jam and nectar of Khartoum genotypes

The results of the taste panel of jam and nectar products are shown in Table 7 and 8. The results of sensory analysis for jam processed from Khartoum City genotypes showed that the control sample was preferred overall the other samples. There are no significance differences (*p*<0.005) between the jam processed from Khartoum 3, Khartoum 7 genotypes and the control in texture and overall acceptability (Table 7). Khartoum 3 has been chosen for jam processing.

As shown in Table 8, the sensory analysis of nectar processed from Khartoum genotypes was recorded. Genotype Khartoum 7 has been preferred more than the control in all the sensory parameters.

Table 7. Mean score for sensory attributes of jam processed from various genotypes of Guava from Khartoum City.

Sample	Appearance	Texture	Color	Flavor	Overall acceptability
Control	8.2 a	8.0 a	8.1 a	8.4 a	7.9 a
Khartoum 1	7.2 b	6.8 b	7.1 b	6.7 b	7.2 ab
Khartoum 2	7.3 b	7.1 ab	7.5 ab	6.9 b	7.0 bc
Khartoum 3	7.3 b	7.4 ab	7.1 b	7.1 b	7.2 ab
Khartoum 4	7.3 b	7.3 ab	7.6 ab	6.9 b	7.2 ab
Khartoum 5	7.1 b	7.1 ab	7.1 b	6.1 b	6.7 bc
Khartoum 6	7.6 ab	7.4 ab	7.8 ab	7.0 b	7.1 b
Khartoum 7	7.6 ab	7.3 ab	7.6 ab	6.8 b	7.1 b
Khartoum 8	7.1 b	6.9 b	7.2 b	6.4 b	6.3 c

Table 8. Mean score for sensory attributes of nectar processed from various genotypes of Guava from Khartoum City.

Sample	Appearance	Texture	Color	Flavor	Overall acceptability
Control	5.6 bc	5.8 b	5.8 b	5.2 def	4.9 c
Khartoum 1	6.7 ab	7.3 a	7.3 a	6.1 bcd	6.2 ab
Khartoum 2	5.4 bc	4.7 c	4.7 c	5.4 cde	4.8 c
Khartoum 3	6.7 ab	7.7 a	7.7 a	4.7 ef	5.2 bc
Khartoum 4	4.5 c	4.5 c	4.5 c	6.3 abcd	5.1 bc
Khartoum 5	6.0 ab	6.8 ab	6.0 a	6.6 abc	6.3 ab
Khartoum 6	6.5 ab	6.2 b	6.6 a	7.0 ab	6.7 a
Khartoum 7	6.4 ab	7.6 a	6.0 a	7.4 a	7.0 a
Khartoum 8	7.0 a	7.6 a	6.8 a	4.1 f	5.3 bc

Conclusion

Depend on the chemical and sensory analysis; it can be made of jam and nectar from these genotypes of guava. Genotype Singa 2 was superior for jam, while Singa 4 was superior for nectar processing. Genotype Khartoum 3 was superior for jam, while Khartoum 7 was superior for nectar processing.

Acknowledgments

The authors thank the Ministry of Higher Education and Scientific Research, The Republic of Sudan for the financial support. We would like also to thank everybody helped us to complete this research work.

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Quick Response Code	Subject: Agricultural Sciences
DOI:10.22192/ijarbs.2017.04.01.020	

How to cite this article:

Mohammed H. Mekki, Azhari Siddeeg, Ali E. El Jack, Ali O. Ali. (2017). Chemical and Sensory Characteristics of Jam and Nectar Processed from some Sudanese Guava Genotypes. Int. J. Adv. Res. Biol. Sci. 4(1): 181-187.

DOI: http://dx.doi.org/10.22192/ijarbs.2017.04.01.020