EPRA International Journal of Agriculture and Rural Economic Research (ARER)- Peer-Reviewed Journal
Volume: 9 | Issue: 3| March 2021 | Journal DOI: 10.36713/epra0813| Impact Factor SJIF (2021) : 7.604| ISSN: 2321 - 7847

PREPARATION AND QUALITY EVALUATION OF BAOBAB FRUITS PULP AND PINEAPPLE BLENDED JAM

Osei-Agyeman Millicent[1]
[1]Vocational/Technical Department, St. Monica's College of Education, Box 250, Mampong Ashanti –Ghana

Kate Bigson[2]
[2]Department of Hotel, Catering and Institutional Management, Wa Technical University, Upper West Region-Ghana

Veronica Akwaah[3]
[3]Vocational/Technical Department, St. Monica's College of Education, Box 250, Mampong Ashanti –Ghana

ABSTRACT

Quality jam from blends of pineapple and baobab pulp was produced and appraised. This study was undertaken to investigate the possibility of producing jam from pineapple and baobab fruits pulp and to assess the nutritional compositions and consumer acceptability of the product. Three different jam samples were produced in a ratio of 100:00, 60:40 and 50:50. Sample ABC served as control and contained 100% pineapple, BCD 60% pineapple and 40% baobab fruits pulp and EFG 50% pineapple and 50% baobab fruits pulp. Proximate analysis and consumer acceptability of the jam samples were determined. The results of the proximate analysis of the jam blends showed nutrient values of moisture 53.67- 61.31%, ash 1.02-1.06%, fat 0.04 - 0.10 %, protein 0.90- 1.33% and carbohydrate 36.84- 44.22%. The results of sensory analysis of the jam samples showed significant ($p \leq 0.05$) differences in colour, aroma, taste, spreadability and overall acceptability of the jam. Statistical evaluation using Analysis of Variance (ANOVA) and Tukey Test were used to determine the significant difference among the various samples in duplicates. Some assessors, however, scored jam made of 60% pineapple and 30% baobab fruits pulp high for flavour and spreadability.

KEY WORDS: *Pineapple, watermelon, apple, jam, composite ingredients, proximate composition*

1. INTRODUCTION

Jam is a shelf stable food made from fruit mash, pectin and sugar which are cooked to form a gel. Fresh or mushy fruit like pineapple, pawpaw, orange, Apple, banana and mango or blends of these fruits are generally used [1]. Jams are thick and sweet spreads made by cooking the cubed or grated fruits with sugar making it firmer when cooked [2]. Jam making is a way of preserving fruits and used when fruits are out of season.

Pineapple is a tropical fruit which can be eaten raw, juiced or canned [3]. Pineapple is a good source of dietary fiber, loaded with vitamins C, manganese and minerals [3]. Pineapple can be used in the preparation of juices, drinks, fruit cream, puddings, weaning foods, yogurt, stewed fruits and jam. Pineapple can also be used in cosmetic applications to produce moisturizer and soothing product, anti-aging as well as hair colouring product [4]. Pineapple fruit contains some amount of sugar, gelatin and acid. Nevertheless, the amount and proportion present is not adequate for an effective gel formation and therefore requires other ingredients blend to achieve good result [5].

Pineapple has high nutritional benefits and a good source of vitamin C, Potassium and fiber. It contains 85.4% water, 52 Kcal/mg energy, 0.4% protein, 0.2% fat and 13.7% starch. The mineral elements are calcium 18 mg, phosphorus 8 mg, iron 0.5 mg and vitamin contents are vitamin B 15, thiamine 0.08 mg, riboflavin 0.04 mg, nicotinic acid 0.2 mg and ascorbic acid 61 mg [6].

Baobab (*Adansonia digitata L.)* is a versatile tree type belonging to the *Malvacea* family [7]. It is used as food for mankind and animals as well as traditional medicine to treat intestinal sickness, tuberculosis, fever, constipation, iron deficiency, diarrhea and toothache [8]; [9]; [10]. [11], reported that with an average of 8.7% water, the mash contains about 74% carbohydrates, 3% proteins, 9% fibre, 6% ash and 0.2% fat. The constituent of gelatin is roughly 56% [12]. This is the reason the mash is used as a base for jam. Baobab fruit pulp can be used to prepare frozen yogurt, drinks, thickeners for sauces and soups. Few scientific examinations have been performed by [13] on anti-diarrheic properties; showing its calming, pain relieving and temperature diminishing properties.

A composite jam is a blend of two or more fruits such as mango, pawpaw, and pineapple which improve the nutritive content of the final product. This study was therefore undertaken to produce and evaluate the consumer acceptability of pineapple and baobab fruits pulp jam.

2. MATERIALS AND METHODS

2.1 Source of Raw Material

Baobab fruits (*Adansonia digitata L.)* were collected from the bush in the northern part of Ghana. Other ingredients such as pineapple, sugar, and lemon were purchased from Kumasi central market.

2.2 Sample Preparation

Samples of Pineapple were thoroughly washed under running tap water to reduce soil, plant and debris load. Pineapples were peeled and grated with a manual stainless steel grater. Unblemished baobab fruits with no indications of visible discoloration were selected for the jam. The baobab fruits were cracked and pounded using mortar and pestle and the crude mixture pulp and seeds were sifted through an 800-micron sieve. The various samples obtained from the pineapple and baobab fruits pulp was packaged separately, sealed and stored at 5 °C for the jam.

2.3 Sample Formulation

Three different jam samples were produced in a ratio, 100:00, 60:40 and 50:50. Sample ABC served as control and contained 100% pineapple. Samples BCD 60% pineapple, 40% baobab fruits pulp and sample EFG 50% pineapple, 50% baobab fruits pulp.

Table 1: Formulation of ingredients for Jam making

INGREDIENTS	ABC	BCD	EFG
Pineapple (g)	100	60	50
Baobab fruits pulp (g)	0	40	50
Sugar (g)	100	100	100
Lemon (ml)	10	10	10
Water (ml)	500	500	500
Ginger (Grated)	1Tsp	1Tsp	1Tsp

Sample ABC (control- 100% pineapple), BCD (60% pineapple, 40% baobab fruits pulp) and EFG (50% pineapple, 50% baobab fruits pulp)

2.4 Method of preparation

Fortified jam was prepared using the method described by [14] with minor modifications. The fruits were washed twice with potable water and wiped with a clean dish cloth. Fruits were then cut and peeled manually with a knife while wearing non-medicated gloves. (100g) of pineapple was grated using stainless steel grater. Sugar (100g) and lime juice (10ml) were added to each of the pulps. The mixture was left at room temperature for 15 minutes and subsequently cooked slowly with infrequent stirring for 15 minutes. The jam was poured into a sterilized bottle and allowed to cool at a room temperature (290^0C-320^0C) for further analysis.

2.5 Proximate composition

The jam samples were assessed to determine their nutritional quality. The parameters determined according to standard methods [15] were moisture content, ash, protein, fat and carbohydrates

2.5.1 Moisture content and total solids: Oven Drying Method

Five grams (5g) of the sample was transferred to the previously dried and weighed dish. The Dish was placed in an oven and thermostatically controlled at 105 degrees for 5 hours. Dish was removed and placed in a desiccator to cool to room temperature and weighed. It was then dried again for 30 minutes, cooled down again and weighed. Drying, cooling and weighing were repeated until a constant weight was reached. (Alternatively, sample could be dried in a thermostatically controlled oven for at least 8 hours where a constant weight would be achieved). The determinations were duplicated and the average found [16].

Calculations

$$\% \text{ Moisture (wt/wt)} = \frac{\text{wt } H_2O \text{ in sample}}{\text{Wt of wet sample}} \times 100$$

$$\% \text{ Moisture (wt/wt)} = \frac{\text{wt of wet sample-wtof dry sample}}{\text{Wt of wet sample}} \times 100$$

$$\% \text{ Total solids (wt/wt)} = \frac{\text{wt of dried sample}}{\text{Wt of wet sample}} \times 100$$

Where wt= Weight of sample/spread

2.5.2 Ash Content

5g sample was weighed into a tarred crucible and was pre-dried. Crucibles were placed in cool muffle furnace using tongs, gloves and protective eyewear. The crucibles Ignited for 2 hours at about 600 degrees Celsius. Muffle furnace was turned off and opened when temperature dropped to at least 250 degrees preferably lower. The door was carefully opened to avoid losing ash that may be fluffy. Safety tongs was used to transfer crucibles to a desiccator with a porcelain plate and desiccant. Desiccator was closed and allowed crucibles to cool prior to weighing

Calculations

$$\%\text{Ash} = \frac{\text{wt of ash}}{\text{Wt of sample}} \times 100$$

$$\%\text{Ash} = \frac{(\text{wt of crucible+ ash}) - \text{wt of empty crucible}}{(\text{wt of crucible+ sample}) - \text{wt of empty crucible}} \times 100$$

Where wt= Weight of sample/spread

Fat content: soxhlet extraction

Previously dried (air oven at 100°C) 250 ml round bottom flask was weighed accurately. 5.0g of dried sample to 22 ×80mm paper thimble or a folded filter paper was weighed. A small of cotton or glass wool was placed into the thimble to prevent loss of the sample. 150ml of petroleum spirit B.P 40-60°C was added to the round bottom flask and assembled the apparatus. A condenser was connected to the soxhlet extractor and reflux for 4 - 6 hours on the heating mantle. After extraction, thimble was removed and recovered solvent by distillation. The flask and fat/oil was heated in an oven at about 103°C to evaporate the solvent. The flask and contents were cooled to room temperature in a desiccator. The flask was weighed to determine weight of fat/oil collected.

$$\% \text{ Fat (dry basis)} = \frac{\text{fat/oil collected} \times 100}{\text{Weight of sample}}$$

$$\% \text{ Fat (dry basis)} = \frac{(\text{wt of flask + oil}) - \text{wt. of flask} \times 100}{\text{Weight of sample}}$$

2.5.3 Crude Fibre Determination

Two grams (2g) of the sample from crude fat determination was weighed into a 750ml Erlenmeyer flask. Two hundred milliliters (200ml) of 1.25% H_2SO_4 was added and immediately flask was set on hot plate and connected to the condenser. The contents were boiled within 1 minute of contact with solution. At the end of 30 minutes, flask was removed and immediately filtered through linen cloth in funnel and washed with a large volume of water. Filtrate (containing sample from acid hydrolysis) was washed and returned into the flask with 200ml 1.25% NaOH solutions. Flask was connected to the condenser and was boiled for exactly 30 minutes. It was then filtered through Fischer's crucible and washed thoroughly with water and added 15ml 96% alcohol. Crucible and contents was dried for 2 hour at 105 °C and cooled in desiccator and it was weighed. Crucible was ignited in a furnace for 30 minutes and after that it was cooled and reweighed.

$$\% \text{ Crude fibre} = \frac{\text{weight of crude fibre} \times 100}{\text{Weight of sample}}$$

$$\% \text{ Crude fibre} = \frac{\text{wt of crucible + sample (before – after) ashing} \times 100}{\text{Weight of sample}}$$

Where wt= Weight of sample/spread

2.5.4 Protein Determination

2.5.4.1 Digestion Method

Two grams (2g) of sample and a half of selenium –based catalyst tablets and a few anti-bumping agents were added to the digestion flask. Twenty five milliliters (25ml) of concentrated H2SO4 was added and the flask was shaken for the entire sample to become thoroughly wet. Flask was placed on digestion burner and heated slowly until boiling ceased and the resulting solution was clear. The sample was then cooled to room temperature and digested sample solution was transferred into a 100ml volumetric flask and made up to the mark.

2.5.4.2 Distillation Method

To flush out the apparatus before use, distilled water was boiled in a steam generator of the distillation apparatus with the connections arranged to circulate through the condenser, for at least 10 minutes. The receiving flask was lowered and continued to heat for 30 seconds in order to carry over all liquid in the condenser. 25 ml of 2% boric acid was pipetted into 250ml conical flask and 2 drops of mixed indicator added. The conical flask and its contents were placed under the condenser in such a position that the tip of the condenser is completely immersed in solution. 10ml of the digested sample solution was measured into the decomposition flask of the Kejdahl unit, fixed it and add excess of 40% NaOH (about 15-20ml) to it. The ammonia produced was distilled into the collection flask with the condenser tip immersed in the receiving flask till a volume of about 150ml– 200ml is collected. Before distilling another sample and on completion of all distillations, the apparatus was flushed as in step 1 above. Steam was allowed to pass only until 5ml of the distillate is obtained.

2.5.4.3 Titration Method

The Distillate with 0.1N HCL solution was titrated. The acid was added until the solution became colourless. Any additional acid added made the two solutions become pink. The nitrogen content was determined in duplicate, and a blank determination was run using the same amount of all reagents as used for the sample. The blank was meant to correct for traces of nitrogen in the reagents and included digestion as well as distillation methods.

Calculation

$$\% \text{ Total nitrogen} = \frac{100 \times (Va\text{-}Vb) \times NA \times 0.01401 \times 100}{W \times 10}$$

Where:
Va- volume in ml of standard acid used in titration
Vb- volume in ml of standard acid used in blank
NA- normality of acid
W- Weight of sample taken

2.6 Carbohydrate content

The calculation of available carbohydrate (nitrogen-free extract-NFE) was made after completing the analysis for ash, crude fibre, ether extract and crude protein. The calculation was made by adding the percentage values on dry matter basis of these analysed contents and subtracting them from 100%.

Calculation:

Carbohydrate (%) = % crude fibre + % NFE

OR

Carbohydrate (%) =100 - (% moisture +% fat +% protein +% ash)

ӿ. Calculation for dry basis = $\frac{(100-\%\ \text{moisture}) \times \text{wet basis}}{100}$

2.7 Sensory Analysis

For sensory analysis of the jam varieties, 50 untrained food tasters received a portion of the sample (10g) white disposable plastic cups, accompanied by disposable spoons. Then, the panelists answered a sensory ballot sheet where the result was used to evaluate the attributes of colour, aroma, texture, smoothness, spreadability, taste and overall Acceptability of the jam. For each sample, 10 g of jam was served in white disposable plate with a piece of toast. The plates were coded as 'ABC, BCD and EFG' respectively. The panelists assessed spreading behaviour of the jam on the toast by applying the jam on a piece of toast and allowing the panelists to write their comments on the sensory ballot sheets. The food panelists provided answers regarding the acceptance of samples based on a 9 point hedonic scale ranging from 1 (dislike extremely) to 9 (like extremely) as adapted from [17]. The average attributes relating to the preference of the study sample was supplemented with a descriptive statistical analysis of the respective standard deviations and coefficients of variation.

2.8 Statistical Analysis

Data were subjected to Analysis of Variance (ANOVA) and Tukey Test was used to determine the significant difference among the various samples in duplicates. Data were analyzed using the software, Statistical Package for Social Sciences (SPSS) version 22.00 (SPSS inc., Chicago), IL, USA at the 0.05 level of significance.

3. RESULTS AND DISCUSSION

The result of the proximate analysis of the various jams is presented in Table 2. The moisture content ranged from 53.67±1.46% to 61.31±0.69%. The control sample (ABC) made of 100% pineapple recorded higher moisture content than the jam blends. The variance in moisture was as a result of the heating process involved during the jam processing. Moisture has a great influence on the shelf life of products [18]. Arnold et al., [11] has stated moisture content of 76.00-86.00% in the jam prepared from mango varieties, [19] also recorded 72.10-85.50% of jam prepared from different mango jam varieties. The study showed no significant difference among the composite jam samples but recorded a significance ($p \leq 0.05$) difference between the control sample ABC (100% pineapple) and the composite jam (EFG, 50% pineapple, 50% baobab fruits pulp).

Ash content provides an evidence of minerals composition of food sample as this is important in many biochemical reactions which help physiological functioning of key metabolic processes in the body [20]. The ash content was found to be 1.06% for the control sample ABC (100% pineapple), 1.02% for sample BCD (60% pineapple, 40% baobab fruits pulp) and 1.04% for sample EFG (50% pineapple, 50% baobab fruits pulp), showing no-significant difference among the ash content of these jam varieties. Singh & Dewivedi [21] has reported the ash content of jam produced from varieties of mangoes between 0.26-1.16 percent. The ash content of these jams composite was within the range. 0.02% was also recorded by [23] in black-plum fruit jam prepared. There was a significant ($p \leq 0.05$) difference between samples BCD and ABC. There was no significant ($p \geq 0.05$) difference between samples ABC and sample EFG. This result indicated that the blend samples had high protein content which was similar to the protein content of 3.08% in sample BCD could be attributed to the incorporation of baobab fruits pulp.

As can be seen in Table 2, the crude fat content of the jam ranged from 0.04 to 0.10%; EFG had the highest ash content of 0.10% followed by control sample ABC with 0.04%. The ash content was lower compared to the data obtained for prickly pear jam which had 3.81% fat content [22]. The high fat content might be attributed to the ratio of composition of the composite ingredients. There
was a significance ($p \leq 0.05$) difference between the control sample ABC (100% Pineapple) and the jam blends. The crude protein value of the jam samples ranged from 0.94-1.33%; sample BCD (60% pineapple, 40% baobab fruits pulp) was the highest (1.33%) compared to the control sample (ABC 100% pineapple). High protein

On the other hand, the carbohydrate content of the various jam samples ranged from 36.84±0.47-44.22±0.13%. Sample EFG recorded the highest carbohydrate content (44.22%) while the least was the control

ABC (36.68%). The highest carbohydrate content observed in BCD might be attributed to the high carbohydrate content in baobab fruits pulp [24]. It was realized that increasing the proportion of the baobab fruits pulp resulted in the corresponding increase of the carbohydrate. A significance ($p \leq 0.05$) difference was observed in the control sample (ABC) and the composite jam samples.

Table 2: *Proximate Composition of Jam*

Samples	Moisture %	Ash%	Fat%	Protein%	Carbohydrate%
ABC	61.31±0.69	1.06±0.04	0.04±0.03	0.90±0.04	36.68±0.68
BCD	61.04±0.53	1.02±0.06	0.05±0.04	1.33±0.08	36.84±0.47
EFG	53.67±1.46	1. 04±0.16	0.10±0.03	0.94±0.06	44.22±0.13

Sample ABC (control- 100% pineapple), BCD (60% pineapple, 40% baobab fruits pulp) and EFG (50% pineapple, 50% baobab fruits pulp)

SENSORY PROPERTIES OF THE JAM

The colour of the jam samples were evaluated and results presented in Table 3. The colour readings were rated on a 9 point hedonic scale. The sensory panellists rated colour from 6.72±1.44 to7.04±1.48. From the scale colour of all samples were rated as being liked moderately. Analysis of variance found no significant ($p>0.05$) differences in the colour rating of the samples. The sensory score for texture of the jam samples are presented in Table 2. The scores ranged between 7.29±1.21 and 7.98±1.30. Sample CFG was the sample with the most preferred softness. From the study there exit significant ($p<0.05$) differences in the softness of samples ABC, BCD and CFG. Samples ABC and BCD also differed significantly ($p<0.05$) among themselves. These findings are also supported by facts given by [25] who concluded that spread texture was dependent upon the low iodine value (25-27). Moreover, the spread with good fat content gives good texture scores. This result is also supported by [26] that fatty acids content of spread affect the texture of butter samples and 80% variation in texture is attributed to fatty acids, which gives desirable softness.

The Aroma of the samples is presented Table 3. The aroma ranged from 7.05±1.39 to 7.57±1.36. The study showed no significant ($p>0.05$) differences in the aroma of sample ABC and CFG. Samples ABC and BCD also differed significantly ($p<0.05$). Beside textural attributes, overall liking of spread such as hazelnut spread is related to the flavour of the product [27]. Flavour liking cannot be measured directly by instruments; it is an interaction of consumer and product [28]. Good aroma may be associated with the incorporation of baobab fruits pulp. The result for Taste of the jam samples are presented in Table 3. These were within the ranges of 7.40±1.41 and 7.95±1.45. Jam sample BCD (60% pineapple, 40% baobab fruits pulp) recorded the highest mean score (7.95±1.45) against the control sample ABC (7.40±1.41). From the study, there were significant ($p<0.05$) differences in the taste of samples BCD, ABC and CFG. Equally, the study is in line with [29] and [30] whose work disclosed that the taste of jam processed from blends of pineapple, tomato and pawpaw showed dominance over the control (commercial strawberry jam). They recorded (7.85 %) of taste compared slightly low to jam from apple (8.3%) and coconut based jam (9.0%). Levaj Dragović-Uzelac [31] further recorded a high mean score for taste of the composite jam produced. Again, these results are supported by the conclusion of [26] who indicated that taste is attributed to the texture of the jam and how it taste in the mouth.

The sensory score for spreadability of the jam samples are presented in Table 2. The scores ranged between 7.30±1.69 and 7.80±1.08. Sample BCD (60% pineapple, 40% baobab fruits pulp) was the sample with the most preferred Spreadability. From the study, there were significant ($p<0.05$) differences in the spreadability of samples ABC, BCD and EFG

This Spreadability is one of the sensory properties of foods that play a major role in consumer buying decisions and eventual consumption. It was found to be the single most dominant attribute of consumer preference of foods [32]. Spreadability is an extremely important attribute of semi-solid food texture. Spreadability is a subjective term related to how easy a sample is uniformly distributed over a surface. Gills [32] reported that descriptive attributes of spreadability of jam produced was highly correlated with consumer likeness.

Results for the overall acceptability of the samples are presented in Table 2. The study recorded the mean ranged between 7.30±1.18 and 7.86±2.06. From the study sample BCD (60% pineapple, 40% baobab fruits pulp) was accepted by the consumers. Consumers liked the product very much. The study showed a significant ($p>0.05$) differences in the overall acceptability of the control samples ABC (100% pineapple) and the composite samples BCD (60% pineapple, 40% baobab fruits pulp) and EFG (50% pineapple, 50% baobab fruits pulp). Similarly, [33] also examined similar results of decreasing trends (9.00 to 7.00) in overall acceptability in fruit jam.

Table 3: the sensory properties of the jam

Samples	Colour	Texture	Aroma	Taste	Spreadability	Level of acceptability
A	7.04±1.48	7.66±1.081	7.08±1.35	7.40±1.41	7.30±1.62	7.48±1.50
B	6.092±1.53	7. 98±1.30	7.57±1.36	7.35±1.45	7.67±1.08	7.19±2.06
C	6.72±1.44	7.29±1.21	7.05±1.39	7.43±1.46	7.53±1.69	7.86±1.18

Sample ABC (control- 100% pineapple), BCD (60% pineapple, 40% baobab fruits pulp) and EFG (50% pineapple, 50% baobab fruits pulp)

CONCLUSION

The study reveals the possibility of substituting pineapple with baobab fruits pulp in the production of jam with required sensory attributes and extensive nutritional contents. The replacement of pineapple with 40% and 50% baobab fruits pulp resulted in higher proximate and sensory qualities. This means that jam can be produced using baobab fruits pulp up to 40% without an adverse effect on the nutritional and sensory attributes.

REFERENCES

1. ***UNIFEM**1 (998)**. Fruit and Vegetable Processing. UNIFEM U.S.A. Vol. 2:*
2. *Barbara H. Ingham (2008). Making Jams, Jellies and Fruit Preserves: Wisconsin Safe Food Preservation Series.*
3. *Ackom N. B and K Tano-Debrah (2012). Processing Pineapple Pulp into Dietary Fibre Supplement. African Journal of Food, Agriculture, Nutrition and Development, 2(6).*
4. *Taussig S., Batkin S., (1988). Bromelain, The Enzyme Complex Of Pineapple And Its Clinical Application. An update. J Ethnopharmacol, 22: 191- 203.*
5. *Afoakwa, E. O., Nartey, D., Ashong, J. and Annor, G. (2006). Effect of Sugar, Pectin and Acid Balance on the Quality Characteristics of Pineapple (Ananas Comosus) Jam*
6. *Chundawat B.S and Sen N.L (2002). Principles of fruit culture. Agrotech publishing Acadamy, Udaipur, pp: 15-16*
7. *Bremer, B., Bremer, K., Chase, M.W., Fay, M.F., Reveal, J.L., Bailey, L.H., Soltis, D.E., Soltis, P.S. and Stevens, P.F. (2009). An update of the Angiosperm Phylogeny Group classification for the orders and families of flowering plants: APG III. Botanical Journal of the Linnean Society. 161(2),pp.105–121.*
8. *Caluwé, E. De, Damme, P. Van and Halamova, K. (2010). Adansonia digitata L . A review of traditional uses, phytochemistry and pharmacology. Afrika Focus. 23(1), pp.11– 51.*
9. *Kubore, J., Siriamornpun, S. and Meeso, N. (2011). Phytochemicals, vitamin C and sugar 241 content of Thai wild fruits. Food Chemistry. 126(3),pp.972–981.*
10. *Vermaak, I., Kamatou, G.P.P., Komane-Mofokeng, B., Viljoen, A.M. and Beckett, K. (2011). African seed oils of commercial importance - Cosmetic applications. South African Journal of Botany. 77(4),pp.920–933.*
11. *Arnold T.H.; Well M.J.; Wehmeyer A.S. (1985): Koisan food plants: taxa with potential for economic exploitation. In, G.E. Wickens; J.R. Goodin; D.V. Field (eds.), Plants for arid Lands, Allen and Unwin, London: 69-86.*
12. *Nour A.A.; Magboul B.I.; Kheiri N.H. (1980): Chemical composition of baobab fruit (Adansonia digitata). Rivista italiana delle sostanze grasse, 73 (8): 371-388.*
13. *Dia A. et al. (1997): A Baobab solution for the prevention and treatment of acute dehydration in infantile diarrhea. Dakar Med 42 (1): 68-73.*
14. *Adepoju O.T., Adegun M.O., Lawal M., and Olaide E.A. (2010). Nutrient and Antinutrient composition of jam preparation from Hibiscus sabdarrifa calyx extract'. Nigerian Journal of Nutritional Sciences. (31): 8-11*
15. *AOAC, (2005). Official Methods of Analysis of AOAC International. 18th Ed., AOAC International, Gaithersburg, Md, USA.*
16. *AOAC (2000). Association of Official Analytical Chemist. Official Methods of Analysis 17th edition, Washington DC.*
17. *Ihekoronye AI, NgoddyPO. Integrated Food Science and Technology for the Tropics. London, UK: MacMillan Edu Publishers; 1985. p. 283–285.*
18. *Eke-Ejiofor. J, Owuno. F. (2013). The Physico-chemical and Sensory Properties of Jackfruit (Artocarpus heterophilus) Jam. International Journal of Nutrition and Food Sciences. 2 (3): 149-152.*
19. *Caygill, J.C; Cooke, R.D.;Moore, D.J;Read, S.J. and Rassam, H.C.(1976). The mango (Mangifera indica L.). Harvesting and subsequent handling and processing.An Annotated Bilography. Tropical products Institute.PP.57, 61,65,66,67.*
20. *Ashaye, O. A. and Adeleke, T. O. (2009). Quality Attributes of Stored Roselle Jam. International Food Research Journal, 16: 363-371.*
21. *Singh, P.and Dewivedi, N.U. (2008).Purification and characterization of multiple forms of poly-glacturonase from mango (Mangifera indica L. Dashehari) fruit.J.of Fd. Chem.111 :345-349.*
22. *Atef, A. M. Abou-Zaid, Nadia, I. Ibrahim, Mostafa T. Ramadan and A. Nadir (2013). Quality Evaluation of Sheets, Jam and Juice from Prickly Pear and Melon Blends. Life Science Journal; 10 (2): 200-208.*
23. *Ajenifujah-Solebo, S. O. and Aina, J. O. (2011). Physico- Chemical Properties and Sensory Evaluation of Jam Made from Black-Plum Fruit (Vitex Doniana). African Journal of Food, Agriculture, Nutrition and Development, 11 (3).*

24. *Franz Augstburger Franz, Jörn Berger, Udo Censkowsky, Petra Heid, Joachim Milz, Christine Streit (2001). Bananas Organic Farming in the Tropics and Subtropics. Naturlande. V, 2nd edition, pp 1-21.*
25. *Bornaz S, Fanni J, Parmentier M (1995). Heat-treatment of cream: A model of the butter texture*
26. *Baer RJ, Ryali J, Schingoethe DJ, Kasperson KM, Donovan DC, Hippen AR, Franklin ST (2001). Composition and properties of milk and butter from cows fed fish oil. J. Dairy Sci. 84(2): 345-353.*
27. *Di Monaco, R.; Giancone, T.; Cavella, S.; Masi, P. (2008). Predicting texture attributes from microstructural, rheological and thermal properties of hazelnut spreads. Journal of Texture Studies. 39: 460–479.*
28. *Rohm, H. (1990). Consumer awareness of food texture in Austria. Journal of Texture Studies. 21: 363–374.*
29. *Muhammad A., Durrani, Y. M Ayub Zeb A., Ullah J. (2009). Organoleptic evaluation of diet apple jam from apple grown in Swat valley'. Sarhad Journal of Agriculture; 25(1): 81-86.*
30. *Shrinivasan PS, Sundaram G and Oberoi VB (1977). Study on pineapples. Indian Food Packer, pp: 33-34.*
31. *Levaj Dragović-Uzelac B., Dančević, V.T.,. Liber, S., Repajić, M., Bursać K.D (2009). Quality of clementine jam influenced by purée pretreatment, sugar type and pectin addition'. Agricultural Conspectus Scientificus.74 (3):227-231***.**
32. *Ehsan E.B., Naeem, Z.P. Javid A., Nazir A. (2003). Development, standardization and storage studies on grape fruit apple marmalade'. Pak J Food Sci 13: 11-15.*
33. *Gills, L.A. (2000). Resurreccion Overall acceptability and sensory profiles of unstabilized peanut butter and peanut butter stabilized with palm oil. Journal of Food Processing and Preservation. 24: 495–516*