

Proximate Composition and Consumer Acceptability of Wheat-Soy Composite Rock Cake

¹*Sampson G. O., ¹Adam, N. and ¹Boakye, V.

¹Department of Hospitality and Tourism Education, University of Education, Winneba

*Corresponding author: gosampson@uew.edu.gh

Abstract

Cookies are traditionally made from soft wheat, a cereal, which is cultivated mostly in temperate regions but imported by countries in the tropics with unfavorable climatic conditions to cultivate the cereal. The aim of the study was to determine the proximate composition and consumer acceptability of rock cakes developed from soy flour. Four different products were thus formulated viz., 0%, 20%, 25% and 75% being replaced with soy flour equivalence in each sample. Samples were examined for their proximate composition using AACC, 2000 methods. Sensory evaluation was also conducted under a 7-point hedonic scale, where 1 represented dislike extremely and 7 represented like extremely. Data was analyzed using SPSS v 20 at 95% confidence interval. Proximate composition analysis showed no significant difference between the means of the constituent nutrients measured. However, the proportionate increased percentage fat, fiber and protein; 26 ± 2.45 , 2.00 ± 0.28 and 16.80 ± 2.94 respectively, showed the potential effect of soybean flour in the production of rock cakes. The sensory analysis also showed no significant difference at $P < 0.05$ between the means and according to the hedonic scale evaluation, WSR11, WSR12 and WSR13 composite rock cakes compared to WSR10, the 100% wheat flour rock cake were “moderately liked” and “like very much” that is, between 5.3 to 6.6 by the fifteen semi-trained panelist. In effect, soybean flour could serve as a nutrient fortification raw product component and as well, to be accepted by consumers of pastries.

Keywords: Rock cakes, proximate analysis, sensory analysis, consumer acceptability, hedonic

1. Introduction

Cookies are snacks that are popular and widely consumed all over the world by people of all ages (Okpala et al., 2013). They are traditionally made from soft wheat, a cereal, which is cultivated mostly in temperate regions but imported by countries in the tropics with unfavorable climatic conditions to cultivate the cereal (Sampson and Assuah, 2016). Such importing countries spend a lot of foreign exchange on importation of wheat (Okpala et al., 2013). Snacks come in a variety of forms including packaged snack foods and other processed foods, as well as items made from fresh ingredients at home (CASRC, 2011). In Ghana however, snacks are often localized to more of carbohydrate based components, especially of cereal origin.

Rock cakes, one of the highly patronized snacks in Ghana market and consumed by almost all age groups, are mostly produced with cereal-based flour component. This makes rock cakes high in carbohydrates, fats as well as calorie, making it unhealthy for daily consumption especially for people who are diet conscious (Serrem et al., 2011).

According to Ayo and Nkama (2003), the consumption of biscuits and other western styled bakery products such as bread and cakes prepared from wheat flour has become very popular in developing countries, especially, among children. The relatively low protein content of wheat (refs), as well as the presence of gluten which predisposes consumers to celiac diseases (refs) has been of major concern in its utilization in most snacks in Ghana. Also Ghana spends lots of its foreign exchange to import wheat thus putting strain on the economy (refs), the ripple effect is transferred into the cost of wheat-based products.

Protein Energy Malnutrition (PEM) is one of the four major nutritional problems in Ghana (refs) and most developing countries due to the prominence of cereal-based dietary patterns (refs). The fortification bakery products with other protein sources such as oilseeds and legumes have received considerable attention by most food product developers. This is because oil seed and legume proteins are high in lysine, an essential limiting amino acid in most cereals (Ihekoronye and Ngoddy, 1985).

According to FAO (1995), suggestion to meet the Recommended Dietary Allowances of infants, preschool children, adolescent girls, pregnant and lactating women, low-cost supplementary foods could be processed domestically by simple inexpensive processing technology. Whole legumes contain relatively high amount of protein compared to other plant foodstuffs. Legume proteins complement the protein in cereal grains since the chemical and nutritional characteristics of legumes make them natural complements to cereal-based diets (Altschull, 1994).

Soybean, (*Glycine max*) a grain legume, is one of the richest and cheapest sources of plant protein that can be used to improve the diet of millions of people, especially the poor and low income earners in developing countries because it produces the greatest amount of protein used as food by man (Liu, 2000). Soybean has been processed into many secondary products viz., soymilk, soy sauce, tofu (soybean curd), soy-yoghurt, soy sprouts, soy flour and many other soy products with the objective of adding value to the plant protein as well as diversifying its utilization. Defatted soybean flour can be used for the production of protein isolates and concentrates. *Glycine max* contains 43.2% good quality protein but only minimal saturated fat, 21% carbohydrates (Gopalan et al., 1999) and sufficient amount of minerals and vitamins which helps in the conversion of carbohydrates, fat and protein into energy.

Many Ghanaians are faced with acute economic hardship and the lack of knowledge about less expensive but high protein food options, has consequently lead to inadequate intake of balanced diets as well as poor eating habits. Thus predisposing lots of middle class Ghanaians to non-communicable diseases such as type 2 diabetes and cardiovascular diseases. In addition, post-harvest losses of most Agricultural produce has become a predominant phenomenon that has devastating consequences on the issue of food security in the country and thus continues to impoverish growers in developing countries like Ghana, typically soybean, which has over the years been designated as neglected underutilized legume (NUL) in Ghana.

In tackling the PEM phenomenon while managing the low economic status of the Ghanaian populace, much knowledge about the diversity of use of legumes (soybean) in the production of bakery products such as rock cakes, tit bits, pie crust etc needs to be intensified. For this reason, the study focused on analyzing the proximate composition and consumer acceptability of rock cakes developed from soybean flour.

2. Material and Methods

The ingredients used for the product included soybean flour, wheat flour, sugar, margarine, egg, currants and baking powder. Equipment used included; oven, patty tins, baking sheet, mixing bowl, pastry brush, kitchen scale and measuring cup.

2.1 Preparation of Soybean Flour

The soybean flour was prepared according to the method described by Ihekoranye and Ngoddy (1985). About two kilograms of soybean seeds which were free from dirt and other foreign particles such as stones, sticks and leaves were weighed, cleaned and soaked in tap water for 8 hours. Thereafter, the seeds were drained, de-hulled manually, boiled (100°C, 30min) and dried in cabinet dryer to constant mass at 65°C for 6hr. During drying, the de-hulled seeds were stirred at intervals of 30 minutes to ensure uniform drying. The dried seeds were milled using the attrition mill and sieved to obtain cooked soybean flour with particle size of 0.2mm. The soybean flour obtained was finally packaged in an air tight HDPE and stored in a cool and dry place for further treatment and analysis.

2.2 Product formulation

Samples of four (4) Test Treatments with labels; WSR10, WSR11, WSR12 and WSR13 were used and per the various percentage incorporation of both wheat flour and soybean flour as well as the other ingredients are shown in the Table 1 below

Table 1: Formulations of full wheat and composite rock cakes

Product	Flour (%)		Margarine (g)	Sugar (g)	Egg (1 large)	Currants (g)	Baking powder (g)
	WF%	SF%					
WSR10	100	0	75	75	1	50	5
WSR11	80	20	75	75	1	50	5
WSR12	75	25	75	75	1	50	5
WSR13	25	75	75	75	1	50	5

WSR10 = Control (100% WF) WSR11 = (80% WF: 20% SF) WSR12 = (75% WF: 25% SF)
 WSR13 = (25% WF: 75% SF); WF = Wheat flour SF = Soy flour

2.3 Physiochemical parameters

Proximate composition (water, ash, fiber, protein, fat and carbohydrate) of the various samples were determined using official methods (AACC, 2000).

2.4 Sensory evaluation

A panel of fifteen semi-trained judges were employed for the Sensory Analysis based on a hedonic scale of 1-7; where 1 = Dislike extremely and 7 = like extremely under the following criteria: colour, taste, after taste, hardness and overall acceptance. A 4 x 3 factorial experiment laid out in a randomized complete block design with three replications was used for the study.

2.5 Statistical analysis

A descriptive analysis encompassing means, standard deviation, coefficient of variation and least significant difference were computed. Analysis of variance (ANOVA) was computed and differences in means were located using Least Significant Difference (LSD) test at 95% confidence interval. Statistical Package for Social Scientists version 16 was used for all computations.

3.0 Results and discussion

Proximate analysis

The results of proximate composition of the four products developed in the current study are shown in Table 2.

Table 2: Percentage mean values of the proximate composition of the Rock cake formulations developed.

Product	Moisture (%)	Ash (%)	fat (%)	fibre (%)	Protein (%)	Carbohydrate %
WSR10	8.70 ^a ±0.13	0.36 ^a ±0.72	20.00 ^a ±2.04	1.49 ^a ±0.21	9.50 ^a ±2.94	60.00 ^a ±1.58
WSR11	8.75 ^a ±0.24	0.23 ^a ±0.13	20.00 ^a ±2.49	1.92 ^a ±0.11	9.76 ^a ±4.14	59.46 ^a ±6.31
WSR12	9.95 ^a ±0.50	0.77 ^a ±0.28	22.00 ^a ±1.58	1.35 ^a ±0.19	11.34 ^a ±1.49	54.60 ^a ±2.11
WSR13	8.75 ^a ±0.48	1.30 ^b ±0.42	26.00 ^b ±2.80	2.00 ^b ±0.20	16.80 ^b ±2.11	45.50 ^b ±5.81
CV%	7.68	89.66	12.87	24.12	29.47	13.13
LSD	1.35	0.70	2.45	0.69	2.35	14.4

WSR10 = Control (100% WF) WSR11 = (80% WF: 20% SF) WSR12 = (75% WF: 25% SF) WSR13 = (25% WF: 75% SF); WF = Wheat flour SF = Soy flour

3.1 Moisture content of rock cake with varying soy flour composition

Moisture content of food is a quality parameter that estimates shelf life (ref). Moisture is one of many environmental conditions that support microbial growth and spoilage. As a food preservation principle, the water activity level in food product should prevent microbial growth and thus prolong the shelf life of food. The percentage mean moisture content recorded in the current study ranged between 8.70%±0.13 to 9.95 %±0.50. Generally, moisture content of the soy-wheat composite rock cakes recorded relatively higher mean values compared to the 100%WF (control) rock cake. Rock cake with 25% replaced soybean flour recorded the highest moisture content while the control sample recorded the least. The increase in moisture content could be associated with increase in fiber content of the soybean generally. No significant difference (P<0.05) however existed among the means of the four treatment samples used in the study.

3.2 Ash content of rock cake with varying soy flour composition

Ash refers to the inorganic residue remaining after either ignition or complete oxidation of organic matter in a foodstuff, and it represents the total mineral content in food (Nielsen, 2010). Availability of minerals in diet helps in the metabolism of macro nutrients for the release of energy. The ash content of the composites rock cakes gave increased percentage nutrient measures with increasing proportions of the soybean flour. This phenomenon could be attributed to the fact that legumes are reported to be good sources of ash (Pyke, 1981). Sample WSR13 had the highest ash content which was significantly different from the other three.

3.3 Fat content of rock cake with varying soy flour composition

The substitution of soybean flour for the wheat flour was also found to increase the fat component especially for sample WSR12 (22.00±2.45) and WSR13 (26.00±2.45), respectively as shown in Table 2. Analysis of variance revealed that WSR13 was significantly different from the other three samples at 95% confidence interval. Soybean is credited with the ability to lower total blood cholesterol levels by up to 30% because of its high water soluble fibre content (Teixeira et al., 2000; Desroches et al., 2004). As such the high crude fat content might not impose a negative nutritional property to the rock cakes.

3.4 Fiber content of rock cake with varying soy flour composition

The crude fibre analysis showed a higher percent mean value for the 75% soy fractioned rock cake (Sample WSR13) recorded as 2.00±0.28 as shown in Table 2 above. Nonetheless, the differences between the mean values from the table were not significantly different (at P < 0.05) for samples WSR10, WSR11 and WSR12. The increased fiber values in the composite rock cakes with consequent lower carbohydrate content have several health benefits, as it will aid in the digestion in the colon and reduce constipation.

3.5 Protein content of rock cake with varying soy flour composition

This proportionate addition effect was also observed for protein as shown in Table 2. The percent mean protein content ranged between 9.50±0.25 to 16.80±0.88 with full wheat rock cake recording the least while 75% replaced soybean flour recorded a significantly higher (P<0.05) protein content compared to the other three samples examined. That is, protein contents of the wheat-soy composites in the rock cakes increased as the proportion of the soybean flour inclusion increased. The increase in the protein content agrees with the report of other workers (Fukushima, 1999; Olaye et al., 2006)

3.6 Carbohydrate content of rock cake with varying soy flour composition

The carbohydrate content of the composites rock cakes decreased proportionally with increasing soybean flour composition. This result attests to the fact that soybeans possess relatively lower carbohydrate compared to other legumes (Salunkhe et al., 1992). The increased fiber and the lower carbohydrate content of wheat-soy flour composite rock cakes thus have several health benefits, as fibre aids in the digestion in the colon and so reduce constipation often associated with high carbohydrate concentrated flour products. However, at P < 0.05 level of probability no significant differences existed in the means of WSR10, WSR11 and WSR12 but were significantly different from WSR13 per this study.

3.7 Sensory evaluation

Sensory evaluation is a scientific discipline used to evoke measure, analyze, and interpret those responses to products that are perceived by the senses of sight, smell, touch, taste, and hearing (Stone and Sidel, 1993). The results of the sensory evaluation are presented in Table 3.

Table 3: Average score of sensory evaluation of formulations

Product	Food characteristics				
	Colour	Taste	After taste	Texture	Overall acceptance
WSR10	6.6 ^a ±0.27	6.1 ^a ±0.41	6.4 ^a ±0.27	6.1 ^a ±0.03	6.1 ^a ±0.17
WSR11	6.5 ^a ±0.20	5.5 ^a ±0.11	5.6 ^a ±0.36	5.6 ^a ±0.09	5.9 ^a ±0.22
WSR12	6.1 ^a ±0.17	6.3 ^a ±0.01	6.1 ^a ±0.11	5.7 ^a ±0.23	6.1 ^a ±0.36
WSR13	5.9 ^a ±0.37	5.3 ^a ±0.61	5.5 ^a ±0.75	5.5 ^a ±0.29	5.8 ^a ±0.13
CV%	5.58	8.23	7.45	4.42	3.37
LSD	0.76	1.03	0.95	0.54	0.44

WSR10 = Control (100% WF) WSR11 = (80% WF: 20% SF) WSR12 = (75% WF: 25% SF)
 WSR13 = (25% WF: 75% SF); WF = Wheat flour SF = Soy flour

3.8 Colour of rock cakes

Colour is a sensory attribute that consumers explore in purchasing new products due to its aesthetic appeal. Generally, it refers to the appearance of the product. According to the hedonic scale, the respective mean values showed that the entire four different samples were liked very much. Though WSR10 (control sample) recorded the highest value, there was no significant difference (at P < 0.05) between the mean values as compared to the other composite rock cakes produced. This means that the replacement of wheat flour with of soybean flour did not impart significant difference on the appearance of the products.

3.9 Taste of rock cakes

Taste refers to sensation perceived by the tongue which includes sweet, salty, sourness and bitterness (Potter and Hotchkiss, 1996). This may however be influenced by the quality of the raw materials used in the processing of the rock cakes. The mean taste scores of the samples WSR10 and WSR12 were 6.1 and 6.3, respectively and represented were liked very much on the hedonic scale whereas samples WSR11 and WSR13 were rated 5.5 and 5.3, respectively representing moderately liked on the hedonic scale. However, by statistical inference, there was no significant difference (at $P < 0.05$) among the four experimental samples. This implies that, the taste of all four sample were generally satisfactory irrespective of the fortificant.

3.10 After taste of rock cakes

After taste was defined as the residual taste perception by panelists after tasting the products. From Table 3 above, the score of after taste ranged from 5.5 ± 0.29 to 6.4 ± 0.27 which represented like moderately to like very much on the hedonic scale. Statistically there was no significant difference (at $P < 0.05$) among the experimental samples, implying that, regardless level of replacement of wheat flour with soybean flour it did not exert negative residual taste on the taste buds of the panelists.

3.11 Texture of rock cakes

The hardness food characteristic gives an inference of the ease with which the cakes could be broken into bits. Per the mean values in Table 3 showed that respondents liked the hardness of the rock cakes produce from the 100%WF very much according to the hedonic scale compared to the other ones produce from the soy-wheat composites respectively. However, at $P < 0.05$ level of probability showed that there was no significant difference between the 100%WF rock cake and the composites ones which were also moderately liked according to the hedonic scale measures. In effect, it implies that, rock cakes produced per this study have its hardness very satisfactory.

3.12 Overall acceptance of rock cakes

Consumers choose foods based on the quality which is the degree of excellence and include taste, appearance and nutritional content which have significance and make for acceptance [16]. With reference to the hedonic scale values, the means of overall acceptance of the rock cakes showed that samples WSR10 and WSR12 were liked very much while WSR11 and WSR13 moderately liked. However, under One-way analysis of variance (ANOVA) statistical model at $P < 0.05$ level of probability as showed no significant difference between all the samples, WSR10 to WSR13. This implies that, the panelists have generally approved the rock cakes produced from the blends of the soybean flour and the wheat flour as compared to the traditional, the 100% wheat flour rock cake.

Per the established analysis in this study, producing rock cakes with the stated blends of the soybean flour and the wheat flour could be accepted by the majority of consumers of snacks. Also, with the addition of the soybean flour component which added some level of fortification per the averages recorded though not statistically significant, could somewhat improve the nutritional status of the populace when consumed, thus help address the effect of malnutrition to some extent.

4. Conclusion

Soybean flour used as a composite material for the preparation of rock cake has proven to be reasonable and could therefore be possibly used to increase the nutritive spectrum of rock cake consumers. Per result of this study. It showed increased crude fat, crude fibre and protein and is reported to reduce cholesterol levels, improve digestibility in the colons as well aiding build body tissues. Consequently, the decreased carbohydrate content with increasing proportion of the soybean flour reflected the effect of the high protein content of soybean on the manufactured rock cake. However, results from the study established no significant difference ($P < 0.05$) existed between the mean values of the samples being compared to the pure (100%) wheat flour rock cake. This notwithstanding, it is needful to incorporate the use of soybean as a raw manufacturing product in the pastries industry.

This was also practically demonstrated accordingly, as the results from the sensory evaluation analysis gave an acceptable inference by the panellist, who according to the hedonic scale of assertion proved to have “liked very much” and “moderately liked” the new product of soybean flour combined with wheat flour being compared to the hitherto pure (100%) wheat flour by fifteen (15) semi-trained panellist.

5. References

Altschull, A.M. 1994. New protein foods. Vol.1a. Academic Press Ltd, Ibadan. pp 20-24.

- Ayo, J.A and Nkama, I. 2003. Effect of acha (*D. exilis*) flour on the physico chemical and sensory qualities of biscuits. *Nutrition and food science* 33(3): 125-130.
- FAO. 1995. Food and Agriculture Organization. Annex 6. Requirement for effective fortification in food aid programmes. FAO Technical consultation on food fortification: Technology and Quality Control Rome, Italy, 20 and 23 November.
- Gopalan, C., B. U. R. Shastri, and S. C. Balasubramaniam. 1999. Nutritive value of Indian Foods, National Institute of Nutrition, Indian Council of Medical Research, Hyderabad, India (reprinted), 1-156.
- Ihekoronye, A.I and Ngoddy, P.O. 1985. *Integrated Food Science and Technology for the Tropics*. Macmillian Publishers Ltd, London and Oxford. Pp 283-292
- Liu, K. 2000. Expanding soybean food utilization. *J. Food Technol.* 54(7): 46-47.
- Nielsen, S. S. 2010. *Food Analysis*, Food Science Text series, DOI 10.1007/978-1-4419-1478-1_7.
- Okpala, L., Okoli, E. and Udensi, E. (2013). Physico-chemical and sensory properties of cookies made from blends of germinated pigeon pea, fermented sorghum, and cocoyam flours. *Food Sci Nutr.* 1(1): 8–14.
- Pyke, M. 1981. *Classification of Wheat: Food Science and Technology*. 4th edition. John Murray Publishers Ltd, London, pp 44-56.
- Serrem, C., H. Kock. and J. Taylor. 2011. Nutritional quality, sensory quality and consumer acceptability of sorghum and bread wheat biscuit fortified with defatted soy flour. *International Journal of Food Science and Technology.* 46:74-83.
- Desroches, S., Mauger, J. F., Ausman, L. M., Lichtenstein, A.H. and Lamarche, B. 2004. Soy protein favourably affects LDL size independently of isoflavones in hypercholesterolemic men and women. *Journal of Nutrition* 134: 574-579.
- Teixeira, S.R., Potter, S.M., Weigel, R., Hannum, S., Erdman J.W. and Hasler, C.M. 2000. Effects of feeding 4 levels of soy protein for 3 and 6 week on blood lipids and apolipoproteins in moderately hypercholesterolemic men. *American Journal of Clinical Nutrition.* 71: 1077-1084.
- Olaoye, O.A., Onilude, A.A. and Idowu, O.A. 2006. Quality characteristics of bread produced from composite flours of wheat, plantain and soybeans. *African Journal Biotechnology* 5:1102-1106.
- Fukushima, D. 1999. Recent progress of soybean protein foods: Chemistry, Technology and Nutrition. *Food Review International* 7(B): 323-352.
- Salunkhe, D.K., Charan, J.C., Adesule, R.N., and Kadam, S.S 1992. *World oil seed, chemistry, Technology and Utilization*. An Avi Book Published by Van Nostrand Reinhold, New York, pp 115-136.
- Sampson, G.O and Assuah, P. (2016). Consumer acceptability of Ghanaian Unpolished rice biscuits. *International Journal of Research in Agriculture and Forestry.* 3(7): 8-15
- Stone, H. and Sidel, J. L. 1993. *Sensory Evaluation Practices*. 2nd ed. Academic Press: San Diego.
- Potter N.N. and Hotchkiss, J.H. 1996. *Food Science* 5th ed. CBS Publisher and Distributors, New Delhi.