UTILIZATION OF COCOYAM (*Xanthosoma* sp.) FLOUR FOR FOOD

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ABSTRACT

Cocoyam flour was prepared into cookies, chips and noodles and used as binder in meat loaf. The sensory attributes of the products were comparable to the same products produced from wheat flour and corn starch, and all the processed products were acceptable.

Product evaluation revealed that the level of cocoyam flour in meat loaf formulation is inversely related to the degree of shrinkage and volume of drippings. Cookie measurements showed that the height and weight of baked cookies were not significantly affected by the addition of cocoyam flour. However, the diameter and spread ratio of baked cookies decreased.

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KEY WORDS: *Xanthosoma* sp. Cocoyam flour. Cookies. Chips. Noodles. Meat loaf.

INTRODUCTION

Xanthosoma sp. is one of the several rootcrops which are abundantly grown in the country. Locally known as cocoyam, it resembles *Colocasia* and is often confused with taro. The plant has central tuberous roots called corms surrounded by potato-like cormels. Cormels are usually used for food while corms are used as animal feed and planting materials. The cocoyam cormels are comparable to potato in their nutritive value with a protein content of 2-3%, rich in minerals and vitamins but deficient in lysine, methionine and cystine (NAS, 1975). Despite its adaptability and commercial food value, cocoyam receives little attention from researchers and food processors thus the crop is unpopular and unexplored.

Past and present investigations on rootcrops have been concentrated only on the feasibility of utilizing cassava, potato and yam. Nevertheless, cocoyam is already utilized for food in some places where young leaves and buds are made into a thick sauce called *vembe* (Karikari, 1971). It is also widely used in modern African kitchens (Lyonga, 1979). In Ghana and Gabon, cocoyam is economically important since corms, cormels and leaves are utilized for food (Wilson, 1979). In the Philippines, the potential of cocoyam as food ingredient is not fully investigated yet. Moreover, studies to assess the processing potential of cocoyam have not been conducted to date and hence, this study.

MATERIALS AND METHODS

Procurement of the Sample

Cocoyam tubers were purchased from Baybay, Leyte. Tubers about 9-12 months old were used and the time between harvest and processing was kept minimal.

Preparation of Cocoyam Flour

Fresh cocoyam tubers were washed, peeled and sliced thinly. The slices were washed with water and dehydrated in a cabinet dryer maintained at 50 ± 5°C. The dried slices were ground in a cereal mill and passed through a 60-mesh screen. The resulting flour was stored in an airtight container until used.

Product Development

Food products prepared in the study were cookies, meat loaf, chips and noodles. Ingredients used and procedure followed for each product were based on the study of Atutubo (1983).

Sensory Evaluation

Sensory evaluation was carried out to determine if the products developed from cocoyam flour possess desirable sensory attributes. Sliced samples of meat loaves from different treatments were evaluated for crumbliness, juiciness, flavor and acceptability; cookies for color, texture, flavor and acceptability; and noodles and chips for texture, flavor and acceptability. Sensory attributes of processed cocoyam products were evaluated by at least 10 experienced panelists who are staff and students of the Institute of Food Science and Technology in UPLB. Samples were randomly coded with 3-digit numbers. Evaluation of samples was carried out at about mid-afternoon in individual booths provided with daylight. Each judge was provided with a glass of water for rinsing his mouth in between samplings. Sensory attributes were assessed using quality scoring.

Product Evaluation

Meat loaf. Cooking losses and amount of drippings from the meat loaf were evaluated. Percentage cooking loss of each treatment was calculated using the following formula:

$$\text{Cooking loss (\%)} = \frac{\text{original weight} - \text{drained weight}}{\text{original weight}} \times 100$$

The amount of drippings from each treatment was determined by allowing the oil from the cooked meat loaf to drip, collecting the drippings and measuring the volume using a 100-mL graduated cylinder.

Cookies. Baked cookies were evaluated using the modified method of Finney et al. (1949) in order to determine the effect of substituting wheat flour with cocoyam flour on cookie quality. Parameters measured were weight, height, diameter and spread ratio. Five samples were randomly taken from the baked cookies of each treatment and individual weights were noted. The diameter at three different locations of the samples was measured after weighing. The height of cookies was determined at the middle portion of the product after cutting it at the center. Spread ratio of the cookies was obtained by dividing the diameter of the cookies by the height.

Noodles. Cocoyam flour was processed into noodles employing the methods of Atutubo (1983). The freshly cut noodles were blanched, drained and washed with tap water. The blanched noodles were prepared into noodle soup and subjected to sensory evaluation.

Chips. Chips were prepared from wheat flour with different levels of cocoyam flour substitution. The method of kropeck production was followed. Dried chips were deep fried and subjected to sensory evaluation.

Statistical Analysis

The experiment was set up using the randomized complete block design (RCBD). Data from sensory evaluations were subjected to analysis of variance. The least significant difference (LSD) was computed to determine differences among treatment means.

RESULTS AND DISCUSSION

Meat Loaf

In terms of cooking losses, meat loaf with 100% cocoyam flour as binder showed the least amount of cooking loss (Table 1). However, it did not significantly differ from other treatments except from that of the sample with no added binder. The capacity of cocoyam flour to minimize cooking loss in the meat loaf explains the minimal shrinkage observed in the product with 100%

Table 1. Cooking losses of meat loaf using different levels of cocoyam flour as binder.

Cornstarch-Cocoyam Flour Ratio (%)	Cooking Loss[1] (%)
No binder	23.00a
100: 0	9.71b
85:15	9.46b
50:50	9.10b
35:65	8.70b
15:85	8.35b
0:100	7.55b

[1] Values followed by a common letter are not significantly different at 5% level, LSD.

cocoyam flour as binder. This trend supports the data obtained on the water absorbing capacity of cocoyam flour. Cocoyam flour has high water absorbing capacity which could explain the minimal cooking loss and shrinkage of the meat loaf (Lauzon, 1984).

The volume of drippings from meat loaf with different levels of cocoyam flour instead of cornstarch as binder is shown in Table 2. Meat loaf with cocoyam flour as binder gave significantly less drippings than that with 100% cornstarch. The high fat absorbing capacity of cocoyam flour explains the minimal amount of drippings in the former formulation. This is apparently also the reason why meat loaf with 100% cocoyam flour as binder was most juicy and compact.

Table 3 shows the mean sensory scores of meat loaf with cocoyam flour instead of cornstarch as the binder in the formulation. The meat loaf using 100% cocoyam flour as binder obtained the highest mean sensory scores in all quality attributes evaluated although all the samples did not significantly differ. This implies that 100% cocoyam flour can be used as meat loaf binder without affecting the sensory attributes of the product. Waldt and Kehoe (1959) obtained similar observations with the use of cassava flour as binder in meat loaf. Due to the bland taste of cassava flour, the flavor of the meat loaf was not altered. This was likewise noted in cocoyam flour.

Table 2. Volume of drippings from meat loaf using different levels of cocoyam flour as binder.

Cornstarch-Cocoyam Flour Ratio(%)	Volume of Drippings[1] (mL)
No binder	47.5a
100: 0	19.0b
85:15	17.0b
65:35	12.5cd
50:50	10.0de
35:65	8.0de
15:85	7.0de
0:100	5.0e

[1] Values followed by a common letter are not significantly different at 5% level, LSD.

Table 3. Mean sensory scores of meat loaf using cocoyam flour as binder.

Cornstarch-Cocoyam Flour Ratio (%)	Sensory Attribute[1]			
	Crumbliness	Juiciness	Flavor	Acceptability
No binder	4.0	4.2	5.6	5.9
100: 0	4.7	4 6	5.1	5.9
85:15	4.9	4.5	5.3	5.7
65:35	4.9	4.4	5.2	5.3
50:50	4.6	4.8	5.1	5.5
35:65	4.9	5.2	5.2	5.7
15:85	4.5	4.8	5.1	6.0
0:100	5.1	5.7	6.1	6.1

[1] Means of 10 replications. In a column, values are not significantly different. Rating scales used:

Crumbliness : 8 = extremely compact,
1 = extremely crumbly

Juiciness : 8 = extremely juicy,
1 = extremely dry

Flavor : 8 = extremely full, rich and blended flavor,
1 = extremely weak and bland flavor.

Acceptability : 8 = extremely acceptable,
1 = extremely unacceptable

Cookies

The mean sensory scores of cookies prepared with different amounts of wheat flour substituted with cocoyam flour are summarized in Table 4. Results disclosed that cocoyam flour can substitute for wheat flour in cookie formulations since the sensory quality attributes of the products did not significantly differ.

The mean weight and height of cookies using different levels of cocoyam flour did not significantly differ (Table 5). However, the diameter of cookies appeared to vary inversely with the amount of cocoyam flour in the cookie formulation. All cookies with formulations wherein cocoyam flour was used to replace wheat flour were significantly smaller in diameter than those produced from wheat flour. Consequently, the smaller diameter of cookies produced from cocoyam flour as compared to those produced from 100% wheat flour resulted in a decrease in the spread ratio of the cookies.

The mechanism affecting cookie spread reduction by certain wheat flour substitutes is not completely understood (Sathe et al., 1982). Kissell and Yamazaki (1975) revealed that addition of ingredients to a cookie system with high water retention properties results in increased competition for the limited amount of free water present in the cookie dough. The rapid partitioning of water to added site of hydrophilicity within the system results in decreased solution of sugar, increased concentration of solution and greater dough viscosity. Yamazaki (1955) has shown that such conditions reduce cookie spread ratio and limit top grain formation. This is supported by the present data which indicate that as the amount of substitution increases, the spread ratio correspondingly decreased.

Chips

Results revealed that cocoyam flour can successfully replace wheat flour in the formulation of chips, since the sensory quality attributes of the two flours are comparable (Table 6). Based on the results of sensory evaluations, the judges could not discern any difference in the qualities of the products. Furthermore, the chips were found acceptable even with 100% cocoyam flour.

Noodles

The mean sensory scores for noodles prepared from cocoyam flour are presented in Table 7. All the products were comparable in terms of texture, flavor, off-flavor and acceptability. Thus, cocoyam flour can be used as wheat flour substitute, up to 100% substitution in noodle production without altering the basic sensory attributes of the product.

CONCLUSION AND RECOMMENDATION

The results of the study imply that substituting wheat flour with

Table 4. Mean sensory scores of noodles using different levels of cocoyam flour as wheat flour substitute.

Amount of Cocoyam Flour (%)	Sensory Attribute[1]			
	Color	Texture	Off-Flavor	Acceptability
0	4.1	4.0	4.9	4.4
10	3.9	3.0	4.7	4.9
20	4.0	3.8	4.7	4.1
30	4.3	3.8	4.7	4.7
40	4.2	3.6	4.5	4.3
50	3.7	3.5	4.5	3.9
100	3.4	3.6	4.1	3.0

[1] Means of 10 replications, in a column, values are not significantly different. Rating scales used:

Color : 5 = uniform golden brown, 1 = uneven golden brown
Texture : 5 = fine, 1 = tough
Off-flavor : 5 = none, 1 = highly perceptible
Acceptability : 5 = most acceptable, 1 = least acceptable

Table 5. Mean scores for cookie measurement.[1]

Percent Cocoyam	Weight (g)	Height (cm)	Diameter (cm)	Spread Ratio
0	4.10a	1.10a	3.55a	1.15a
10	4.15a	1.20a	3.40a	2.80a
20	4.10a	1.40a	3.30a	2.25b
30	4.10a	1.65a	3.30a	2.00b
40	4.05a	1.80a	3.25a	1.75bc
50	4.10a	1.85a	3.05b	1.60bc
100	4.05a	1.90a	3.90bc	1.45bc

[1] Means of 7 replications. In a column, means followed by a common letter are not significantly different at 5% level, LSD.

Table 6. Mean sensory scores of chips using different levels of cocoyam flour as wheat flour substitute.

Amount of Cocoyam Flour (%)	Sensory Attribute[1]			
	Texture	Flavor	Off-Flavor	Acceptability
0	4.2	4.2	4.1	4.4
10	4.2	4.3	4.4	4.3
20	4.2	4.5	4.4	4.4
30	4.5	4.4	4.3	4.5
40	4.3	4.2	4.2	4.5
50	4.3	4.3	4.1	4.5
100	4.3	4.2	4.2	4.4

[1]Means of 10 replications. In a column, values are not significantly different. Rating scales used:

Texture	: 5 = crispy and fracture easily, 1 = tough and compact
Flavor	: 5 = very desirable, 1 = extremely undesirable
Off-flavor	: 5 = none, 1 = highly perceptible
Acceptability	: 5 = most acceptable, 1 = least acceptable

Table 7. Mean sensory scores of noodles using different levels of cocoyam flour as wheat flour substitute.

Amount of Cocoyam Flour (%)	Sensory Attribute[1]			
	Texture	Flavor	Off-Flavor	Acceptability
0	4.0	3.8	4.5	3.9
10	3.9	3.8	4.5	4.0
20	4.0	3.9	4.6	4.3
30	4.2	3.7	4.5	4.3
40	3.9	3.9	4.8	4.3
50	4.3	3.9	4.8	4.3
100	3.9	3.8	4.6	4.0

[1]Means of 10 replications. In a column, values are not significantly different. Rating scales used:

Texture	: 5 = soft but firm noodles, 1 = soft and mushy, grain coarse and unblended ingredients
Flavor	: 5 = flavorsome, 1 = unappetizing
Off-flavor	: 5 = none, 1 = highly perceptible
Acceptability	: 5 = most acceptable, 1 = least acceptable

cocoyam flour in the preparation of meat loaf, cookies, chips and noodles will not alter the sensory quality attributes of the products. Products with cocoyam flour were comparable to those prepared from wheat flour or cornstarch. Therefore, cocoyam flour is a potential substitute for wheat flour in the preparation of the aforementioned food products. However, there is a need to verify the results in the laboratory by conducting consumer testings to determine consumers' reaction to the products. Furthermore, studies on product storage which include microbiological analysis of stored products, evaluation of packaging materials and chemical composition of the products should be undertaken.

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