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Nutritional composition and sensory evaluation of jam from blends of pineapple and mango enriched with honey for sustainable health

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Abstract
This study examined the production, nutritional analysis and sensory assessment of Jam made from mango blend with 30%, 40% and 50% size of pineapple and enrich with honey for sustainable health. Fruits are functional foods enriched with nutrients for sustainable health and wellbeing. Fruits especially mangos are generated in such large quantities during their season that they would be a huge waste if not properly maintained. One such food that can be made to increase food value, decrease food waste, generate income, and circulate products in and out of season is jam. This study sought answers to four research questions. A nine-point hedonic scale was employed as the data collection tool, and its reliability was examined, a laboratory analysis of samples and keen observation. In this study, two fruits—mango and pineapple—were utilised to make jam. Mango has a low acid and pectin content. To produce mango jam of acceptable qualities, pectin (from pineapple blends), sweetness and acid were added. The degree of acceptability of the organoleptic qualities of taste, flavour, colour, and texture as well as the overall acceptability of the items were then determined by a sensory evaluation. Findings show that blending mango with pineapple resulted in jam products with acceptable sensory qualities. Mango/pineapple jam blends (samples MP1, 2, 4). The study also revealed that these fruit jams are rich in nutrients that can sustain health and wellbeing. Based on the findings the researchers concluded that homemade pineapple and mango jam blends have good flavour, taste, colour, texture, acceptable nutritional composition and shelf life and recommend production and consumption of same for sustainable health.

Keywords: Keywords: Mango-Pineapple Jam, Nutritional Composition, Sensory Evaluation, Fruit Blends, Sustainable Health

1. Introduction

Provide Fruits are functional foods that have proven to be of immense benefits to consumers as they supply the body with the required nutrients needed for all round goodness. For this reason, Sissons (2019) opined that the consumption of fruits is an excellent way to get better overall health and decrease the risk of diseases. This is because fruits are brilliant sources of vital vitamins plus minerals such as foliate, ascorbic acid, potassium, alpha and beta carotene. Fruits are high in cellulose (fibre), and provide a wide range of phytochemicals and antioxidants such as carotenoids and flavoniods. Seasonal fruit abundance can lead to significant waste if not preserved properly. However, through food preservation and processing, we can minimize waste, diversify food options, and enhance their value. This not only creates income and job opportunities but also helps address nutritional disparities. To preserve fruits, methods such as drying, canning, jellying, curing, and fumigation can be used. All these methods help to expand the ledge life of food which Nicoli (2012) described as the limited period of time following manufacture (or, in certain situations, following maturity or ageing) when, under well watched storage circumstances, the food product retains the required level of quality (Nicoli, 2012). The process of making jam uses the jellying preservation method, which lowers food waste, boosts value, and guarantees availability all year long, no matter the season. According to Awulachew (2021), jam is a semi-solid food product that is created by boiling sugar with pectin, fruit or vegetable pulp, acid, and other ingredients until the mixture reaches the proper

consistency. Making jam is an effective way to preserve fruits and vegetables that is also relatively less expensive than many other preservation methods. Ogunlade and Oluwafemi (2021) stated that jam is made from 45% fruit ingredients to 55% sugar which is then cooked to 68% concentration to achieve a balanced quality. Jam, which is often used as a spread for bread, pancakes, and pies, among other uses, are available in a wide variety of fruit and vegetable varieties that are high in nutrients.

Jam can be produced either from a single or mixed fruits or vegetables. The raw materials for jam production include: fruits/vegetables, pectin, sweetener, and acid. The fruit or vegetable is the basic ingredient whose composition determines the amount of the other ingredients needed. Fruits for jam should be rich in sugar (available as fructose); should contain some amount of acid (citric or tart) and some amount of pectin - a non - starch polysaccharide whose presence gives jam it's peculiar texture/consistency. This is because it forms colloidal solution in water and can undergo gelatinization under suitable conditions. Sugar plays a vital role in jam production, contributing to the sweet taste, preservation, and caramelization that aids in thickening the jam. Although sugar (sucrose) is typically utilised, this study tested using honey for long-term health benefits. Eteraf-Oskouei and Najafi (2013) state, honey exhibits inhibitory effects on approximately 60 bacterial species, as well as certain fungi and viruses. Additionally, honey possesses antioxidant properties, making it a valuable component in managing various diseases. Fruit oligosaccharides, vitamins, minerals, enzymes, and amino acids are all present in honey, which is mostly composed of fructose and glucose. These characteristics make honey a suitable and healthy additive for jam production, particularly when combined with the fruits examined in the study.

Connelly (2013) noted that citrus and cherries, apples and pineapple fruits are more suitable for jam making as they possess the features that makes a fruit suitable for jellying which include as High levels of pectin, a comparatively low pH, and a high concentration of total soluble solids (TSS) were noted by Awulachew (2021). Plums and berries on the other hand are limited in these qualities. However, change and variety are important components of life. If the products of this experimental study will gain high acceptance, they will increase the healthy options of spreads available to consumers and bridge the gap between fruit seasons. Pineapple (*Ananas comosus*), a nutrient-rich tropical plant belong to the Bromeliaceae family, is utilized to produce healthy and nutritious jams. Native to South America, pineapple was introduced to the world by Portuguese explorers, who brought it to Saint Helena in 1502, and later to Africa and India (Imonikebe, 2022). Today, pineapple is widely cultivated and found in Nigeria. This fruit has been linked to a summary risk of various lifestyle-related health conditions. Notably, fresh pineapple is the sole source of bromelain, an enzyme with potential health remuneration. (Shamsudin, *et. al.*, 2007). According to Ancos, *et al.,* (2017), pineapple boasts an impressive nutritional profile, rich in vitamins, minerals, fiber, flavonoids, and carotenoids. Additionally, Rashima, *et al.,* (2019) highlighted pineapple's appealing sensory attributes, including its flavor, aroma, color, and taste. However, its high water content (82-92wt %) makes it prone to spoilage. In this study, pineapple was combined with mango to create a unique, nutritious jam blend.

Bjarnadottir (2015) identified mango (*Mangifera indica*) as one of the delicious seasonal fruits grown in the tropics. Mango is a nutrient dense fruit rich in vitamin A, C and D, calories, dietary fibres, flavonoids like the beta and alpha carotene. The nutritional composition of mango is such that Levi (2021) termed it “the king of fruits” stating that its unique flavour, texture, fragrance, taste and health promoting qualities makes it the preferred among new functional foods. Ribeiro and Schieber (2010) stated that mango is a great source of vitamin A and C, as well as phytochemicals, which include carotenoids and phenolic compounds. Venkateswarlu and Reddy (2014) credited the distinctive yellow colour of the fruit to the presence of carotenoids. Mangoes are mostly consumed fresh but due to its perishable and highly seasonal nature, they cannot be kept for a long period nor can they be enjoyed all year round. (Nour, *et al.,* 2011). It is imperative that a suitable preservative method be used to keep it longer. Being a berry fruit, although this fruit is rich in nutrients, it is not very suitable for jam making. It will be blended with pineapple experimentally to observe the outcome.

The nutritional composition of fruits encompasses a broad spectrum of elements that collectively support optimal health. Fruits' dietary constituents include water, fiber, proteins, select fats (e.g., olive, avocado, nuts), organic acids, and digestible carbohydrates. As a rich source of essential macronutrients (like fiber) and micronutrients (including minerals, vitamins C, B vitamins, and others), fruits play a vital role in maintaining sustainable health and well-being. Additionally, phytochemicals present in fruits, such as polyphenolics, carotenoids, and glucosinolates, offer additional nutritional benefits (Imonikebe, 2020). The United Nations' 2015 Sustainable Development Goals (SDGs) prioritize sustainable health, aiming to ensure healthy living and well-being for all, regardless of age. This vision, as outlined by the World Health Organization (2017), encompasses an environmentally and nutritionally sustainable

health system that improves, maintains, and restores health. Arubayi (2021) categorized the SDGs into four groups, with Health and Well-being (Goal 3) being a primary focus. Furthermore, Arubayi emphasized the significance of Home Economics in achieving Health and Well-being, highlighting Food and Nutrition as a crucial pillar. Therefore, healthy nutrition and informed food choices play a vital role in sustaining health and well-being. Consequently, expanding the availability of healthy food options for consumers becomes essential hence the need for this study.

Post production, sensory evaluation and nutritional analysis (proximate and parametric) helped to ascertain the level of acceptability of the organoleptic attributes of taste, flavour, colour, texture of the samples as well as establish their nutritional composition in relation to sustainable health. According to Stone (2018), sensory assessment is a science that measures, examines, and interprets how consumers react to goods as experienced by their senses. It connotes the overall look, colour, flavour, texture, and presentation. Food acceptance or rejection is solely determined by how well it meets the demands and expectations of the consumer (Sousa- Gallagher and Mahajan, 2011).This study employed sensory evaluation and shelf life assessment to examine jam products made from mango blended with 30%, 40%, and 50% pineapple proportions, enriched with honey. A control sample of 100% pineapple jam was used for comparison. The jam products'shelf life was determined by monitoring production dates, storage conditions, and signs of deterioration. This research aimed to promote sustainable health by producing and evaluating nutritious jam products.

Purpose of the Study

Finding the nutritional makeup, sensory assessment, and shelf life of jam created from pineapple and mango blends enhanced with honey for long-term health was the aim of this study**.**

Research Questions

The following research questions were the focus of the study:

1. What is the mean (x) difference in organoleptic qualities (taste, flavour, colour and texture) ratings of jam produced with mango blended with 30%, 40% and 50% proportions of pineapple and enriched with honey and that of 100% pineapple jam?
2. What is the mean (x) difference in the general acceptability rating of jam produced with mango blended with 30%, 40% and 50% proportions of pineapple and enriched with honey and that of 100% pineapple jam?
3. What is the nutritional composition of jam produced with mango blended with 30%, 40% and 50% proportions of pineapple and enriched with honey and that of 100% pineapple jam?
4. 7. What is the shelf life of jam produced with mango blended with 30%, 40% and 50% proportions of pineapple and enriched with honey and that of 100% pineapple jam?

2.0 Materials and methods

The study adopted an Experimental Research Design.

The study population consist of Vocational Education lecturers in Delta State University, Abraka numbering eighteen (18). They were involved in the study as panelists. The population is of a manageable size thus, there was no sampling. The sample size therefore consisted of 18 panelists. The study's tools included laboratory nutritional analysis, observation, and a 9-point Hedonic Scale Questionnaire. The Hedonic Scale Questionnaire has nine points, ranging from "dislike extremely" to "like extremely." Each sample that was offered to the judges was evaluated based on these scores, which included flavour, taste, colour, texture/consistency, and overall acceptability. To determine the samples' nutritional makeup, laboratory analysis was performed at the National Centre for Energy Research and Development UNN. Utilising observation, the items' shelf life was tracked.

Materials and Methods

The materials that were used for this study included mango and pineapple fruits, sugar, honey, and citric acid from lime. Equipment includes pots, gas cooker, spoons, plates, knives, blender, chopping board, weighing scale, measuring spoons, hair net, apron, and hand gloves.

Method of Preparation of Samples

Ripened mango and pineapple fruits were purchased, selected, and washed under running water. All the unwanted parts (peels, core, seeds) were removed; The flesh was further made into puree and kept aside. The puree prepared from each fruit (mango and pineapple) were measured according to the various proportions needed in each sample, The pulp for each sample was 200g, which was shared in various proportions. Pulps samples containing 30% (60g),

40% (80g), and 50% (100g) proportions of pineapple were prepared, with an addition of 70% (140g), 60% (120g), and 50% (100g) of avocado, pulps. The 100% (200g) pineapple pulp was used as control. A total of four (4) different samples were prepared. These samples were simmered with low heat and stirred to bring out the pectin. Caramelized sugar was added to the control sample, and honey to the treatment samples; and boiled rapidly. Furthermore, lime was added to both the control and treatment samples to give the final product of avocado and pineapple jam.. The jam were packaged into sterilized containers, labeled, pasteurized and cooled for storage.

Sensory Evaluation

The sensory evaluation was performed using a 9-point standardized hedonic scale of: Like Extremely (LE) = 9, Like Very Much (LVM) = 8, Like Moderately (LM) = 7, Like Slightly (LS) = 6, Neither Like nor Dislike (NLD) = 5, Dislike Slightly (DS) = 4, Dislike Moderately (DM) = 3, Dislike Very Much (DVM) = 2, and Dislike Extremely (DE) = 1. The sensory attributes, which include colour, taste, flavour, texture/consistency, and overall acceptance were evaluated. In doing this, various jam samples were presented to the 18 panelists used in the study, and they were asked to evaluate the samples using the hedonic scale.

Laboratory Analysis Procedures

The samples were tested for proximate nutrients (crude protein, ash content, moisture content, fat content and crude fibre) and other parameters (-Vitamin A, B, C & E, sodium and potassium) Moisture content, ash content and crude fibre were analyzed using the AOAC method of 1990. The crude protein was determined using the micro-Kjadahl method while the fat content was determined using the Pearson (1976). Minerals (potassium and sodium were detected through dilution with reagents Hcl and HNO2 Vitamin A was determined using the Jakutowicz et al procedure. Vitamin B were detected through a dilution with Dil. Hcl. Vitamin C was identified by a dilution with indophenol while Vitamin E was identified by a dilution with distilled water.

Method of Data Collection

Copies of the hedonic scale were administered with the help of two (2) research assistants who have been briefed on how to administer questionnaires. Eighteen (18) copies of the hedonic scale questionnaire were administered to the 18 panelists for sensory evaluation, and collected thereafter. The data realized from the questionnaire was subjected to descriptive statistical analysis.

Method of Data Analysis

Mean and standard deviation was used to analyze data pertaining the research questions. Any item between 5 – 9 is "like". Any item less than 5.00 is dislike.

3.0 Result and Discussion

Research Question 1: What is the mean (x) difference in the organoleptic qualities (taste, flavour, colour and texture) ratings of jam produced with mango blended with 30%, 40% and 50% proportions of pineapple and enriched with honey and that of 100% pineapple jam?

Table 1: Mean ($\bar{x}$) and Standard Deviation (SD) of Sensory Evaluation (taste, flavour, colour and texture) of all the Jam Samples.

Samples and Proportions

Parameter	MP1	MP2	MP3	MP4
	140g:60g	**120g:80g**	**200g**	**100g:100g**
Flavour	7.07;	7.60;	7.60;	7.53;
	1.22	1.24	0.99	1.60
Colour	7.33;	8.07;	7.73;	7.80;
	1.76	1.58	1.03	0.94
Texture	7.07;	7.60;	6.93;	7.40;
	1.16	1.18	1.83	1.88
Taste	6.87;	6.93;	7.93;	7.67;
	2.10	1.71	0.88	1.68

Key: MP1= Mango/Pineapple 70:30%; MP2 =Mango/Pineapple = 60:40%;; MP3= Pineapple 100%;; MP4 = Mango/Pineapple 50:50%. Source: Field Work (2024)

Table 1 shows the mean ($\bar{x}$) and standard deviation values of the sensory evaluation of all the jam samples. From the Table, Samples MP2 and MP3 (Mango/pineapple 60:40% and Pineapple 100%) with a mean ($\bar{x}$)score of 7.60 has the best flavour, Sample MP2 (Mango/Pineapple 70:40%) with a mean ($\bar{x}$) score of 8.07 has the best colour. Sample MP2 (Mango/Pineapple 70:40%) with a mean (x) score of 7.60 has the best texture, Sample MP3 (Pineapple 100%) with a mean ($\bar{x}$) score of 7.93 has the best taste. and Sample B (Pineapple 100%) with a mean ($\bar{x}$) score of 7.33 is more generally accepted than other samples.

Research Question 2:
What is the mean ($\bar{x}$) difference in the general acceptability rating of jam produced with mango blended with 30%, 40% and 50% proportions of pineapple and enriched with honey and that of 100% pineapple jam?

Table 2: Mean ($\bar{x}$) and Standard Deviation (SD) of the General Acceptability of Jam Produced with Mango Blended with 30%, 40% and 50% Proportions of Pineapple and Enriched with Honey and that of 100% Pineapple Jam (n = 15).

Samples	**Mean ($\bar{x}$)**	**SD**
MP1	7.00	1.56
MP2	7.67	1.18
MP3	7.93	1.23
MP4	7.53	1.46

Key: MP1= Mango/Pineapple 70:30%; MP2 =Mango/Pineapple = 60:40%;; MP3= Pineapple 100%;; MP4 = Mango/Pineapple 50:50%. Source: Field Work (2024)

Research Question 3
Table 3: Summary of the Nutritional Composition of Jam Produced with Mango Blended with 30%, 40% and 50% Proportions of Pineapple and Enriched with Honey and that of 100% Pineapple Jam.

Parameter	**MP1**	**MP2**	**MP3**	**MP4**
CRUDE PROTEIN(Weight of sample (g) =	1.001	1.000	1.006	1.002
Titre value (T) =	4.1	2.5	3.9.	3.7
%N =	0.287	0.175.	0.271.	0.259
%Protein = %N X 6.25 =	1.79	1.09	1.70	1.62
MOISTURE CONTENT (Weight of sample (g) =	1.048	1.064	1.*059*	1.005
Weight of dry matter ($\bar{x}$) =	0.577	0.343	0.551	0.465
Loss in weight (g-x) =	0.471	0.721	0.508	0.540
% moisture content (X) =.	44.94	67.76	47.97	53.73
ASH CONTENT (Weight of sample (g) =	1.006	1.035	1.050	1.031
Weight of ash (x)	0.001	0.006	0.004	0.006
% ash ( ) =	0.10	0.58	0.38	0.58
CRUDE FAT (Weight of sample (g) =	2.002	2.000	2.008	2.009
Weight of fat (x)	0.058	0.028	0.054	0.051
% fat (X) =	2.90	1.40	2.69	2.54
CRUDE FIBRE: Weight of sample (g) =	1.002	1.000	1.008	1.002
Weight of dry matter (x) =	0.033	0.023	0.034	0.034
Weight of residue (y) =	0.001	0.006	0.004	0.006
% fibre (X)=	3.19	1.70	2.98	2.79
VITAMIN A (ug/100)	2.1	1.4	2.0	1.9
VITAMIN B (mg/100)	0.08	0.03	0.07	0.07
VITAMIN C (mg/100)	5.2	3.6	5.0	4.9
VITAMIN E (ug/100)	0.09	0.03	0.08	0.08
SODIUM (Na) (mg/100)	20.67	17.51	21.29	17.69
POTASSIUM (K) (mg/100)	4.51	8.38	5.80	0.35

Key: MP1= Mango/Pineapple 70:30%; MP2 =Mango/Pineapple = 60:40%;; MP3= Pineapple 100%;; MP4 = Mango/Pineapple 50:50%. Source: Field Work (2024)

Table 2 shows the mean ($\bar{x}$) scores and standard deviations of the general acceptability of jam produced with mango blended with 30%, 40% and 50% proportions of pineapple and enriched with honey and that of 100% pineapple jam. The table revealed that all the jams were generally acceptable to the panelists. However, Sample B (Pineapple 100%) has the highest mean ($\bar{x}$) score of 7.93, showing that it is more generally accepted than others, followed by mango/pineapple jam (MP2) with mean ($\bar{x}$) score of 7.67.

Research Question 4

What is the shelf life of jam produced with mango blended with 30%, 40% and 50% proportions of pineapple and enriched with honey and that of 100% pineapple jam?

Table 4: Shelf Life of Jam Produced with Mango Blended with 30%, 40% and 50% Proportions of Pineapple and Enriched with Honey and that of 100% Pineapple Jam

Samples	Duration	Reactions
Mango Jam (MP-1,2,4)	Production Date: 11th March, 2024.	At the time of writing this report (11/11/2024), product is yet to show any sign of deterioration. All sensory qualities are still intact.
Pineapple Jam (MP3)	Production Date: 11th March, 2024.	At the time of writing this report (11/11/2024), products have not shown any sign of deterioration yet. The colour, texture and overall appearance are still intact.

Key: MP1= Mango/Pineapple 70:30%; MP2 =Mango/Pineapple = 60:40%;; MP3= Pineapple 100%;; MP4 = Mango/Pineapple 50:50%

Source: Field Work (2024)

Table 4 revealed the shelf life of jam produced with mango blended with 30%, 40% and 50% proportions of pineapple and enriched with honey and that of 100% pineapple jam. From the table, it was revealed that all the jams produced have long shelf life, which means that they can be kept and used for a period of time. The pure pineapple jam (Sample MP3) is still intact at the time of compiling this report. Likewise all the mango pineapple jam blends (MP- 1,2,4). This therefore means that both pineapple and mango fruits can be used to produce jam with reasonable shelf life (more than seven months).

Discussion of Findings

Table 1 revealed a summary of mean and standard deviation values on the organoleptic/sensory qualities of the jam samples. It was shown that Sample A (mango/pineapple, 70:30%) has the best texture. This finding corresponds with that of Levi (2021) stating that the unique flavour, texture, fragrance, taste and health promoting qualities of mango makes it the preferred among new functional foods. Sample B, (Pineapple 100%) has the best taste, and is more generally accepted. This finding aligned with the opinions of Othman (2011) that pineapple supplies arrays of colour, flavour and texture for pleasurable eating. Additionally, Rashima,*et al.*, (2019) highlighted pineapple's appealing sensory attributes, including its flavor, aroma, color, and taste. These findings therefore indicated that pineapple is good for the preparation of fruit jams that can be consumed by all. This study's findings indicate that combining mango and pineapple can yield a jam product with satisfactory sensory attributes. As consumer acceptance or rejection of food is primarily driven by whether it meets their expectations and demands (Sousa-Gallagher,*et al.*, 2011), the blended mango-pineapple jam demonstrates potential for consumer acceptance Again the study established that jam produced from mango and pineapple fruits and enriched with honey are rich in nutrients such as fiber, carbohydrates, protein, fat, vitamins A, B, C and E, minerals such as potassium and sodium. Proper consumption of these nutrients can help in maintaining optimal health. This finding corresponds with the opinions of Imonikebe (2020) that fruits are functional foods that can perform maintenance and therapeutic functions on the body.

Furthermore, this research has established that jam making is an acceptable method of preserving mango and pineapple as the jam have reasonable shelf life and can be stored for a period of time as they have a reasonable shelf life. This highlights the definition of shelf life by Nicoli (2012), as a finite length of time after production (in some cases after maturation or aging), during which the food product retains a required level of quality under well-defined storage conditions

4.0. Conclusion

From the findings, it is evident that organoleptically acceptable jam can be produced by blending mango and pineapple. Pineapple helps to address the deficiencies of avocado in pectin and fructose. Pure pineapple jam has the best taste, flavour, colour and is more generally accepted while mango/pineapple jam (70:30%) has the best texture and other avocado/pineapple blends received above average consumer acceptance. Finally, all the jam samples have reasonable shelf life. The researchers concluded that homemade pineapple and mango jam blends have good flavour, taste, colour, texture, acceptability and shelf life.

5.0 Recommendation

Based on the findings and conclusion, it was recommended that:

1. The production of avocado and pineapple jam should be encouraged at substantial and commercial level since they have good sensory qualities.
2. Consumption of these jam products should also be encouraged as both avocado and pineapple are rich in nutrients that can support growth, prevent diseases, maintain the immune system and generally promote sustainable health.

References

Ancos, B., Sánchez-Moreno, C. & González-Aguilar, G.A. 2017. Pineapple composition and nutrition. In: Ancos B, Moreno CS, Aguilar GAG. Handbook of pineapple technology: production, postharvest science, processing and nutrition. Chichester: John Wiley & Sons.

Arubayi, D. 2021. Home Economics and the actualization of Sustainable Development Goals Vision 2030: Home Economics and the actualization of sustainable development. *Nigeria Journal of Home Economics*, *9*(5), 1-10.

Awulachew, M.T. 2021. Fruit jam production. *International Journal of Food Science and Nutritional Diet, 10*(4), 532-553.

Bjarnadottir, A. 2015. Nutrition facts and health benefits. Retrieved on 15th, October 2020 from https://www.healthline.com/ nutrition/ foods/tomatoes

Connelly, A. 2013. The science and magic of jam production. Retrieved on 24th March, 2023 from *https://www.theguardian.com/science/blog/2013/oct /03/science-magic-jam-making*

Eteraf-Oskouei, T. & Najafi, M. 2013. Traditional and modern uses of natural honey in human diseases: A review. *Iranian Journal of Basic Medical Sciences, 16(6), 731-742.*

Imonikebe, B.U. 2022. Malnutrition, prevention and treatment of diseases nutritionally for longevity. 95th in the Series of Inaugural Lectures of Delta State University, Abraka, Nigeria.

Levi, J. 2021. The fruits we eat and how they behave. God of Thunder Publisher.

Nicoli, M. C. 2012. *Shelf life assessment of food*. Boca Raton: Taylor & Francis

Nour, A.A.M., Khalid, K.S.M. & Osman, G.A.M. 2011. Suitability of some Sudanese mango varieties for jam making. *American Journal of Scientific and Industrial Research, 2*(1), 17-23.

Ogunlade, A.O.& Oluwafemi, G.I. 2021. Production and evaluation of jam produced from plum and African Star apple blends. *Food Research, 5*(4), 93 – 98.

Rashima, R.; Maizura, M.; Hafzan, W.M.; & Hazzeman, H. 2019. Physicochemical properties and sensory acceptability of pineapples of different varieties and stages of maturity. *Food Research 3*(5), 491 – 500

Ribeiro, S.M.R. & Schieber, A. 2010. Chapter 34 - bioactive compounds in mango (Mangifera indica L.). In: R.R. Watson & V.R. Preedy, Bioactive Foods in Promoting Health (507– 523). Cambridge: Academic Press.

Shamsudin, R.; Daud, W. R. W.; Takriff, M. S.; & Hassan, O. 2007. Physicochemical properties of the josapine variety of pineapple fruit. *International Journal of Food Engineering*, *3*(5), 1 – 16.

Sissons, B. 2019. Benefits of fruit consumption. Retrieved on 15th February, 2023 from *https://www.medicalnewstoday.com/articles/324431*

Sousa-Gallagher, M. J., Mahajan, P. V. 2011. Stability and Shelf Life of Fruit and Vegetables' In: Kilcast & Subramaniam (Eds.). Food and Beverage Stability and Shelf-Life. Chapter 22, pp 641-656, Cambridge, UK: Woodhead Publishing Ltd.

Stone, H. 2018. *Sensory evaluation practices*. San Diego: Academic Press.

Venkateswarlu, K. & Reddy, P.S.K. 2014. Mango: carotenoids. *International Journal of Pharmaceutical Sciences*, *2*(2), 741-744.

WHO 2017. Environmentally sustainable health systems: A strategic document. Retrieved on 12th March, 2023 from *https://www.who.int/publications/i/item/ WHO-EURO-2017-2241-41996-57723*