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Evaluation of Chemical and Sensory Properties of Fruit Bar from Blends of Banana and Paw-Paw Fortified with Protein Concentrate from African Yam Bean

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Abstract

This study aimed at evaluating chemical and sensory properties of fruit bar from blends of banana and paw- paw fortified with protein content from African yam bean Fruit bar samples were prepared with blends of ripe bananas and pawpaw, and protein concentrate from African yam bean in the ratios of 100:0:0, 70:25:5, 60:30:10 and 50:35:15 respectively, which were labeled as BPA1, BPA2, BPA3, and BPA4. The formulated samples were used to produce fruit bar. The proximate and vitamin composition were determine using standard methods. Sensory properties were evaluated using 9-point Hedonic scale. The results showed that the proximate composition of fruit bar samples ranged from 18.83 to18.19 % for moisture, 1.5 to 9.38 % for protein, 14.61 to 16.77 % for fat, 0.23 to 0.23% for fibre, 1.49 to 1.99 % for Ash, 63.37 to 53.45% for carbohydrate. Vitamin B_2 content ranged from 0.014 to 0.022 mg/100g. Increasing proportion of protein concentrate from African yam bean in fruit bar significantly ($p<0.05$) increases protein, fat, ash and fibre content of fruit bar. The sensory score showed that all the samples were generally accepted but the sample with 100% banana (BPA1) was the most preferred, followed by sample produced from 70% Banana, 25% Pawpaw and 5% African yam bean. Protein content of fruit bar from blends of banana and paw- paw was improved due to addition of African Yam bean.

Keywords: African Yam Bean, Banana, Pawpaw, Fruit Bar, Fortification, Protein Content.

Introduction

Fruit bars are dried sheet bars of fruit pulp that have soft, rubbery texture and sweet taste and it's also known as fruit leather or fruit roll. (Huang. and Hsieh 2005) It is classified as a confectionary product with longer shelf life and hygienic. They attractively packed and consumed readily. Fruit bar is a dehydrated and shelf stable product used as confectionary. Fruit bars are natural and nutritious product which can be eaten as a healthy alternative to other sweets, cookies, cakes which contain very high fat or sugar. Fruits bars basically made from pulp of fruit like pawpaw, mango, orange, grape etc which will retain most of the nutrients, minerals and flavor constituents thus forming a good nutritional supplement.

Banana (*Musa sapientum*) is the banana plant is the largest herbaceous flowering plant. A banana is a curved, yellow fruit with a thick skin and soft sweet flesh. The ripe banana is soft and delicate with a post- harvest shelf life of 5-10 days. Banana is rich in vitamin B6 (pyridoxine), manganese, vitamin C (ascorbic acid) a powerful natural antioxidant, potassium, dietary fibre, biotin and copper (Anon, 2016). Parimata and Puneet (2013) reported that banana pulp is very of soft, easily digestible and also contain simple sugars such as fructose and sucrose that when eaten replenishes energy and revitalizes the body instantly. The various parts of the plant such as the leaves, root, fruit stalk, bract and fruit have been used for medicinal and domestic purposes. Its sap is used as a remedy for diarrhea, dysentery,

Pawpaw (*Carica papaya*) is a tropical and subtropical food plant gaining popularity worldwide not just for the delicious fruit but also for medicinal properties of the whole plant part, leaf, fruit root, bark, peel, seed and pulp (Aravvind *et al;* 2013). The fruit is freshly, juicy and usually green and turns yellow or orange when ripe. Ripe pawpaw is usually consumed raw while the unripe is added in salads (5). Chukwuka *et al*; (2013) reported that unripe papaya fruit has higher amount of nutrients and beneficial ant-nutrients such as saponins, flavonoids, alkaloids and plants compared to hard ripe or very ripe fruit. The many benefits of papaya owed due to high content of vitamin A, B and C, proteolytic enzymes like papain and antibacterial properties (Tietze.2002). *Carioca papaya* can be used for treatment of a numerous diseases like warts, corns, eczema, cutaneous tubercles, glandular tumors, blood pressure, dyspepsia, constipation, amenorrhea and stimulate reproductive organs and many, and as a result *Carica papaya* can be regarded as nutraceutical (Aravvind *et al.* 2013). It contains vitamin C , magnesium, iron, and manganese. The fruit also contains a moderate amount of vitamin A.

African yam bean (*sphenostyli sstenocarpa*) is a hard- to- cook underexploited *leguminious* plant grown extensively in western African yam bean is rich in protein with values ranging between 19 and 30 % (Anya and Ozung, 2019, The protein in African yam bean compares favourably with those in pigeon pea, chicken pea, Bambara and common bean. It is also rich in dietary fiber (Anya and Ozung, 2019), Carbohydrate and important minerals such as calcium, iron, zinc, magnesium amongst others with values higher or comparable to soy and common bean (Nwosu, 2013; Ndidi and. Ndidi, 2014, Ajibola and Olapade, 2016, Adamu *et al., (*2015)). African yam bean is rich in essential amino acid (Ade-Omowaye *et al., 2015;* Chinonyere *et al.,* 2017,). Ajidola *et al* (2016) reported that albumin and globulin are the prevalent proteins present in AYB. Therefore, more attention needs to be given to this underexploited, cheap, and nutritionally important legume. African yam bean has been used in the development of fortified and enriched foods such as cookies and snacks (Idowu, 2014; Igbabul *et al.*, 2015), African yam bean has used to produced maize-AYB meal composite (Idowu, 2014), AYB enriched fufu (Aniedu and Aniedu,2014). Therefore, they can be used to fortify other food products low in protein to address protein malnutrition among the susceptible population. It is against this background that this seeks to improve the nutritional content, create variety and a shelf lasting fruit bar produced from blends of banana, and pawpaw pulp fortified with protein concentrate from African yam bean.

Statement of Research Problem

Fruit bar or leather are dehydrated and shelf stable product used as confectionary. The fruit bar is processed from available fruist such as mango, guava, banana pineapple among others. Fruit pulp is good source of carbohydrates, vitamin C and inorganic potassium, but lacks in protein and fat and therefore it is not considered to be nutritionally complete food. However, exorbitant cost of animal protein which low income earners cannot obtain has led to malnutrition in developing countries. The direct use of African yam bean flour to fortified food products results in the incorporation of protein and calories. It has great potential to provide good quality protein and calorie at low price and also which helps in combating protein-calorie malnutrition in the country. Inclusion of African yam bean in production of fruit bar is a means of tackle this problem.

Objectives of the study

The specific objectives of the study are to:

1. Produce fortified fruit bar from blends of Banana Paw- Paw and African yam bean
2. Evaluate proximate and vitamin content of developed fruit bar.
3. Evaluate consumer's acceptability of fortified fruit bar

Materials and Methods

Procurement of raw materials

The banana (1kg) and Pawpaw (3kg) were purchased from the Eke market Oko Orumba-North L.G.A Anambra State while African yam bean (AYB) was purchased from local market in Enugu State.

Sample preparation

Preparation of banana and paw paw pulp

The method of (Arinzechukwu and Nkama, 2019) was used to processed banana and pawpaw with slight modification. The ripe banana and pawpaw fruit were sorted to remove unwanted parts, then washed, peeled, and cult/sliced, the fruit were then blended with electric blender separately. The banana and paw paw pulp were packaged separately and kept in airtight container for further use.

Preparation of African Yam Bean Protein Concentrate

The method of Ajibola et al (2016) was used to produced African yam bean protein concentrate. The African yam bean was soaked for 12 hours, washed, dehulled and grinded. The grinded African yam bean was sieved, and the filtrate was heated to almost boiling. The heated filtrate was poured into a bowl immediately and lemon juice was added and covered till it precipitates. The precipitate was sieved with muslin cloth and placed on an expeller to remove more water, then dried in an oven.

African Yam Bean

↓

Selected and soaked for about 12hrs

↓

Washed

↓

Blend/grind

↓

Sieving

↓

Heat filtrate to almost boiling

↓

Precipitation

(Poured into a bowl and add lemon juice)

↓

Sieving

↓

Draining of water

↓

Oven drying

↓

Protein concentrate

Figure 1: extraction of protein concentrate from AYB.

Formulation of the fruit pulp and AYB concentrate

Table 1: Proportions of the fruit pulp and AYB concentrate for the production of the fruit bar sample.

Sample	Banana pulp	Pawpaw pulp	AYB Concentrate
BPA 1	100	0	0
BPA 2	70	25	5
BPA 3	60	30	10
BPA4	50	35	15

Production of fruit bar from blends of banana and pawpaw pulp fortified with protein Concentrate from African Yam Bean

The method of (Arinzechukwu and Nkama, 2019) was used to produce fruit bar Fruit bar sample was prepared from blends of fruit pulp (banana and pawpaw pulps) and AYB concentrate in the ratios as shown in the table above. The blended samples were mixed with sugar (70g), citric acid (5g), ground date powder (50g) and sodium meta-bisulphite (2g) and all were thoroughly homogenized using blender. The mixture was heated to 95°c for 5 minutes to concentrate the mixture, inactivate enzymes and inhibit microbial actions. The mixture was then poured into 25 X 25cm aluminum trays covered with aluminum foil that was smeared with glycerin which aided the easy peeling off of the fruit bar after drying. The fruit bar was then oven dried at 90 °c for 9hrs. The dried fruit bars was manually cut into equal shapes or bars and packaged.

Banana pulp pawpaw pulp protein conc. of AYB

↓

Mixed

↓

Addition of sugar and citric acid

↓

Pouring into aluminum trays [1cm thick in 25x25cm]

↓

Drying [90°c for first 9 hours]

↓

Cooling

↓

Cutting into equal shapes

↓

Packaging

↓

Fortified fruit bar

Figure 2: Production of fortified fruit bar.

Determination of Proximate Composition

Samples were analyzed for proximate composition using the method of AOAC (2010).

Moisture content determination

Two gram (2 g) of each sample was weighed into an aluminum dish with cover. Dish cover and covered dishes and was place in an oven previously regulated to 135±2 °C and samples dried until constant weight was obtained. Each cover was put on the dish, then moved to a desiccator to cool before being weighed again. Each sample's percentage moisture content was estimated using the formula:

$$\%\,moisture\ content = \frac{W_2 - W_3}{W_2 - W_1} \times \frac{100}{1}$$

Where: W_1 = weight of empty oven dish, W_2 = weight of oven dish + sample before drying, W_3 = weight of oven dish + sample after drying.

Crude protein determination

Kjeldahl technique, as specified by AOAC, (2010) was used to measure crude protein. Each sample was weighed at 1.0 g and placed in a Kjeldahl flask along with 3.0 g of hydrated cupric sulphate (catalyst). The materials were digested by adding 20 mL of anhydrous sodium sulfate and 1.0 g of concentrated sulphuric acid (H2SO4). The mixture was heated while being clamped, rendering the solution colorless. After cooling, the clear solution was diluted with distilled water to a final concentration of 100 mL. The digest (10 mL) was done by mixing with 5 mL of 40 percent sodium hydroxide solution and distilled. 0.1M hydrochloric acid was used to titrate the distillate (HCL). When the color changed from green to pink, the titre value or end point, the crude protein was measured as a percentage using the following formula:

$$\%\ Nitrogen = \frac{Titre\ value - Blank \times Normality\ of\ acid}{Weight\ of\ sample} \times \frac{100}{1}$$

Crude protein = %N x 6.25

Crude fibre determination

Using the AOAC, (2010) method, the crude fiber content of each sample was determined. A digital balance with the model number LP202A was used to weigh the sample, which weighed two grams (W_1) and was then placed in a beaker with 100 mL of 0.12M H_2SO_4 to boil for 30 minutes. This was then thoroughly rinsed with hot water until the washing was no longer acidic, and then it was filtered using muslin cloth on a fluted funnel. Then, using a spatula, it was scraped back into the flask. The sample in the flask was mixed with 100 mL of 0.02M NaOH, which was then gently heated for 30 minutes before being filtered through muslin cloth. The residue was carefully cleaned for three minutes using boiling distilled water and methylated spirit. The residue was put into a crucible that has already been dried and weighed, and it was dried in an oven (model number BS2648) for an hour. After cooling in a desiccator, the crucible with its contents will be weighed (W_2) using a digital balance (model no- LP202A). The sample was then fired at 600 °C for three hours in a muffle furnace, cooled, and weighed (W_3) using a digital balance (model no- LP202A). The formula: was used to get the crude fiber (%).

$$Crude\ fibre\ (\%) = \frac{Wt.of\ dried\ sample - Wt.of\ sample\ after\ incineration}{Initial\ wt.of\ sample} \times \frac{100}{1}$$

Ether extracts determination

The sample's fat content was determined using the Soxhlet extraction method (AOAC, 2010). Two grams (2.0 g) of each sample was weighed into the extraction thimble using a digital balance (model no – LP202A), and put in the soxhlet extraction tube. Petroleum ether (BP=40–60 °C) was added to a weighted flask until it was nearly three quarters full. The apparatus will be then set up and extraction was done for 6-8 hours to achieve complete extraction. The solvent (petroleum ether) was recovered and the oil was left in the flask at the end of the extraction. The flask with the oil was dried in the oven (model no: B & T-BS2648) at 80°C for 30 minutes, weighed using a digital balance after being desiccated and chilled (model no - LP202A). A proportion of the raw material was used to represent the fat content. The weight of the oil-filled flask differed from the empty one, and the amount of fat in each was estimated as follows:

$$\% \text{ Fat} = \frac{C-A}{B}$$

Where: A = Weight of empty flask
B = Weight of sample in g
C = Weight of flask + oil

Ash content determination

Using the AOAC (2010) method, the sample's ash content was determined. Weighing was done on a cooled and heated crucible (W_1). Each sample was added to the crucible weighing two grams (2 g) (W_2). In a fume cupboard, a Bunsen flame was used to char the sample. The charred sample in the crucible was transferred into preheated muffle furnace and ignited in a temperature-controlled furnace at 550 °C for 2 hours. The removed crucible and its contents were cooled in a desiccator, weighed, and then returned (W_3).
The following formula was used to determine the percentage ash content:

$\% \text{ Ash content} = \left(\frac{W_2-W_3}{W_2-W_1}\right) \times \frac{100}{1}$ 6Where: W_1 = weight of empty crucible, W_2 = weight of crucible and sample before ash,
W_3 = weight of crucible and sample after ash.

Carbohydrate content determination

The sample's carbohydrate content was assessed using various methods, such as;

$$\%Carbohydrate = 100 - (\%Moisture + \%\ protein + \%\ fibre + \%Ash + \%fat)$$

Determination of Vitamin B_2 content

The (A.O.A/C 2010) technique was used to calculate the riboflavin content. The standard ethanoic sodium hydroxide solution in 5 ml was used to homogenize a five gram (5g) sample. Filtered, the homogenate was increased in volume by the extract solution to 100 ml. The extract was aliquoted into a flask with a volume of ten (10) milliliters, and ten milliliters of potassium dichromate solution was then added. At room temperature (25 + 1°C), the resulting solution was incubated for 15 minutes. Using a reagent blank to calibrate the instrument to zero, the absorbance was measured using a spectrophotometer (Jenway, 6305 UV, United States) at 36 nm. It was determined how much riboflavin was present:

$$\text{Riboflavin (mg/100 ml)} = \frac{100}{w} * au * \frac{c * d}{as}$$

Where;
w = weight of sample analyzed; au =absorbance of the sample solution;

as = absorbance of standard solution;
c = concentration of standard solution;
d = dilution factor

Sensory Evaluation

This sensory evaluation was performed using the method of (Iwe, 2002). The twenty panelists were used for the sensory evaluation of fruit bar, they were selected in polytechnic community. The panelists were guided on how to carry out the test. The fruit bar samples were evaluated for sensory attributes such as colour, taste, texture, aroma and overall acceptability. A 9-point Hedonic scale (9 for extremely like to 1 for dislike extremely). A questionnaire was distributed among the panelists.

Statistical Analysis

The t data generated from proximate analysis and sensory evaluation were subjected to analysis of variance (ANOVA) and Duncan multiple range tests was used to separate the means at (P<0,05).

Results and Discussion

Table 2: Proximate composition of the fruit bar from blends of banana, pawpaw and African Yam Bean protein concentrate

Sample	Moisture	Protein	Fat	Fibre	Ash	CHO
BPA 1	$18.61^{a}\pm 0.89$	$1.57^{d}\pm 0.31$	$14.70^{a}\pm 0.31$	$0.30^{a}\pm 0.26$	$1.49^{a}\pm 0.00$	$63.32^{a}\pm 0.14$
BPA 2	$18.51^{a}\pm 0.14$	$5.23^{c}\pm 0.00$	$14.11^{a}\pm 0.08$	$0.77^{a}\pm 0.20$	$1.67^{a}\pm 0.58$	$59.38^{ab}\pm 0.02$
BPA 3	$18.27^{a}\pm 0.04$	$6.08^{b}\pm 0.00$	$15.12^{a}\pm 1.61$	$0.30^{a}\pm 0.26$	$1.27^{a}\pm 0.23$	$53.52^{b}\pm 0.01$
BPA 4	$18.18^{a}\pm 0.05$	$9.38^{a}\pm 0.00$	$16.24^{a}\pm 1.82$	$0.30^{a}\pm 0.23$	$1.66^{a}\pm 0.57$	$53.52^{b}\pm 1.61$

Mean values in the same column with the same superscripts are not significantly (p>0.05) different. **Key:** BPA1=100% banana**,** BPA2=70% banana, 25% pawpaw, 5% African yam bean**,** BPA3=60% banana, 30% pawpaw, 10% African yam bean. BPA4=50% banana, 35% pawpaw, 15% African yam bean

Effect of Protein Concentrate from African Yam bean (AYB Proximate Composition of Fruit bar from blends of banana and paw paw

Table.1. Shows the results of the proximate composition of the fruit bar from blends of banana, pawpaw and protein concentrate from African yam bean. The moisture content of the fruit bar samples ranged from 18.61% in sample BPA1 to 18.18% in sample BPA4. There were no significant (p>0.05) differences among the samples. The range of moisture content observed in this study was lower than the ranged (18.92 to 22.64 %) recorded by Arinzechukwu and Nkama,(2019) and Rehman et al.(2022) in fruit bars prepared by banana and cashew pulp and Apricot respectively. This may be due to addition of protein concentrate from African yam been. The low moisture content of these fruit bar product indicates longer storability and shelf life. Increasing proportion of protein concentrate from African yam bean in fruit pulp decreases moisture content of fruit bar. This might increase the shelf life stability of this fruit bar.

There were significant ($p<0.05$) differences in the protein content of formulated fruit bar samples. The protein content ranged from 1.57% in sample BPA1 (100% Banana) to 9.38% in the sample BPA4(50% Banana, 35% Pawpaw and 15% African yam bean). The value (9.38%) of protein content in this study was higher than value (3.32%) recorded by Arinzechukwu and Nkama, (2019). This may be attributed to addition of protein concentrate from African yam bean. Increase in proportion of AYB protein concentrate increases the protein content of fruit bar.

The Fat content of the fruit bar sample ranged from 14.70% in sample BPA1 to 16.24% in sample BPA4. There was no significant ($p>0.05$) difference among the samples. Increase in addition of protein concentrate from African yam bean in fruit pulp increases the fat content of fruit bar. The variation may be due to high oil content in African yam bean.

The crude fibre content of the fruit bar ranged from 0.23 to 0.30% in the sample BPA4 (50% Banana, 35% Pawpaw and 15% African yam bean). There was no significant ($p<0.05$) difference existed among the sample. The values obtained from this study was lower than value (1.00 to 2.05%) obtained by Arinzechukwu and Nkama (2019) in fruit bar produced from banana and Cashew apple fruit blends. This implies that sample BPA2 (70% Banana, 25% Pawpaw and 5% African yam bean) is a good source of dietary fibre. Fibre is advantageous in food as it absorbs water and provides roughage for bowel, assisting intestinal transit (Ibeji,2021)

There was no significant ($p>0.05$) in ash content of fruit bar. Sample BPA4 had the highest value (1, 66 %) in ash content while sample had lowest value (1.49%) The range of ash content of fruit bar in this study was lower than range (8.27 to 12.47%) recorded by Offia-Olua and Ekwunife (2014) in fruit bar produced from apple, banana and pineapple

The percentage ash of a sample gives an idea on the inorganic content of the samples from where the mineral content could be obtained. Sample with higher ash content is expected to have high concentration of various mineral elements

The carbohydrate content of the fruit bar decreased significantly with the increase in the concentration of the African yam bean. There was no significant ($p<0.05$) difference between the samples BPA1(100% Banana), BPA2(70% Banana, 25% Pawpaw and 5% African yam bean), BPA3(60% Banana, 30% Pawpaw and 10 African yam bean) and BPA4(50% Banana, 35% Pawpaw and 15% African yam bean). This result is in agreement with the production and evaluation of fruit bars from banana and cashew apple fruits blends by Arinzechukwu and Nkama, (2019).

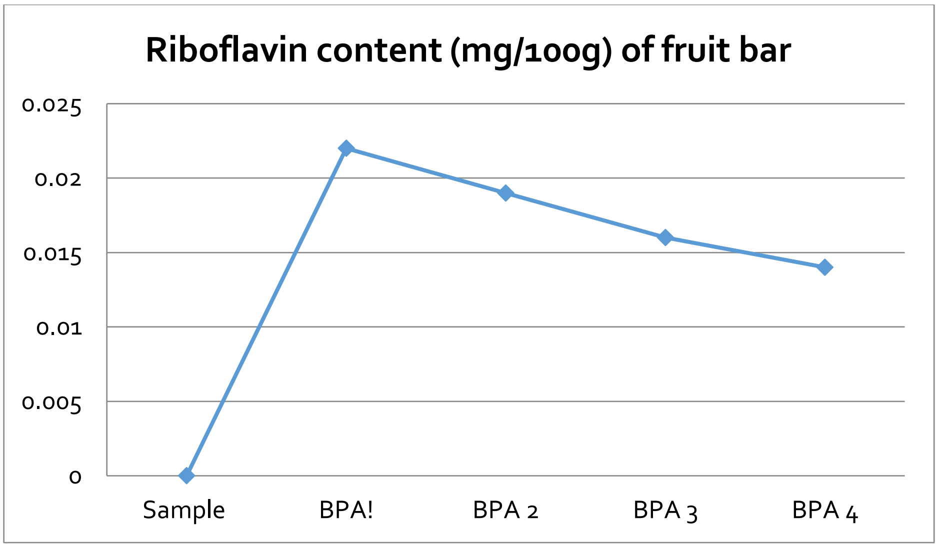

Figure 2: Riboflavin content of fruit bar

Effect of Protein Concentrate from African Yam bean (AYB Vitamin B_2 content of fruit bar from blends od banana and pawpaw)

Vitamin content of fruit bar ranged from 0.014 to 0.022 mg/100g. According to the results above, the vitamin B_2 values decreases as the ratio of bananas decrease. This might be because of the fact that the banana fruit contains more riboflavin than the pawpaw and the African yam bean concentrate. Increase in addition of protein concentrate from African yam bean significantly ($p>0.05$) decreases the vitamin B_2(Riboflavin) of fruit bar. Riboflavin is important for energy production, enzyme function and normal fatty acids and amino synthesis It also play vital role in regulation of human health and metabolic process and act as antioxidant (Jurgen 1999; Tzeyan , 2023).

Table 2: Sensory evaluation of fruit bars from blends of banana, pawpaw and African Yam Bean protein concentrate.

Sample	Color	Taste	Texture	Aroma	Overall acceptability
BPA 1	$7.15^{ab}\pm 0.50$	$8.30^{a}\pm 0.00$	$8.35^{a}\pm 0.21$	$8.10^{a}\pm 0.00$	$8.00^{a}\pm 0.14$
BPA 2	$6.95^{b}\pm 0.35$	$7.60^{a}\pm 0.14$	$7.80^{a}\pm 0.70$	$8.10^{a}\pm 0.00$	$7.75^{a}\pm 0.24$
BPA 3	$6.80^{b}\pm 0.42$	$7.05^{ab}\pm 0.21$	$7.15^{ab}\pm 0.07$	$7.50^{a}\pm 0.14$	$7.00^{ab}\pm 0.70$
BPA 4	$6.50^{b}\pm 0.00$	$6.80^{b}\pm 0.14$	$6.65^{b}\pm 0.21$	$7.10^{a}\pm 0.14$	$6.65^{ab}\pm 0.49$

Mean values in the same column with the same superscripts are not significantly different ($P>0.05$). **Key:** BPA1=100% banana, BPA2=70% banana, 25% pawpaw, 5% African yam bean**,** BPA3=60% banana, 30% pawpaw, 10% African yam bean. BPA4=50% banana, 35% pawpaw, 15% African yam bean.

Effect of Protein Concentrate from African Yam bean (AYB Sensory Properties Of Fruit Bar from banana and pawpaw

Sensory properties of products are the most vital attributes, as they are most apparent to consumers. Colour is one of the important quality parameters of the fruit bars which contribute to its aesthetic appeal. The mean scores for colour ranged from 6.50 to 7.15. Sample BPA1 (100 Banana) had the highest score (7.15) for colour while sample BPA4(50% Banana, 35% Pawpaw and15% African yam bean) had the least mean score (6.50) for colour. There were no significant (p>0.05) differences between the samples. The appearance of the samples must have been influenced by the variation in colour and the mixing formulations of the fruit purees and ingredients with the acceptability of appearance decreasing with increase in addition of protein concentrate from African yam bean.

Taste acceptability ranged from 6.80 to 8.30. The highest value was obtained for sample BPA1 (100% Banana) while the least was obtained for sample BPA4 (50% Banana, 35% Pawpaw and 15% African yam bean). Taste are one of the important sensory attributes which to a large extent determine the acceptability of food products. Therefore, the results showed that there were no significant (p>0.05) differences between the samples.

There were no significant (p>0.05) differences among the samples. Mouthfeel ranged from 8.35 to 6.65. Sample BPA1 (100% Banana) had the highest mean score. The result showed that the sample BPA1 was preferred more than the other samples of the formulated fruit bar samples.

The flavour of food is a very essential parameter in sensory qualities. The mean scores of flavour ranged from 8.10 in sample BPA1(100% Banana) to 7.10 in sample BPA4(50% Banana, 35% Pawpaw and 15% African yam bean). There were no significant (p>0.05) differences existed among the samples. The results showed that the flavour of all the samples were liked by the panelists.

There were no significant (p>0.05) differences in the overall acceptability of all the samples. All samples were accepted by the panelists. Sample BPA1 (100% banana) was most preferred by the panelists in all the sensory attributes

Generally from the result, the mean scores for overall acceptability of all the different formulated fruit bar samples with African yam bean protein concentrate were more than 6.0 (slightly like),Tthis implies that mixed fruit bar from blends of banana and pawpaw fortified with African yam bean protein concentrate could be produced without having a negative impact on the consumer's preferences.

Conclusion

From this study, it has shown that the utilization of African yam bean (AYB) into the fruit bars produced from blends of banana and pawpaw improved the nutritional qualities. The addition of African yam bean improved the protein content of the formulated fruit bars which is an essential nutrient needed in the body for growth and repair of tissue. It is also evident that the incorporation of the African yam bean improves the nutritional and vitamin content of; rather it had some positive effect like the increase in the ash content which provides minerals to the body and the decreased in moisture content which helps to improve the shelf stability of the fruits and its sustainability over a long period of time. The sensory results showed that all the samples were generally accepted but the sample with 100% banana was the most preferred followed by the sample produced from 60 % Banana, 30% Pawpaw and 10% African yam bean (BPA3).

Recommendations

- Inclusion of indigenous crop like African yam bean in fruit bar increase the protein content and also nutrition content is recommended to produce it.
- Further studies should be conducted to determine the mineral and amino acids profile of this fortified fruit bar.
- Studies should also be conducted to evaluate storage stability of this developed fruit bar.

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