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Research Article

Effect of Producing Energy Bars from *Xanthosoma sagittifolium cv okoriko* and Some Fruits and Nuts

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Abstract

This study utilized flour from *Xanthosoma sagittifolium cv okoriko* and some fruits and nuts for the production of energy bars with the bid to promote the utilization of *Xanthosoma sagittifolium cv okoriko*. The cocoyam (*Xanthosoma sagittifolium cv okoriko*) was peeled, washed, sliced and sun dried and further dried in oven at 65oC for 9h, milled into flour and sieved. The proximate composition of the flour sample was determined. Energy bars were produced from 100% cocoyam flour with varying fruits and nuts. The result of proximate composition of the flour sample indicated a protein content of 7.8%, ash content of 3.2%, fiber content of 0.5%, fat content of 4.5%, moisture content of 11.5% and carbohydrate content of 72.5%. The organoleptic properties of the energy bar samples indicated that the control had the highest values for taste, aroma, texture and overall acceptability with scores of approximately 8.0 for each attribute and was significantly ($p \leq 0.05$) different from other samples in terms of texture and overall acceptability while sample EBGD3 (100% cocoyam flour, groundnuts and dates) was the most accepted of all the samples excluding the control with the highest value in crispiness (approximately 8.0) and it was significantly ($p \geq 0.05$) similar to sample EBCD1 (100% cocoyam flour, cashew nuts and dates) in terms of colour. The findings from this work indicates that cocoyam (*Xanthosoma sagittifolium cv okoriko*) flour could be used in the production of quality energy bars and could also be used for substituting wheat flour up to 100% in energy bar production without adversely affecting the sensory attributes of the products.

Keywords: *Energy Bars; Flour; Okoriko; Organoleptic Properties*

Introduction

Energy foods are foods that contain many calories and give a lot of energy when they are broken down and absorbed in the body (http://www.dictionarycentral.com). Energy is required by the body to do work and to perform all the physiological functions of the body. The foods which provide the energy giving nutrients are called energy giving foods. Energy giving nutrients include carbohydrates and fats, although proteins also provide energy their most important function is to build and repair body tissues (www.wikieducators.org). Energy bars are examples of energy foods. They are confectionary products usually coated with chocolate and are sometimes referred to as food bars, snack bars and protein bars depending on its composition. Energy bars are bar-shaped foods, similar in size and shape to a chocolate bar, which has high calorie content and is considered a convenient source of energy. They typically contain a combination of fats, carbohydrates, proteins and fortified with vitamins and minerals https://en.wikipedia.org). Energy bars vary in size and composition, but most times their major ingredients are whole grains, nuts and seeds, dried fruits, flour, fat, egg and chocolate. Biscuits coated or enrobed with chocolate are referred to as snack or energy bars (https://en.wikipedia.org).

Flour used in making specialty foods is made from soft wheat, it is therefore of economic importance if wheat importation is reduced by substitution with other local sources of flour for baking [1]. For example, cocoyam, cassava, maize and other carbohydrate and protein rich flours commonly found in abundance in Nigeria can be used for wheat flour substitution.

Cocoyam (*Xanthosoma sagittifolium* and *Colocasia esculenta*) is an edible root crop grown in the tropics of which Nigeria is a major producer. It belongs to the family *Araceae* [2]. Cocoyam contributes significant portion of the carbohydrate content of the diet in many regions in developing countries and provide edible starchy storage corms or cormels [2]. Cocoyam has nutritional advantages over other root and tuber crops [3]. It has more crude protein than other root and tuber crops and its starch is highly digestible because of the small size of the starch granules, its contents of calcium, phosphorus, vitamin A and B [3]. All these are lost to nutrition because of low production and underutilization. Ammar., *et al*. [4] noted that edible aroid flours could be advantageous in the preparation of myriad products by the food development industry since it could be used in dehydrated soup formulation, baking goods, formulation of baby food, snacks and breakfast products. The flour from cocoyam has been used in baking of products as it has been reported that cocoyam has fine starch granule, which improves binding and reduces breakage of snack products [5]. Recent studies show that cocoyam starch can be incorporated in the development of weaning food which is easily digestible and accessible to low income earners in developing countries [6].

The cocoyam (*Xanthosoma sagittifolium cv okoriko*) is one of the important root food crops especially among the low income earners in Nigeria. However, the utilization options of cocoyam are mainly limited to direct consumption as whole and boiled tuber or pounded into fufu and used as a soup thickener, thus making it an underutilized tuber and an insufficiently studied crop [7]. The utilization and market options of cocoyam are very limited due to limited processing and utilization options. *Xanthosoma sagittifolium cv okoriko* is no longer in use and are uprooted by farmers and thrown away. They are currently found in abandoned farmlands and in disposal dumps. *Okoriko* has large corms and is very prolific indicating that it will have high carbohydrate content and nutritive value needed for food. The major limiting factor in the utilization of *Xanthosoma sagittifolium cv okoriko* is the presence of oxalates which impart an acrid taste or cause irritation in the throat and mouth when foods prepared from it are eaten and interfere with bioavailability of calcium [8], high rate of post-harvest losses and the lack of scientific attention [9]. Other problems associated with processing and utilization of okoriko among others, include low storage and bulkiness. For greater utilization, *Xanthosoma sagittifolium cv okoriko* should be processed into dehydrated forms to maintain stability, for better storage and offer convenience and ease in preparation into other food forms [10], investigation should be made into forms that *Xanthosoma sagittifolium cv okoriko* corms and cormels should be converted to for ready utilization and acceptability and further exploration be made on the use of *okoriko* flour as a composite in specialty foods. Therefore, the objective of this study is production and sensory evaluation of energy bars from *Xanthosoma sagittifolium cv okoriko* flour and various fruits and nuts.

Over the years, the demand for pastry products in Nigeria has been on the increase and these are sold at every corner of the street as snacks. As the demands increase, there is tendency for the cost of wheat flour to increase and the cost implication of importing wheat flour on the nation's foreign reserve. The use of *Xanthosoma sagittifolium cv okoriko* in specialty foods will improve cocoyam competitiveness alongside other root and tuber crops, enhance its application in other food systems and improve economic potentials. Furthermore, the farmers are bound to grow more *Xanthosoma sagittifolium cv okoriko* as its utilization potentials are increased and this will in turn enhance their earnings and hence value addition for cocoyam in energy bar production.

Materials and Methods

Cocoyam (*Xanthosoma sagittifolium cv okoriko*) used in the research work was purchased from a local market in Mbaise, Imo state. The cocoyam was purchased wholesome, that is, it was free from rot and had no physical damage. The milk powder, sugar, egg, salt, margarine, baking powder, chocolate, fruits and nuts were purchased from Owerri main market, Imo state.

Equipment, chemicals (reagents) and other facilities used in the research work were obtained from the laboratories of the Department of Food Science and Technology and Department of Biochemistry, Federal University of Technology, Owerri, Imo state.

Production of cocoyam flour

The fresh corms of cocoyam (*Xanthosoma sagittifolium cv okoriko*) were washed, peeled, washed again and shredded into thin slices/size or thickness. The slices were sundried for 2h. After which the slices were spread thinly on drying trays and placed in the oven. It was then dried at a temperature of 65°C for 9h. The dried samples were removed from the oven, cooled and stored in a polyethylene bag. Before milling, the samples were put in the oven and dried at 65°C for one hour to make the slices crispy. Then, the samples were cooled and ground into flour using a disc attrition mill. The flour was sieved using a 60 mesh sieve. The cocoyam flour was stored in air tight bottles, labelled and kept in a cool dry place for further analysis. The flow diagram for the production of the flour is shown in figure 1. Pictures of *Xanthosoma sagittifolium cv okoriko* corms and dried slices are shown in plate 1 and 2.

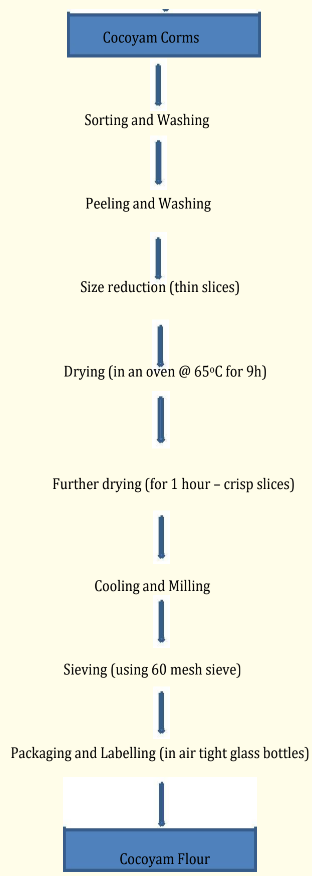

Figure 1: *Flow chart for cocoyam (Xanthosoma sagittifolium cv okoriko) flour production.*

Plate 1: *Cocoyam (Xanthosoma sagittifolium cv okoriko) corms and Plant.*

Plate 2: *Shredded and dried Cocoyam (Xanthosoma sagittifolium cv okoriko).*

Production of Energy Bar

The processed cocoyam (*Xanthosoma sagittifolium cv okoriko*) flour was used for the production of energy bar using standard recipe. The technology used in the formulation of the energy bar was previously reported by Silva., *et al.* [11], with some modifications. Ingredients used are stated in table 1.

Ingredients	Percentage	Proportion (g)
Flour	100	200
Fat	60	120
Sugar	60	120
Egg	25	50 ml
Water	15	30 ml
Salt	1.5	3
Baking powder	1.5	3
Vanilla powder	2.5	5
Milk powder	2.5	5
Dates	60	120
Cashew nuts	60	120
Chocolate	100	200

Table 1: *Ingredients for Energy bar production.*

Source: (Silva., et al. 2014)

The method used is based on Silva., *et al*. [11]. The flour (200g), baking powder (3g), milk powder (5g), vanilla powder (5g) and salt (3g) were sieved together using a fine sieve (1 mm aperture) to get a uniform particle size. The creaming method was used. In a large bowl, the fat (120g) and sugar (120g) were mixed using a wooden spoon for 3 min; the egg (50 ml) was added to the mixture and further mixed. The dates were pitted and soaked in warm water for 5 min. The cashew nuts and dates were crushed to reduce its size. The sieved dry ingredients, crushed dates and cashew nuts were added to the fat-sugar-egg mixture with water (30 ml) and kneaded to form dough. The dough was rolled into a uniform thickness of about 6 - 7 mm on a lightly floured surface. The dough was cut into bar-shaped sizes using a cookie cutter and placed half inch apart on a lightly greased baking tray and baked at 220oC for 15 min. After baking, the bars were removed from the oven and placed on a wire rack to cool completely for about 30 min. The chocolate was put into a stainless bowl and melted over simmering water. Each bar was dipped into the melted chocolate until totally coated with chocolate. The coated bars were put back on the wire rack and chocolate was left to harden completely. The energy bars were then packaged in glass cookie jars and sealed tightly prior to further analysis. The flow chart for the production of energy bars is shown in figure 2 and Plate 3.

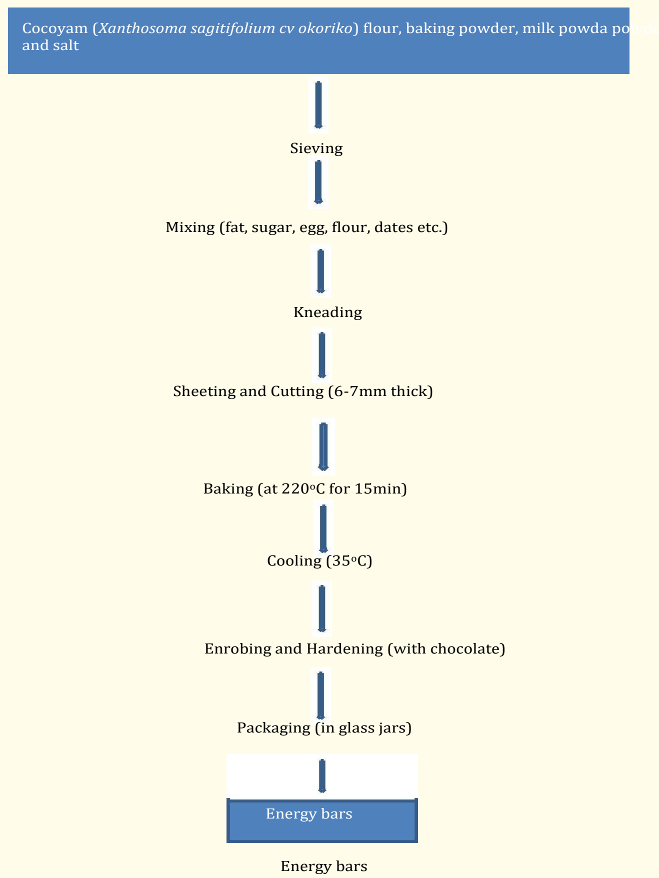

Figure 2: *Flow chart for Energy bar production.*

Plate 3: *Energy bars made from 100% cocoyam (Xanthosoma sagittifolium cv okoriko) flour, fruits and nuts.*

Proximate analysis

The proximate analysis of the flour sample was carried out using standard methods of Association of Official Analytical Chemists [12].

Sensory Evaluation

The energy bars' quality was assessed by a test panel of 20 judges. A 9-point hedonic scale quality analysis as described by Larmond [13], was used with 1 = dislike extremely, 5 = neither like nor dislike, and 9 = like extremely to evaluate the colour, taste, aroma, texture, crispiness and overall acceptability of the samples. The panelists were instructed to rinse their mouths with water after tasting every sample and were also asked to comment freely on samples on the questionnaires given to them.

Statistical Analysis

Data were obtained in triplicate and subjected to analysis of variance (ANOVA) and the treatment means separated using Fishers LSD (Least significant difference) test.

Results and Discussion

Proximate composition

The proximate composition of the cocoyam (*Xanthosoma sagittifolium cv okoriko*) flour is shown in Table 2.

Constituent	Content (%)
Moisture	11.5
Protein	7.8
Ash	3.2
Fibre	0.5
Fat	4.5
Carbohydrates	72.5

***Table 2:** Proximate composition of Cocoyam (Xanthosoma sagittifolium cv okoriko) Flour.*

**Data are mean values of triplicate determination*

The protein content of the cocoyam flour was 7.8%. This protein content of 7.8% was within the range of protein content (7.4 - 8.9%) reported by Amandikwa [14] for cocoyam (*Xanthosoma sagittifolium*) flour, though there was no indication of the cultivar that was used in that work. The ash and fat contents of the cocoyam flour obtained from the work were 3.2% and 4.5% respectively. The fiber content of the flour was 0.5%. Owuamanam., *et al*. [15] reported a similar result where the fiber content of the cocoyam flour ranged from 0.20 - 0.99%, though the cultivars that were used were not stated. The moisture and carbohydrate contents of the cocoyam flour were 11.5% and 72.5% respectively. The low moisture value showed that the cocoyam (*Xanthosoma sagittifolium cv okoriko*) flour could have a long shelf life. The low moisture content of the flour could promote food security and reduce post-harvest losses prevalent with cocoyam. The high carbohydrate content (72.5%) indicated that cocoyam could be a good source of energy.

Sensory properties of the energy bars

The mean sensory scores of Energy bars produced were shown in Table 3.

Sample	Color	Taste	Aroma	Texture	Crispness	Overall Acceptability
EBCD1	7.40 ± 0.82[a]	7.00 ± 1.17[b]	6.85 ± 1.81[ab]	6.50 ± 1.19[b]	6.75 ± 1.59[a]	7.05 ± 0.95[bc]
EBMR2	6.10 ± 1.92[b]	5.55 ± 1.79[c]	6.40 ± 1.60[b]	6.55 ± 1.23[b]	7.10 ± 1.45[a]	6.20 ± 1.06[cd]
EBGD3	7.10 ± 1.89[ab]	7.35 ± 1.87[ab]	6.15 ± 1.79[b]	6.90 ± 1.45[b]	7.60 ± 1.19[a]	7.10 ± 1.55[b]
EBCM4	6.65 ± 1.81[ab]	5.45 ± 2.3[c]	6.85 ± 1.50[ab]	6.60 ± 1.64[b]	6.10 ± 2.36[a]	6.10 ± 1.92[d]
CONT	7.25 ± 1.97[a]	8.35 ± 1.23[a]	7.75 ± 1.12[a]	8.00 ± 1.12[a]	7.35 ± 1.98[a]	8.35 ± 1.09[a]
LSD	1.089	1.082	0.992	0.840	–	1.210

Table 3: *Mean sensory scores of Energy bar samples produced from Cocoyam flour with varying nuts and fruits*

a – d: Means with different superscripts along the same column differ significantly at P < 0.05; LSD: Least significant difference.

Key: EBCD1: Energy bar with cashew nuts and dates; EBMR2: Energy bar with Macadamia nuts and raisins; EBGD3: Energy bar with Groundnut and dates; EBCM4: Energy bar with cashew nuts and mixed fruits; CONTROL: Energy bar purchased from the market.

Colour

Sample EBCD1, which was produced using cashew nuts and dates had the highest score of approximately 7.0 with regards to colour and was significantly ($p \leq 0.05$) similar to the control sample. The colour of all the samples were significantly ($p \leq 0.05$) similar and were moderately liked with a score approximately 7.0 except for EBMR2 which was slightly liked (with a score approximately 6.0).

Aroma

Samples EBMR2 and EBGD3 were not significantly ($p \geq 0.05$) different with regards to the aroma, and they had the lowest mean scores of approximately 6.0 (slightly liked). Also, samples EBCD1 and EBCM4 were "moderately liked" with a score of approximately 7.0, but they showed no significant ($p \geq 0.05$) difference from the control (which had the highest score of approximately 8.0) and was "very much liked" according to the panelists.

Taste

Samples EBMR2 and EBCM4 showed no significant ($p \geq 0.05$) difference with regards to taste and they had the lowest score of approximately 6.0 (slightly liked). Sample EBGD3 and the control were significantly similar ($p \geq 0.05$) although the control sample had the highest score of approximately 8.0 (very much liked). The high rating of all the samples could be due to the fruits and nuts they contained as none of the samples were rejected.

Texture

The texture of the control sample was significantly ($p \leq 0.05$) different from all the other energy bar samples (EBCD1, EBMR2, EBGD3, EBCM4) and was "very much liked" while the other samples were "moderately liked".

Crispiness

There was no significant difference ($p \leq 0.05$) amongst all the energy bar samples with respect to their crispness, hence, samples EBCD1, EBMR2, EBGD3 and EBCM4 compares favorably with the control sample with respect to crispness. Sample EBGD3 had the highest score of approximately 8.0 (very much liked) but the rest of the samples including the control were rated "moderately liked" (with a score of approximately 7.0).

Overall Acceptability

Sensory evaluation of the energy bar samples produced from cocoyam flour using different nuts and fruits showed that the control sample (CONT) had the highest overall acceptance that is, "liked very much" with a score of approximately 8.0. Samples EBCD1 and EBGD3 which were not significantly ($p \geq 0.05$) different and were rated "liked moderately" with a scores of approximately 7.0. Samples

EBCM4 and EBMR2 were also significantly ($p \geq 0.05$) similar and were rated least in overall acceptability with scores approximately 6.0 (that is "slightly liked").

Conclusion

Result from this work showed that cocoyam (*Xanthosoma sagittifolium cv okoriko*) flour could be used in the production of quality energy bars. Also, cocoyam flour could be used for substituting wheat flour up to 100% level in the production of energy bars without adversely affecting the sensory attributes of the products. The energy bars which were made from 100% cocoyam flour, fruits and nuts were reasonably accepted by the judges with sample EBGD3 having the highest score of approximately 8.0 in crispiness and 7.0 in overall acceptability. The control was the most accepted followed by sample EBGD3. The cocoyam flour also impacted a very good colour and nice aroma to the energy bars which aided in increasing the overall acceptability of the energy bars. The use of cocoyam (*Xanthosoma sagittifolium cv okoriko*) flour will reduce the pressure on the use of wheat flour for production of specialty foods and help in utilization of cocoyam corms which is currently underutilized.

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