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Organoleptic and Nutritional Analysis of Taro and Wheat Flour Composite Bread

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Abstract: The effect of supplementing wheat flour with taro flour in the production of bread has been investigated. It is observed from the organoleptic analysis of the taro-supplemented bread samples studied in this work that generally, the preference for taro-supplemented bread decreased with the amount of taro in the bread. However, the panellists scores for the composite bread in some attributes were comparable to the control. Bread with 30 percent taro flour had the highest rating in colour while the bread with 50 percent taro flour had the highest rating in texture. Although the bread from the whole wheat flour was rated higher in many of the attributes, the taro-supplemented bread produced desirable organoleptic quality. Incorporation of taro flour to wheat flour would lead to reduction of cost of bread in Ghana. The preference of the panellists for the sensory attributes of the wheat flour bread may be due to the familiarization of consumers to the normal whole wheat flour. From the proximate analysis, it was observed that the increased amount of taro resulted in decreasing the protein content, fat, carbohydrate and energy while moisture and ash increased.

Key words: Taro · Wheat · Organoleptic analysis · Proximate analysis

INTRODUCTION

Bread is an important wheat based product, which has gained wide consumer acceptability and its consumption is steady and increasing in Ghana and the West African sub-region [1], Bread is prepared by cooking dough of flour, margarine, yeast and water and the addition of other ingredients. It is interesting to know that bread is one of the types of food eaten by both the rich and the poor. It therefore has to be affordable to all irrespective of the social status. However, bread from wheat flour is quite expensive since wheat is not produced by any of the West African countries including Ghana and has to be imported [2].

In order to reduce the cost of bread to meet the pockets of many consumers, there has been the demand for the use of novel sources as substitute for the wheat flour. Various governments in the sub-region are encouraging the inclusion of locally starchy food crops, including cassava (*Manihot esculenta Crantz*) and sweet potato (*Ipomoea batatas*), potato (*Solanum tuberosum*), yam (*Dioscorea spp.*), cocoyam (*Xanthosoma sagittifolium*) and taro (*Colocasia esculenta*), which have been found to be important calorie sources [3], into wheat flour.

Taro is a monocot and a member of the araceae family of plants [4], It is cooked like yam but has an inferior taste as a result of which it is considered as a stand-by crop worth eating only during the seasonal famine period. Its cultivation has therefore received only limited attention [5].

Taro is rich in energy or carbohydrate, low in fibre and is a fair source of oils and fats. When compared with Tania and other roots, it has the highest source of phosphorus, magnesium and zinc. The protein of taro is well supplied with essential amino acids though in low histidine and lysine. It is fairly rich in carotene, ascorbic acid, thiamine, riboflavin and nicotinic acid. Most of the non-starchy nutrients such as proteins, minerals are concentrated in the outer peels of the corms [6], Taro has been reported to have 70-80 % starch with granules of small size [7], The small size granules make taro highly digestible, so it is used in preparation of infant foods in Hawaii and other Pacific islands, as well as in Chad [8, 9], Given these characteristics, taro flour has much potential for use in food formulation.

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Taro has been found to be an important ingredient in the production of beverages and for partial replacement of wheat flour in bread [9], cookies [10], taro-based deserts [11] and miscellaneous taro-based products [9]. There is thus generally thought to be much potential for the partial substitution of wheat flour with taro in order to diversify and upgrade taro use in countries which do not produce wheat, like Ghana. Indeed, partial substitution of wheat bread with up to 20 % of taro has been found to be generally acceptable to bread consumers in some countries in Africa [12-14], This research is to assess the general acceptability of taro-substituted wheat bread (up to 50 %) in Ghana. The chemical composition of the taro-based bread is also investigated.

MATERIALS AND METHODS

Sample Collection: Fresh corms of taro and wheat flour were purchased from a local market in Accra, Ghana and taken to the laboratory of the Food Research Institute of the Council of Scientific and Industrial Research. The corms of taro were washed, cleaned and rinsed with copious amounts of tap water before being used for the study.

Taro Flour Production: Taro flour was prepared by peeling and slicing the corms and cornels and washing the slices thoroughly in portable tap water in order to remove as much mucilaginous material as possible. The slices were then dried to a brittle texture in a convention oven at 60°C for 24 hours. Dried slices were milled into flour using an attrition machine. The flour thus produced is packaged in polyethylene bags and stored in desiccators until required for use. A summary of the preparation of the taro flour is presented in a flow chart in fig. 1.

Thoroughly wash the taro to remove soil.

↓

Peel the taro, wash and drain.

↓

Slice into a required thickness approximately (1/4 inch) and wash

↓

Dry in a regularized mechanical dryer for 24 hours at 60oC.

↓

Mill the taro in attrition machine for 15 minutes.

↓

Package in polyethylene bags and store in a desicator

Fig. 1: Flow chart for the taro flour preparation

Weigh all ingredients into a mixing bowl

↓

Mix all ingredients into dough.

↓

Knead the bread firmly until smooth and free from stickiness.

↓

Divide into required pieces and mould into desired shapes

↓

Place into a greased loaf tins and leave to prove at room temperature.

↓

Bake in a pre-heated oven at 180-200°c in between 25-30 minutes.

↓

Remove and place on cooling rack.

↓

The above method was used for all the samples

Fig. 2: Flow Chart for Preparation of Bread

Wheat-Taro Composite Flour Preparation: Four samples taro-wheat mixture were prepared by mixing taro flour with wheat flour in the proportion indicated in table 1, with appropriate ingredients (water, salt, sugar, yeast milk, etc) using a Kenwood food mixer KN 201, England. The amount of ingredients in the mixture is indicated in table 2. The mixing was done to ensure a homogeneous mixture of the samples. The four sample formulations were baked using the straight dough method [15], (Fig. 2).

All the ingredients were mixed in a Kenwood food mixer (Model A907 D) for approximately 5 min. The dough were left in bowls to prove covered with damp clean muslin cloth for approximately 55min at room temperature (29°C), the dough was then knocked and moulded into a loaf, placed in a loaf tin and further proved in a proving cabinet for 90 min at 30°C, 85% relative humidity and baked at temperature between 180°C and 200°C for approximately 30 min [16], It was removed and placed on a cooling rack and packaged in a transparent polyethylene with a label and stored in a cool dry place until needed.

Sensory Evaluation: The sensory evaluation for the samples was carried out according to the methods of Larmond [17] and Watt *et al.* [18], twenty trained and experienced panellists of the Food Research Institute rated the samples for taste, colour, crust, texture and overall acceptability. All sessions were in a sensory panel room kept at 20°C and equipped with partitioned booths and cold white fluorescent lights. Panellists were each provided with some amount of water at room temperature

Table 1.1: THE PERCENTAGE COMPOSITION OF WHEAT AND TARO FLOUR

SAMPLES	AMOUNT TAKEN(g)	% WHEAT FLOUR	% TARO FLOUR
A	400g wheat flour-0g taro flour	100	0
B	280g wheat flour-120g taro flour	70	30
C	240g wheat flour-160g taro flour	60	40
D	200g wheat flour-200g taro flour	50	50

Table 2:

SAMPLE	Wheat flour	Taro flour	Margarine	Sugar	Dry yeast	Diluted milk	Salt	Nutmeg	Baking time	Oven °C
A	400g	-	50g	50g	½tsp	200ml	1/4stp	1/4tsp	30m	180°C
B	280g	120g	50g	50g	½tsp	220ml	1/4tsp	1/4tsp	30m	180°C
C	240g	160g	50g	50g	½tsp	22ml	1/4tsp	1/4tsp	30m	180°C
D	200g	200g	50g	50g	½tsp	200ml	1/4tsp	1/4tsp	30m	180°C

to rinse their mouths after each sample. A hedonic scale 1-5 was used where 5 was extremely acceptable and 1 extremely unacceptable. Each evaluation was carried out in duplicates.

Statistical Analysis: Data was analysed using analysis of variance (ANOVA). Duncan multiple range test was used to determine significant difference among the various samples. Data were analysed using the software statistical package for social science (SPSS) version 11.00SPSS Inc., Chicago. IL. USA at the 0.05 level using the one-way analysis of variance (ANOVA) test.

Proximate Analysis: Proximate analysis of samples was determined according to [19, 20]. The samples were analyzed for moisture, ash, protein, fat, carbohydrate (By difference) energy (Atwater).

RESULTS AND DISCUSSIONS

Sensory Evaluation: Table 3 gives the percentage score of the comparative sensory evaluation of the taro-wheat flour bread. The *crust* as applied here is the outside layer of the bread. It should be smooth and golden brown. 100 percent of the panellists prefer the crust of sample A while 88 percent prefer sample D. The crust of sample C is the least preferred. Thus, the panelists seem to the crust of the whole wheat bread to the taro-supplemented bread. It can be seen from Table 4 that the whole wheat bread is rated significantly ($p < 0.05$) different from the taro-based samples.

The *colour* of bread talks about the appearance of the bread, how it looks like, if it is appealing to the eyes, inviting and bright. 100 percent of the panellists prefer the colour of sample B while 96 percent prefer sample C.

Table 3:

	Sensory qualities				
Sample	Crust (%)	Colour (%)	Taste (%)	Texture (%)	Overall acceptability (%)
A	100	42	100	97	100
B	79	100	85	77	78
C	68	96	59	90	65
D	88	67	91	100	87

Table 4: Hedonic sensory mean of the taro-based bread

	Sensory qualities				
Sample	Crust	Colour	Taste	Texture	Overall acceptance
A	3.400±0.221	1.900±0.277	3.400±0.277	2.900±0.526	4.600±0.516
B	2.700±0.213	4.500±0.167	2.900±0.167	2.300±0.423	3.600±0.339
C	2.300±0.429	4.300±0.153	2.000±0.153	2.700±0.473	3.000±0.333
D	3.000±0.816	3.000±0.333	3.100±0.303	3.000±0.471	4.000±0.149

Table 5: Results of Proximate Analysis

			Results			
Parameter	Methods	Unit	Sample A100-0	Sample B70-30	Sample C60-40	Sample D 50-50
Moisture	AOAC 925.10 (1990) 15th Edition	g/100g	29.1	37.4	35.6	37.0
Ash	AOAC 923.03 (2000) 17th Edition	g/100g	1.04	1.16	1.28	1.82
Fat	AOAC 920.39C (2000) 15th Edition Modified	g/100g	5.6	2.1	2.9	1.7
Protein	AOAC 984.43 (1990) 15th Edition	g/100g	7.70	5.95	5.42	5.74
Carbohydrate	By difference	g/100g	56.56	53.39	54.80	53.74
Energy	Atwater factor	g/100g	307.4	256.3	267.0	253.22

The colour of the whole wheat bread is the least preferred. The means of the taro-supplemented bread are significantly different from the whole wheat bread at 5% significant level. Thus the panellists prefer the colour of taro-based bread to that of the whole wheat bread.

The *taste* of the bread refers to the sweet sensation caused in the mouth by contact with the bread due to the sweetening agent. 100 percent of the panellists prefer the taste of the whole wheat bread (samples A) while 91 percent prefer the taste of sample D. In terms of taste, the least preferred is sample C. Although the mean of sample D is close to that of sample A, the mean of sample A is found to be significantly different from those of the taro-supplemented samples.

Texture is the quality of the bread that can be decided by touch, the degree to which it is rough or smooth, hard or soft. The panellists slightly prefer the texture of sample D (100 percent) to that of the bread made from the whole wheat sample A (97 percent). 90 percent of the panelists also prefer sample C while 77 percent preferred sample B. The mean indicates that there is insignificant difference between the textures of samples A, C and D at 5% significant level.

The *overall acceptance* expresses how the consumers or panellists accept the product generally. It is observed that 100 percent of the panellists accept the whole wheat flour while 87 percent of the panellists accept the bread with 50 percent of taro flour. 78 The analysis of variance indicates that there is a significant difference between the sample with whole wheat flour and those with taro flour at 5% significance level.

It was observed from the organoleptic analysis that generally, the preference for taro-supplemented bread decreased with the amount of taro in the bread. However, the panellists scores for the composite bread in some attributes were comparable to the control (whole wheat bread-sample A). Bread with 30 percent taro flour (sample B) had the highest rating in colour while the bread with 50 percent taro flour had the highest rating in texture. Although the bread from the whole wheat flour was rated higher in many of the attributes, the taro-supplemented bread produced desirable organoleptic quality. Incorporation of taro flour to wheat flour would lead to reduction of cost of bread in Ghana. The preference of the panellists for the sensory attributes of the wheat flour bread may be due to the familiarization of consumers to the normal whole wheat flour.

Proximate Analysis: The chemical composition of taro-supplemented bread is presented table 5. It was observed that the amount of ash increased slightly with increasing amount of taro in the bread. It can be inferred from the amount of ash that the taro-supplemented bread contains appreciable amounts of minerals compared to that of the whole wheat bread. On the other hand, the level of available carbohydrates in the whole wheat bread drops slightly as the amount of taro increased. The fat content of the whole wheat bread is found to be almost two times that of the taro-based bread. The protein content is also found to decrease as taro is substituted for wheat in the bread. These results agree favourably with the results of Njintang *et al.* [12, 21] and other workers [22].

CONCLUSION

In conclusion, the preference for taro-supplemented bread decreased with increasing amount of taro in the bread. From the proximate analysis, it was observed that increased amount of taro resulted in a decrease in the protein, fat, carbohydrate and energy while moisture and ash increased.

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