Proceedings of the 13th ISTRC Symposium, 2007
pp. 530 - 535

Improvement and popularization of diversified cassava products for income generation and food security: A case study of *Kibabu*

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Abstract. *Kibabu* is a traditional plain deep fried cassava product prepared from cassava paste. It was noticed however that the product was deficient in nutrients and that there was also room to improve product acceptability. A study was conducted to improve nutrient content and palatability of traditional *kibabu*, using 80% cassava and other staple mixture and 20% onion-garlic inclusion in the formulation. Laboratory analysis and sensory evaluation were conducted on *kibabu* from each of the formulations. Results showed that use of groundnuts and soybeans improved the nutritive value while the incorporation of coconut improved palatability of *kibabu* significantly ($P<0.05$). Plain cassava *kibabu* was poor in nutrients and rich in energy. Once blended with groundnuts or soybean, however, its nutrient content improved greatly. The dry matter of the formulated product ranged from 70.36 to 90.34%. On dry weight basis, the nutrient content was as follows: crude protein, 1.21-19.69; fat, 6.74-41.51% and ash content, 1.96-12.45%. The fibre content ranged from 5.46-25.85%, with coconut contributing most to this increase. The improvement resulting from blending with coconut was not outstanding except for fat and protein. Incorporation of high levels of soybean in the formulation increased the protein content greatly, but it also introduced the bean flavour that lowered the acceptability of the resulting *kibabu*. Blending coconut, groundnuts and/or soybeans could result in a product that is acceptable in addition to being nutritionally balanced.

Introduction

Cassava is an important food crop for developing countries, being the main source of energy for between 200 and 300 million people (Gevaudan *et al*., 1998). In Tanzania, cassava is an important subsistence food crop, although it is still considered by many people outside the production areas as a famine reserve crop when cereals, especially maize fail, due to its drought tolerance. Around 84% of total production in the country is utilized as human food. The remaining fraction is used for livestock feed, starch making and export (http/www.global strategic for cassava development/Africa/Tanzania htm, 2000). This crop is bulky and highly perishable. The biggest advantage of this crop is its availability all year round thus contributing to food security, and its high energy content (Hahn *et al*., 1979) that helps in minimizing incidences of energy malnutrition. Due to its inherent characteristics, including having cyanide (Essers, 1995), the value of cassava could be improved through improved processing. Such improvement will increase the scope of utilization and commercialization, which will

in turn stimulate production. The Government of Tanzania has long been advised to encourage production and local consumption of cassava, organize the marketing of cassava and promote cassava drying and the milling industry for export (Silayo *et al*., 2001). Exploitation of various processing methods is often regarded as a means to promote production and enhance food security and commercialization (Silayo *et al*., 2001).

In Tanzania, processing of cassava for value adding has centred mainly on production of fermented and non-fermented flours for making porridge. Such flours could be blended with cereal flours to improve acceptability of the cassava-based porridges. Exact proportions of these blends have not been fully established. Cassava has also been used in baked products (e.g., bread) and fried products like doughnuts, buns and chapatti although not to the extent of the stiff porridges. Another area of utilization of cassava is in the starch industry for food and non-food uses. This product can be obtained from the fresh dried cassava. The easiest form of extraction of this cassava starch is from the fresh cassava using graters to crush the cassava into a fine paste.

Literature on use of cassava as a paste-based product is scanty. *Yake yake* is one paste product obtained after peeling, washing, grating, drying and sieving the cassava to obtain a meal that is moulded and steam-baked). *Agbeli kaklo* is a second product encountered in literature resembling *yake yake* but instead of steam-baking, the meal is mixed with meat, moulded into small cylinders and fried (Doku, 1969).

Only one traditional paste product (*kibabu*) from Muheza district that was encountered in a Participatory Rapid Appraisal (PRA) study in the mentioned district (Silayo *et al*., 2001) could relate to the *yake yake* and *agbeli kaklo*. This product looked promising in broadening the food types of cassava of the Tanzanian community but needed improvement in processing quality and sensory attributes to improve its acceptability. It was prepared from onions and salt as the only ingredients that were mixed with squeezed cassava paste prior to frying. The objective of this study was therefore to improve quality and acceptability of this product through studying chemical composition and sensory attributes for purposes of identifying acceptable formulations.

Materials and Methods

Source of raw materials. The raw materials used in this study included cassava (Kigoma variety), groundnuts, onions, garlic, red pepper and coconut. Soybean (Bossier variety) also purchased from the same market was also included in the study.

Preparation of raw materials. Cassava roots were peeled, split longitudinally, the mid rib was removed and the remaining cassava grated. After grating, the paste was squeezed in a polypropylene bag until no more extract came out. This paste was retained for formulation of *kibabu* that was done on the same day of squeezing. Then, groundnuts were sorted to remove stones, rotten groundnuts and any chaff. The nuts were roasted and skins removed by rubbing between the hands. Coconut was broken into two halves and using a coconut grater, the flesh was grated and then reserved for use during formulation. Soybean seeds were sorted as for groundnuts washed with water and then soaked in water (12h) with 6h changing of soaking water. The soaking water was drained and the soybeans were boiled in water (1:10 for 30 min. at 100°C). The seeds were then cooled with cold water followed by manual decortication. These were then dried in an oven at 70°C and the flour sieved using a 160mμ sieve. The sieved flour was retained until required for formulation. The spices used were onions and garlic. Onions were peeled, washed, cut into very thin slices and retained in an airtight container until needed for formulation. Garlic tubers were likewise treated (Table 1).

Table 1: Formulations of *kibabu* using different ingredients.

Sample number	Amount of ingredient (g)			
	Cassava paste	Ingredient[1]	Onion	Garlic
Groundnut-based *kibabu*				
628	256	64	60	20
910	192	128	60	20
318	128	192	60	20
274	64	256	60	20
Coconut-based *kibabu*				
562	256	64	60	20
825	192	128	60	20
251	128	192	60	20
512	64	256	60	20
Soybean-based *kibabu*				
166	256	64	60	20
327	192	128	60	20
743	128	192	60	20
439	64	256	60	20
Plain *kibabu*				
256	320	0	60	20

[1] The ingredient is groundnut, coconut or soybean depending on formulation.

The general procedure for preparing the cassava-based *kibabu* is summarised in Figure 1. This simply involved moulding in the palm the formulated mixture into a cylindrical mould of dimension 2.5 cm diameter and 7 cm length. Then deep frying the mould for 8-10 minutes to a nice golden yellow colour. Each formulation was done in triplicate. The different formulations are presented in Table 1.

Chemical analysis of *kibabu* samples. The *kibabu* samples were subjected to chemical analysis to establish their proximate composition. The samples were analyzed for moisture content, ash, crude protein crude fat, ether extract, crude fibre and carbohydrate content (AOAC, 1995). These analyses were conducted in duplicates.

Sensory evaluation of *kibabu.* The *kibabu* samples from different formulations were subjected to sensory evaluation using a 5 point hedonic scale where 1-5 stood for dislike extremely, dislike moderately, neither like nor dislike, like moderately and like extremely, respectively. The data obtained was coded and subjected to statistical analysis using Statistical Package for Social Sciences (SPSS) programme.

Results and Discussion

Chemical composition. The proximate analysis of the different *kibabu* samples prepared in the laboratory, where the ratio of spices used was 3:1 onions:garlic is summarized in Table 2. The nutrient content was as follows: crude protein, 1.21-19.69; fat,

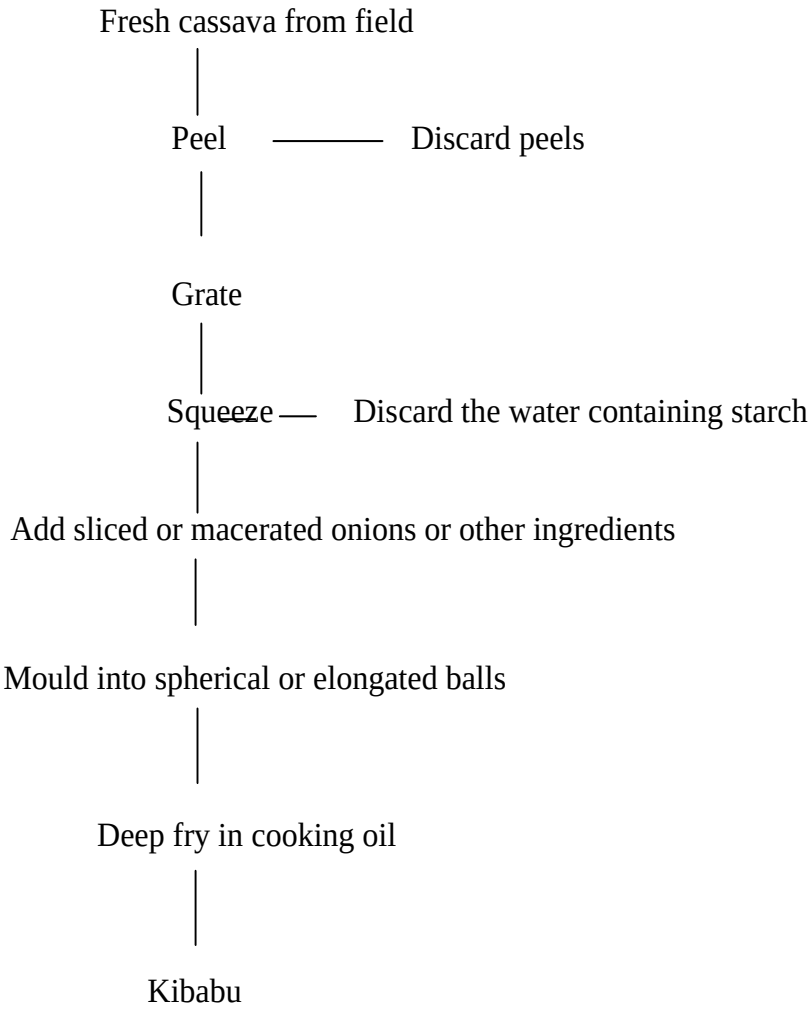

Figure 1: Flow diagram for production of cassava *kibabu.*

6.74-41.51% and ash content, 1.96-12.45%. The fibre content ranged from 5.46-25.85%, with coconut contributing most to this increase. The improvement resulting from blending with coconut was not outstanding except for fat, protein and palatability (Table 3).

As expected, plain cassava was shown to have the lowest fat and protein contents. Fibre content was also generally low, while the carbohydrate content was highest. Judging from these laboratory results, there was a limit to which soybean could be used in the blending. For example, as seen from Table 2 it was not possible to increase soybean content above 40% of the cassava component. This was because the binding properties of the cassava would be marginalized and thus the resulting mixture could not bind properly during frying, consequently leading to fragmentation. Blending with groundnuts or soybean had marked improvement on the crude fibre. Generally, increasing the proportion of legume in the formulation increased the crude fibre, crude protein, and crude fat. However, the total carbohydrate content decreased following this increase. Soybean seemed to produce the highest

Table 2: Chemical composition of *kibabu* (dry weight basis).

Sample	Formulation[1]	Moisture (%)	Ash (%)	Crude fibre (%)	Crude protein (%)	Fat (%)	Carbohydrate (%)
Cassava:coconut							
256	5:0	27.01	2.37	5.46	1.21	6.74	57.22
562	4:1	25.01	2.73	18.36	2.31	21.24	30.36
825	3:2	27.32	2.34	21.70	2.96	25.28	10.40
251	2:3	22.86	2.57	25.05	3.91	37.05	8.57
512	1:4	11.26	1.96	25.85	5.62	36.49	28.82
Cassava:soybean							
166	4:1	29.64	2.78	11.00	11.63	13.51	31.44
327	3:2	19.96	2.53	15.50	18.10	33.24	10.68
Cassava:groundnut							
627	4:1	21.45	12.45	2.85	9.10	12.36	41.79
910	3:2	18.35	9.36	9.17	11.72	30.99	10.92
318	2:3	15.16	3.59	20.16	16.10	38.99	6.01
274	1:4	9.61	2.96	20.69	19.69	41.51	5.54

[1] Formulations missing in the cassava:soybean combinations failed to produce *kibabu.*

Table 3: Mean scores of sensory evaluation results for different formulations of *Kibabu.*

Sample[1]	Taste	Texture	Smell	Colour	Appearance	General acceptability
256 (Cassava)	2.57b	2.60b	3.77a	3.27a	3.67a	2.87a
562(Cas::Co)	2.70b	3.00a	2.93b	3.43a	3.20a	3.17a
825 (Cas:Co)	2.90b	3.20a	2.83b	3.40a	3.50a	3.27a
251 (Cas::Co)	3.27a	2.90a	3.37a	3.70a	3.60a	3.27a
512(Cas:Co)	3.23a	3.23a	3.17a	3.77a	3.57a	3.30a
166 (Cas:Soy)	1.80d	2.37c	3.07b	3.30a	3.07a	1.40c
327 (Cas:Soy)	2.03c	2.60b	2.43c	3.33a	3.77a	2.47b
629(Cas:Gnut)	2.60b	2.77a	2.57c	3.53a	3.50a	2.63b
910(Cas:Gnut)	3.27a	2.83a	3.57a	3.40a	3.10b	3.03a
318(Cas:Gnut)	3.30a	3.07a	3.00a	3.00b	2.83b	2.90a
274(Cas:Gnut)	3.63a	2.83a	3.53a	3.13a	2.73c	3.37a
Grand mean	2.83	2.86	2.89	3.40	3.32	2.92

[1] Cas=Cassava, Co=Coconut, Soy=Soybean and Gnut=Groundnut. The ratios are as shown in Table 1.
[2] Values in the same column bearing a different superscripts are significantly different at ($P<0.05$).

content of protein due to the fact that the protein content of soybean is almost twice that of groundnut. The fat content was highest in coconut formulations and increased as the amount of coconut was increased. This was due to the fact that coconut flesh is quite fibrous.

Sensory evaluation. The sensory evaluation results are summarized in Table 3. For *kibabu* to be considered acceptable the mean score should be at least 3 for a particular parameter. General acceptability encompasses all the parameters and is treated as a true reflection of what the panelist will consider after taking into account all the parameters determining acceptability. Looking at the results, blending cassava with coconuts was the most acceptable.

Implications

Results of this study showed a possibility of producing acceptable *kibabu* by blending with other food staples that could supply the nutrients lacking in cassava. Such staples include coconut that could improve significantly the fat content and soybean and groundnut that could improve in addition to the fat, the protein status. Whereas despite biggest nutrient content improvement shown by soybean, acceptability could pose a serious challenge. Groundnut used in the grounded form offer promising potential. Disregarding the nutritional inferiority of coconut, acceptability results seemed quite acceptable for all formulations used in the study, although the means were not significantly different from that of plain cassava *kibabu.* This hints to the potential of using coconut to blend with cassava paste to produce acceptable snacks. Alternatively, coconut could be used to blend the soybean and groundnut blended *kibabu* to improve acceptability while maintaining acceptable nutritional status.

Acknowledgements

The authors greatly acknowledge financial support by TARPII-SUA Research Project funded by the Royal Government of Norway and the United Republic of Tanzania and the panelists for participating in the sensory evaluation work.

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