SUBSTITUTION OF WHEAT FLOUR FOR CASSAVA FLOUR IN THE MANUFACTURE OF BEEF SAUSAGE

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ABSTRACT

An experiment was conducted to investigate the effects of substituting wheat flour (WF) for cassava flour (CF) on chemical composition, storage stability and sensory qualities of beef sausage. The WF in the sausage was replaced with CF at 0, 25, 50, 75 and 100% levels. Values obtained for protein content were comparable with one another. However, fibre content increased with the increase in the levels of CF in the sausage. The highest fibre content of 0.43% was recorded in sausage with 15% CF. Fat content tended to decrease with increase in the levels of CF in the sausage. Values obtained for cooking and refrigeration losses were comparable with one another. Cooking losses ranged between 1.08 -1.85% while refrigeration loss ranged from 7.60-8.53%. Compared with the control, higher panel scores were recorded on sensory qualities for sausages containing CF.

WF in beef sausage can be substituted with 100% CF without adverse effect on chemical composition, processing yield or sensory qualities. This approach will satisfy the growing demand of consumers for gluten-free meat products, thereby minimising the incidence of coeliac disease in humans.

Keywords: Substitution, wheat flour, cassava flour, beef sausage

1. INTRODUCTION

The meat industry is one of the most important industries in the world and research into related but new products is continuous in order to meet consumer demand. Such research is directed at providing healthy alternatives to what has frequently been accused of causing a variety of pathologies [1]. The vast majority of today's flour consumption is taken in the form of wheat flour (WF). The popularity of WF is because of an important property. When WF is mixed with water, a complex protein called gluten develops which is responsible for gas retention and production of light leavened products. However, certain individuals suffer from intolerance to wheat gluten resulting in coeliac disease, which is one of the commonest chronic disorders in Western countries [2]. Increased awareness of this disorder has led to an increased demand for gluten-free products.

The use of cassava in human and animal nutrition is not a new development. It is a major staple food in Brazil and tropical countries [3]. Processed cassava (Manihot esculenta Crantz) roots provide more than 60% of the daily energy intake for the population of the Democratic Republic of Congo [4]. Although its limitations have been recognised, particularly the cyanide content of some varieties [5], the lack of gluten in its flour has necessitated its use as formulation ingredient particularly in meat processing. Products based on a blend of WF and soybeans have been developed. Zasypkin and Tung-Ching [6] indicate that extruded soybean flour blended with up to 20% WF could be used as textured protein. The use of CF as a non-conventional filler in comminuted meat products has been investigated [7]. The authors observed that 9% CF could conveniently replace fat in comminuted meat products. Bread with 20% CF was made from International Institute for Tropical Agriculture (IITA) improved varieties of cassava [8].

Formulations that reduce cost are of prime concern to the meat processing factories. In some African countries, wheat and yeast are usually imported to meet the needs of fermentation industries [9]. A need therefore exists for the use of cheaper and readily available filler ingredient such as CF in the production of gluten-free meat products. The present study was designed to determine the effect of substituting WF with CF on quality characteristics of beef sausage.

2. MATERIALS AND METHOD

The IITA cassava variety TMS 30572 with low cyanide content was used for the preparation of CF. The tubers were peeled, washed with clean water, sliced into chips and sun-dried for 3 days. The cassava chips were later ground and sieved to remove impurities. The flow chart for preparation of CF is presented in Figure 1 and its chemical composition is presented in Table 1. The WF used for the study was purchased from a local market.

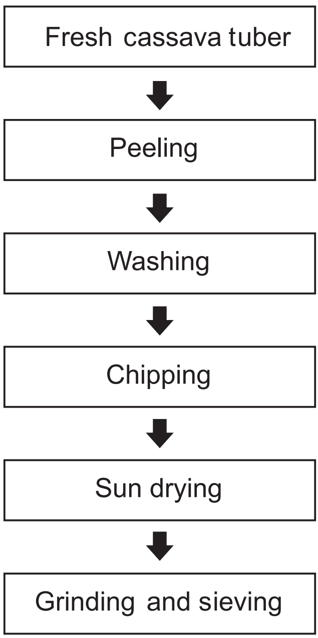

Figure 1: Flow chart for preparation of flour from cassava tuber

Table 1: Chemical composition (%) of cassava flour

Constituents	% Composition
Dry matter	87.12
Ash	1.00
Ether extract	4.25
Crude fibre	2.00
Crude protein	3.40
Nitrogen free extract	76.47

Thigh muscle and back fat of freshly slaughtered cattle obtained from the slaughter slab were ground separately in a Kenwood Chef Model A901 food processor. Five batches of beef sausage (2kg/batch) were prepared in which WF was substituted with CF at 0, 25, 50, 75and 100% levels. Equal amounts of seasoning (salt, spices and herbs) and water were added to each batch of sausage. Ingredient composition of the sausages is shown in Table 2.

Table 2: Composition (%) of beef sausages

Replacement levels of cassava flour

Ingredients	0%	25%	50%	75%	100%
Lean beef	55.00	55.00	55.00	55.00	55.00
Beef back fat	10.00	10.00	10.00	10.00	10.00
Wheat flour	20.00	15.00	10.00	5.00	-
Cassava flour	-	5.00	10.00	15.00	20.00
*Seasoning	1.89	1.89	1.89	1.89	1.89
Water	13.11	13.11	13.11	13.11	13.11
TOTAL	100.00	100.00	100.00	100.00	100.00

*Contained (g/100g): Salt 0.78g; Nutmeg 0.16g; Coriander 0.14g; Pepper 0.46g; Mace 0.16g; Ginger 0.14

Samples of the sausage were used for proximate analysis according to the method of [10] while some samples were stuffed separately into 35mm diameter cellulose casing and tied at both ends. After labeling, samples of sausage in cellulose casing were refrigerated at 20C for 24 hours while some samples were cooked in Gallenkamp water bath model 204 at 800C for 15 minutes. Treatment in both cases was replicated three times and the study was repeated twice.

Cooking losses were based on the pre- and post-cooking weights of samples while refrigeration losses were based on pre- and post-refrigeration weights of samples. The cooked beef sausages were organoleptically evaluated by 10 trained panelists for colour, flavour, juiciness, tenderness and overall acceptability on a 1-7 hedonic scale (1 = unacceptability; 2 = very poor; 3 = poor; 4 = fair; 5 = fairly good; 6 = good; 7 = excellent).

Data collected were subjected to analysis of variance while means were compared using the Duncan's New Multiple Range Test [11].

3. RESULTS AND DISCUSSION

Results of chemical composition of sausage samples are presented in Table 3. Values obtained for moisture, protein, fibre and fat were not statistically significant (P>0.05). However moisture content ranged between 57.74-59.51% with the highest value recorded on batch 3 sausage containing 10% CF. The high water binding quality of CF has been documented. Annor-Frempong et al. [7] report that products with CF had higher water contents due to the higher water binding and retention capacity of cassava. The authors recorded moisture content of 56-64% for cassava products. In the present study, values obtained for protein in all products were comparable with each other. This suggests that the WF and CF used in this study probably had comparable amounts of protein content. Narpinder et al. [12] report protein content of 8.60% for WF (WL-1562 variety) while [13] report a comparable value of 6.50% protein for CF. Cereal flour obtained from wheat or corn is usually low in protein and poor in emulsification ability [14].

Table 3: Chemical composition of beef sausages

Replacement levels of cassava flour

Parameters	0%	25%	50%	75%	100%
Moisture (%)	57.74	58.26	59.51	57.81	57.01
Protein (%)	15.36	15.16	15.55	16.16	15.16
Fibre (%)	0.29	0.28	0.30	0.43	0.41
Fat (%)	10.80	10.01	11.10	10.28	9.92
Carbohydrate (%)	23.07ab	23.91ab	25.64a	25.46a	24.38a

a, b, Means in the same row with different superscripts are significantly different (P < 0.05)

The fibre content increased with an increase in the levels of CF in the sausage. The highest fibre content of 0.43% was recorded on sausage containing 15% CF. This finding confirms that CF has higher fibre content than WF. Ibeawuchi and Echumba [13] record a value of 3.4% crude fibre for CF while Malwinder et al. [15] report 0.55% crude fibre for WF. The significance of dietary fibre in meat products has been reported in various studies. Fibre has been used in cooked meat products to increase the cooking yield due to its water-binding and fat-binding properties to improve texture [16]. Values obtained for carbohydrate are statistically significant (P<0.05). All four cassava products contained more carbohydrate than the control.

Results obtained for cooking and refrigeration losses were not statistically significant (P>0.05) as shown in Table 4. However, cooking losses ranged between 1.08-1.87%. In a related study, Annor-Frempong et al. [7] report least cooking loss of 19% in the product containing 10.80% CF. Abiola and Soremi [17] indicate that WF more satisfactorily controlled shrinkage than corn flour in pure beef liver sausage. Weight losses during storage have been attributed to several factors. Air, temperature and relative humidity in the chill room also have effects on weight loss [18].

Table 4: Cooking and refrigeration losses in beef sausages

Replacement levels of cassava flour

Parameters	0%	25%	50%	75%	100%
Cooking loss:					
Initial weight (g)	50.00	50.00	50.00	50.00	50.00
Final weight (g)	49.39	49.07	49.19	49.07	49.46
Weight loss (%)	1.22	1.85	1.61	1.85	1.08
Refrigeration loss:					
Initial weight (g)	50.00	50.00	50.00	50.00	50.00
Final weight (g)	46.21	45.74	45.87	46.00	45.76
Weight loss (%)	7.60	8.53	8.30	7.61	8.48

Means in the same row are not significantly different (P > 0.05)

Table 5 shows the results of sensory evaluation for the batches of beef sausages. All cassava products were superior in sensory properties compared to the control. The values obtained for colour and acceptability were statistically significant (P<0.05). Flavour increased with increase in the levels of CF in the sausage while scores for tenderness and juiciness were highest for sausage with 50% CF.

Table 5: Sensory evaluation of cooked beef sausages

Replacement levels of cassava flour

Parameters	0%	25%	50%	75%	100%
Colour	4.70b	5.10ab	6.10a	6.10a	5.30ab
Flavour	4.80	5.00	5.10	5.30	5.80
Tenderness	4.80	5.10	5.60	5.10	5.50
Juiciness	4.50	4.90	5.90	4.70	5.30
Acceptability	3.90c	4.50bc	5.40ab	4.90ab	5.50a

a, b, c, Means in the same row with different superscripts are significantly different ($P < 0.05$)

4. CONCLUSION

CF, popularly called tapioca flour, can replace 100% WF in beef sausage without adverse effects on processing yield or sensory qualities. Such formulation will reduce sausage production cost, which is a prime concern to sausage manufacturing companies, and satisfy the growing demand of consumers for gluten-free meat products thereby minimising the incidence of coeliac disease.

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