# Cowpea (*Vigna unguiculata*) as filler in coarse-smoked beef sausages

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**ABSTRACT**

Whole or dehulled cowpea *(Vigna unguiculata)* flour, as filler in coarse-smoked beef sausage preparation, was used to determine inclusion level and production cost. Whole and dehulled cowpea flour (WCF and DCF) were incorporated into the sausages at 5 and 7 per cent levels and designated as 5% WCFS, 7% WCFS, 5% DCFS and 7% DCFS and compared with the control product (whole beef sausage, WBS). The results of the sensory evaluation of the cooked sausage by 20 panelists were statistically analysed. There was significant difference ($P$<0.05) between the control and the cowpea flour products. The cowpea products were found more acceptable ($P$<0.05) than the control, except for 7% DCFS. The decreasing order of preference based on palatability, though insignificant ($P$>0.05), was as follows: WBS (0.265), 5% DCFS (0.033), 5% WCFS (0.000), 7% WCFS (-0.091), and 7% DCFS (-0.207). The production costs of the 5 and 7 per cent inclusion levels of cowpea flour-based sausages were ¢25,000.00 and ¢24,500.00 per kg, respectively, compared with ¢26,000.00 for the control. The resultant savings on cost of cowpea-based sausages were 3.8 per cent (5% DCFS) and 5.8 per cent (7% WCFS). Based on this study, 7 per cent whole and 5 per cent dehulled cowpea flour can be used in coarse-smoked beef sausage with consequent reduction in processing cost without compromising acceptability and palatability.

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**RÉSUMÉ**

DEI, H. K., ZAKARIA, J., TEYE, G. A. & OTCHERE, E. O.: *La farine du dolique intact ou écossé (*Vigna unguiculata*) utilisé comme enduit dans les saucisses de bœuf fumé.* On a utilisé la farine du dolique *(Vigna unguiculata)* intact ou écossé comme enduit dans la préparation des saucisses de bœuf cru fumé, pour déterminer le niveau d'inclusion et le coût de la production. Puis on a incorporé à la fois la farine du dolique intact (FDI) et celle du dolique écossé (FDE) dans les saucisses aux nivaux 5 et 7%, qu'on a désigné comme suit : 5% (SFDI) ,7% (SFDI), 5% (SFDE) et 7% (SFDE), avant de les comparer au produit témoin (Saucisse de bœuf intact, SBI). Un jury de 20 personnes a été constitué pour entreprendre une évaluation sensorielle des saucisses cuisinées, et puis les résultats on été analysés de façon statistique. C'était évident qu'il y avait une différence significative ($P$>0.05) entre le produit témoin et les produits de la farine du dolique. On a découvert que les produits du dolique étaient plus acceptables ($P$<0.05) que le produit témoin. Sauf pour les 7% SFDE. L'ordre décroissant de préférence sur l'acceptabilité en fonction du goût, bien que négligeable ($P$<0.05), était le suivant : SBI (0.265), 5% SFDE (0.033), 5% SFDE (0.000), 7% SFDI (-0.091), et 7% SFDE (-0.207). Les coûts de production des niveaux d'inclusion des saucisses à base de la farine du dolique à 5 et 7% étaient de 25,000.00 cedis et 24,500.00 cedis par kilogramme respectivement par rapport à 26,000.00 cedis pour le produit témoin. Les épargnes réalisés sur le coût des saucisses à base de dolique étaient de 3.8% (5% SFDE) et de 5.8% (7% SFDE). Sur la base de cette étude, on peut utiliser 7% et 5% des farines des doliques intact et écossé respectivement dans les saucisses de bœuf cru fumé avec pour conséquence la réduction du coût de transformation sans compromettre l'acceptabilité et la palatabilité.

## Introduction

Meat consumption increased in the Third World between 1985 and 1994 at an average rate of 5.6 per cent, and in the developed economies at 0.45 per cent (ILRI, 2000). The growth in demand for processed meat products in developing countries is fuelled by factors such as rapid population growth, high rate of urbanization, and often westernization.

Meat is quite expensive, and the cost of raw materials is increasing more quickly than the selling price (Wiriyacharee, 1992). Thus, the high cost of processed meat products, including sausages, leads to their patronage mainly by the wealthy or high-income earners. Attempts to reduce the cost of sausages include the use of meat extenders. Meat extenders are non-meat additives, usually protein extracts that reduce the actual quantity of meat in a unit sausage to reduce the cost of production and, therefore, the price of sausages (FAO, 1991).

Cassava flour, Anchovy, yam flour, and soy protein are among the common fillers or extenders used in Ghana (Anang, 1993; Annor-Frempong, Anan-Prah & Wiredu, 1996; Anang, Teye & Gyamfi,1999). However, it is possible to explore other products (e.g. cowpea) high in protein as fillers in sausages. Such a product must meet two main conditions. First, the product should have desirable characteristics of meat extenders such as the ability to bind water and fat, commercially sterile, free from objectionable flavour and taste, approximately coloured, and readily available at competitive prices (Schmidt, 1998). Second, it is necessary to examine and compare any change that might have occurred with introducing an improved technology, because consumer acceptability is vital for a food-processing operation to market its products (UNIFEM, 1993).

One of such products is cowpea *(Vigna unguiculata)*, a legume that has desirable characteristics of a meat extender. Cowpea is used in various food preparations in Ghana and, therefore, may be readily acceptable as a meat extender. Preliminary studies involving cowpea as filler in coarse-smoked pork sausage have shown promising results (Osei-Frempong, 2002).

The purpose of this study was, therefore, to further find out the suitability of cowpea as filler in coarse beef sausage. The specific objectives of the study were to determine the inclusion levels of whole and dehulled cowpea flour in beef sausages, and to determine the production cost of cowpea-based sausages.

## Materials and methods

*Preparation and processing of cowpea filler*

The white, erect, black-eyed cowpea variety (Bengpla) *(Vigna unguiculata)* was used to prepare the filler. The cowpea was purchased from the local market in Tamale. It is commonly grown in the Northern Region of Ghana. The cowpea was steamed at 100 °C, as described by Ihekoronye & Ngoddy (1985), to get rid of its beany flavour that may affect acceptability of cowpea flour in the beef sausage. It was then sun-dried before milling to produce micro-ground cowpea flour. Two types of cowpea flour were prepared for the experiment. For the first, the filler was prepared from dehulled cowpea grains. The seed coat (testa) was completely removed after steaming and then sun-dried before milling. This sample was labeled dehulled cowpea flour (DCF). The second type of filler was prepared from whole cowpea grains and the sample labeled whole cowpea flour (WCF).

*Formulation of control and test products*

Five different coarse beef sausages were formulated. Materials used were lean beef, pork fat, whole and dehulled cowpea flour, and spices. The control product (whole beef sausage, WBS), made of lean beef mixed with lard at a rate of 75 per cent beef and 25 per cent lard, was minced using a mincer. Thirteen grams of curing salt was added to every kilogram of meat used in the product formulation. Spices such as pepper, 'aldobo', black pepper and curry powder were also added. The minced meat, lard, cowpea flour and spices were thoroughly stirred with a wooden

spoon. The formulated products were stuffed into a natural pig casing and linked at regular intervals. The products were placed on wooden bars and smoked in an enclosed chamber for 4½ h. The products were then cooled and stored in a refrigerator for sensory evaluation.

*Selection of taste panel*

Twenty judges (lecturers, students and other university staff) assessed the taste. The sausages were steamed, fried and sliced to similar sizes before panelists were served. Each judge assessed a coded dish of the various products.

*Sensory evaluation*

The triangle test (Ihekoronye & Ngoddy, 1985) was used to indicate whether there was a detectable difference between the control product and the various types of cowpea products. By this test, each panelist was asked to identify the odd sample from three samples, two of which were the same. The panelists were then asked to indicate the degree of difference between the odd and duplicate samples as slight, moderate, much, and extreme. The degrees of differences were scored as slight (1), moderate (2), much (3), and extreme (4). The panelists were further asked to identify products that were more acceptable (i.e., to indicate either odd sample was more acceptable or duplicate samples were more acceptable). The degrees of differences indicated by the judges who correctly identified the odd sample from the two similar samples were noted and their scores computed. The score for each sample was multiplied by the number of judges who correctly identified the odd sample. The ranking method of sensory evaluation described by Fisher & Yates in 1942 (Ihekoronye & Ngoddy, 1985) was used to determine whether there were significant differences in preference between samples. The panelists received the five coded samples each and were asked to rank them for preference. The sample ranked first was scored (1.16), the second (0.05), the third (0), the fourth (-0.5), and the fifth (-1.16).

*Statistical analysis*

The data were subjected to statistical analysis using methods described by Ihekoronye & Ngoddy (1985). The data for the ranking were subjected to analysis of variance (Steel & Torrie, 1984).

## Results and discussion

*Assessment of cowpea flour products*

Table 1 shows the results of the panelists who assessed the smoked beef sausage. Eighty-eight per cent of the panelists were able to clearly distinguish between the control product and all the cowpea products. The differences between the cowpea products and the control product were significant ($P<0.05$). Moderate difference was detected between the control and the rest of the cowpea flour products; except for the 7% DCFS, which showed much difference. This observation partly agrees with that of Osei-Frempong (2002) who reported moderate differences between control and dehulled cowpea products at the same inclusion levels as used in this study, but observed much difference for whole cowpea

TABLE 1

*Detectable Difference Between Control and Cowpea Flour Products*

| *Product* | *Average difference* | *Degree of difference* | *Level of probability* |
|---|---|---|---|
| 5% DCFS | 1.95 | Moderate | $P<0.05$ |
| 5% WCFS | 2.15 | Moderate | $P<0.05$ |
| 7% DCFS | 2.45 | Much | $P<0.05$ |
| 7% WCFS | 2.30 | Moderate | $P<0.05$ |

products when coarse pork sausage was used.

The reasons given by panelists for the difference detected between the control and test products included taste, juiciness and colour. According to Annor-Frempong *et al.* (1996), good taste, juiciness and bright colour stand the chance of imparting favourable effects on comminuted products. The panelists described 5% WCFS as tender with reddish-brown internal colour and nice flavour. Thus, it was preferred to other cowpea products. But Osei-Frempong (2002) indicated that panelists preferred 5% DCFS to other cowpea products in coarse-smoked pork sausages. The colour change observed in cowpea products could be due to carotene, a plant pigment in the cowpea. The cowpea-based sausages showed good water-binding properties compared to the control. In this study, patches of water could be seen around linked edges of the casing of the control sausage after it was smoked. This might suggest that the beef could not bind the water in the sausage as effectively as the cowpea flour. It was also observed that the cowpea flour in the sausages reduced shrinkage during cooking and improved slicing characteristics. These observations agreed with characteristics of meat extenders listed by FAO (1991), Annor-Frempong *et al.* (1996), and Anang *et al.* (1999) as acceptable for use in sausage formulation. These included the ability to improve water-binding capacity, to reduce shrinkage during cooking, and to improve slicing characteristics.

Table 2 shows the response of panelists when they compared the acceptability of the control and the cowpea-based products. The acceptability of the cowpea-based sausages was overwhelming, except for 7% DCFS, which panelists did not think was more acceptable than the control. Except for 7% DCF, about 56.25 per cent of the panelists found the cowpea-based products more ($P<0.05$) acceptable than the control. They claimed the tenderness, juiciness and flavorous nature of the cowpea products made them quite attractive. These characteristics of the cowpea flour products made the cowpea flour good filler in sausages.

Annor-Frempong *et al.* (1996) and Vassiler & Kostov (1983) reported that filler-based sausage products that are tender, juicy and flavorous are rated acceptable. Osei-Frempong (2002) found that whole cowpea flour filler in smoked pork sausages was least preferred. The panelists indicated that the control product was not quite tender and juicy. However, they testified that the control product had a very good colour appeal and was quite palatable. On the whole, most panelists considered 5% WCFS most acceptable compared to the rest of the cowpea products ($P<0.05$). The 7 per cent dehulled cowpea flour sausage was unacceptable ($P<0.05$) compared to the control, which was also reported to be unacceptable in pork sausage (Osei-Frempong, 2002). The 7% DCFS was unacceptable probably because of its dark colour, loose texture, and less juiciness as indicated by the panelists. These characteristics were reported to affect the quality of comminuted products (Annor-Frempong *et al.*, 1996; Vassiler & Kostov, 1983). Perhaps, dehulling the cowpea removed its desirable characteristics such as colouring agent; hence, the low acceptability as the proportion in

TABLE 2

*Acceptability of Control and Cowpea Flour Products*

| *Product* | *Number of judges* | *Number of judges accepting cowpea products* | *Level of probability* |
|---|---|---|---|
| 5% DCFS | 20 | 12 | $P<0.05$ |
| 5% WCFS | 20 | 14 | $P<0.05$ |
| 7% DCFS | 20 | 7 | $P<0.05$ |
| 7% WCFS | 20 | 12 | $P<0.05$ |

the sausage increased beyond 5 per cent.

*Ranking of the control and cowpea flour-based sausages*

Table 3 shows the mean scores for the products by the judges for palatability and preferences. It was realized that the control product was ranked first because it was most palatable and most preferred to the cowpea-based products, although it was not significantly ($P$>0.05) so. Among the cowpea flour products, 5% DCFS was found to be the most preferred to the rest, and 7% DCFS was ranked lowest. However, there were no significant differences ($P$>0.05) in preference for the cowpea flour-based products. This implied that 5 or 7 per cent level of whole cowpea flour or 5 per cent level of dehulled cowpea flour could be added to coarse-smoked beef sausage without any loss in palatability.

TABLE 3

*Sample Means of Panelists' Ranking of Products Arranged in Order of Decreasing Magnitude*

| *WBS* | *5% DCFS* | *5% WCFS* | *7% WCFS* | *7% DCFS* |
|---|---|---|---|---|
| 0.265 | 0.033 | 0 | -0.091 | -0.207 |

*Formulation cost*

The cost of the control product was ¢26,000.00 and that of cowpea-based products at 5 per cent inclusion level was ¢25,000.00 per kilogram. This indicated a reduction in cost of the cowpea sausage by 3.8 per cent. When 7 per cent of whole or dehulled cowpea flour was included in the product, formulation cost was further reduced to ¢24,500.00 per kilogram, leading to 5.8 per cent reduction in the cost. Thus, the use of dehulled and whole cowpea products could reduce formulation cost of sausages. This was principally due to the lower cost of cowpea (¢6,000.00 per kg) compared to that of meat (¢16,000.00 per kg). This confirms the finding of Osei-Frempong (2002) who found that cowpea flour inclusion at 5 per cent level in coarse-smoked pork sausage reduced formulation cost by a similar margin (3.8%). Annor-Frempong *et al.* (1996) also reported lower cost for filler-based products. Hence, with inclusion levels of 5 or 7 per cent cowpea flour in sausages, a processor could save between ¢1,000,000.00, and ¢1,500,000.00, respectively, on every tonne of sausage produced. Thus, cowpea filler sausage would be more affordable and accessible to consumers, with consequent increase in plant and animal protein intake. More importantly, the acceptance of cowpea flour as filler would provide an additional market channel for cowpea farmers to increase their output.

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