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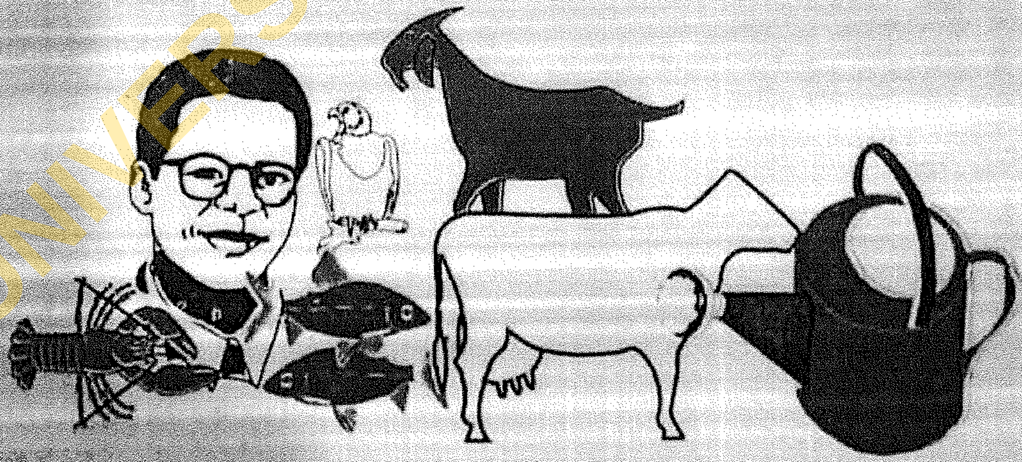

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QUALITY EVALUATION OF BEEF PATTIES EXTENDED WITH COWPEA (*Vigna unguiculata* (L.) Walp) FLOUR

BY

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ABSTRACT

The objective of this study was to evaluate the physicochemical and sensory characteristics of beef patties extended with cowpea flour (CF). Lean beef (1kg) was used for this study. The surface fats and connective tissues were trimmed off the meat which was ground and used to prepare beef filling. Cowpea flour was incorporated into the dough to form the treatments viz: Treatment 0 = (Control) 0% CF inclusion, Treatment 1 = 10% CF inclusion, Treatment 2 = 20% CF inclusion, Treatment 3 = 30% CF inclusion, Treatment 4 = 40% CF inclusion and Treatment 5 = 50% CF inclusion. 50g of beef filling was incorporated into each dough which was cut and folded in half to seal off the beef filling completely within the dough. The patties was brushed with fresh egg albumen and baked in clean pans greased with margarine in the oven at 180^{0}C between 25 and 30mins. Physicochemical and sensory attributes of the beef patties were determined. The results showed that water holding capacity and thermal shortening increased ($p<0.05$) as the CF inclusion level increased while cooking loss reduced ($p<0.05$) at 30% CF inclusion and increased ($p<0.05$) between 40 and 50%. Cooking yield was higher ($p<0.05$) at 30% CF inclusion and decreased between 40 and 50%. The chemical attributes of beef patties extended with CF as well as colour, flavour, texture and overall acceptability scores were higher ($p<0.05$) at 30% inclusion level. It is suggested therefore, that beef patties could be extended with CF up to 30% for optimum physicochemical attributes and consumers acceptability.

Keywords: Quality, Beef patties, Evaluation, Cowpea flour, Extension.

INTRODUCTION

Meat plays an important role in human diets as it supplies high protein, minerals and vitamins that sustain life. It has also been processed further into various meat products in many parts of the world (Gunter and Hautzinger, 2007). However, there is the desire for variation in taste and flavour as well as the need to produce food containing meat with longer shelf-life in order to make meat protein available for consumers (Kassama *et al*; 2003). This fact necessitated the use of meat extenders and binders in ground meat which improve nutritional values and reduces formulation costs (Naveena, 2006; Alakali *et al*; 2010). Among non-meat additives that had been used as meat binders and extenders to improve the sensory qualities of extended meat products include soy and sunflower proteins, wheat and maize derivatives and flours from cottonseed and oats (Rao *et al*, 1997); soyflour in buffalo meat buggers (Modi *et al*; 2003), common bean flour in beef sausages (Dzudie *et al*; 2002) as well as amaranthus in emulsion type products (Bejesano and Corke, 1998).

Cowpea flour is a convenient food ingredient with the potentials to improve the quality of meat product into which it is included thus promote its industrial utilization (Prinyawiwatkul *et al*; 1996). But, cowpea flour has not been fully utilized in both developed and developing countires for increasing protein consumption in such food as baked, extruded, comminuted meat products and weaning foods (Elin *et al*; 2004). The purpose of extending ground beef is to formulate meat products with less expensive materials which do not alter nutritional properties, eating quality or binding indexes of the completed product (Marcus, 1994; McWatters and Heaton, 1999). In industrial meat processing of burger patties, the most commonly used extender is soy concentrate in medium to coarse granular shape as textured vegetable protein (TVP) (Gunter and Hautzinger, 2007). In Africa and other developing countries such concentrate is not readily available hence the need to explore close substitute such as cowpea (Serdaroglu, 2006). The objective of this study therefore, was to evaluate the physicochemical and sensory characteristics of beef patties extended with cowpea flour.

MATERIALS AND METHODS

This study was carried out in the Meat Science Laboratory of the Department of Animal Production, Olabisi Onabanjo University, Yewa Campus, Ayetoro, Ogun State, Nigeria.

Preparation of Cowpea flour

Cowpea flour was prepared from white cowpea variety (vigna unguiculata (L.) Walp). 4.5kg of cowpea was purchased from Ayetoro local market and soaked in 9 litres of clean water for 12hours at room temperature (25^{0}C). 6 litres of hot water (90-95^{0}C) was poured to the cowpea cooled to 35^{0}C and decorticated. The decorticated cowpea was ground and mixed with All Purpose Flour (APF) (Golden Penny Flour) at varying levels as an extender in beef patties in this study.

Beef patties Preparation

Butcher Filling: Lean beef (1kg) was purchased from a butcher shop at Ayetoro abattoir. Surface fats and connective tissues were trimmed off and was ground using electric blender (plate 5mm) Model 242, Nakai, Japan. The ground meat was mixed thoroughly with diced potatoes, onion and thyme, curry powder, vegetable oil, salt and water in a heavy skillet over 55^{0}C heat. The mixture was stired vigorously for 10minutes until it turned brown. It was allowed to cool for 10minutes (Turhan *et al.*, 2007) as shown on Table 1.

Table 1: Ingredient composition of beef filling for beef patties extended with cowpea flour

Ingredients	Weight
Ground beef (g)	1000.00
Potatoes (diced) (g)	250.00
Onion (diced) (g)	200.00
Curry powder (g)	1.50
Thyme (diced) (g)	1.00
Salt (g)	0.50
Vegetable oil (ml)	10.00
Water (ml)	15.00

Modified version of formulations for controls and treatments with Okara powder (Turhan *et al.*, 2007).

Dough/Pastry: All Purpose Flour (APF), with baking powder, salt, sugar, margarine, nutmeg, and water were mixed manually until a crumby form was obtained (Table 1). The dough was rolled on wooden flour board to $^1/_8$cm thickness (Turhan *et al*; 2007) as shown on Table 2.

Table 2: Pastry composition for beef patties extended with cowpea flour

	Treatments					
	T1	T2	T3	T4	T5	T6
Ingredients	0%	10%	20%	30%	40%	50%
Flour (APF) (g)	300APF	270 APF	240 APF	210 APF	180 APF	150 APF
Cowpea Flour (g)	-	30CF	60CF	90CF	120CF	150CF
Salt (g)	1.3	1.3	1.3	1.3	1.3	1.3
Sugar (g)	2.5	2.5	2.5	2.5	2.5	2.5
Nutmeg (g)	1.0	1.0	1.0	1.0	1.0	1.0
Margarine (g)	75.0	75.0	75.0	75.0	75.0	75.0
Water (ml)	10.0	10.0	10.0	10.0	10.0	10.0
Baking powder (g)	12.5	12.5	12.5	12.5	12.5	12.5

Modified version of formulations for control and treatments with Okara powder (Turhan et al., 2007).
APF = All Purpose Flour, CF = Cowpear Flour

Four hundred and eighty (480g) of dough was prepared and was divided into 6 parts. Each part represented a treatment as follows: Treatment 0 = (Control) 0% CF inclusion, Treatment 1 = 10% CF inclusion, Treatment 2 = 20% CF inclusion, Treatment 3 = 30% CF inclusion, Treatment 4 = 40% CF inclusion and Treatment 5 = 50% CF inclusion respectively.

Baking of Beef Patties

The oven used was preheated to 180^{0}C prior to baking. Baking pans were greased with margarine before raw patties were put in them and were placed in oven and cooked between 25 and 30minutes when the patties showed golden colour.

MEASUREMENT OF BEEF PATTIES PARAMETERS

Cooking loss and Thermal shortening

Cooking loss and thermal shortening of beef Patties were determined using the methods described by Dzudie *et al* (2002).

Cooking yield and Water Holding Capacity (WHC)

The patties cooking yield was determined following the procedures of Dzudie *et al*; (2002). While Water Holding Capacity (WHC) of patties was determined according to the methods of Honikel, (1998).

Chemical Composition and pH of Patties

Chemical composition of beef patties prepared in this study was determined according to AOAC (2000) procedures while the pH of the patties using a digital pH meter (Model H18424, Microcomputer Havana Instrument, Romania) equipped with a pH electrode. (Marchiori and Defelicio 2003).

Sensory Evaluation of Patties

The sensory evaluation of patties was carried out by using a 10-memebr semi-trained taste panel. The beef patties were evaluated for colour, flavour, tenderness, juiciness, texture and overall acceptability on a 9-point hedonic scale on which 1 corresponds to extremely dislike and 9 to extremely like (AMSA 1995).

Experimental Design and Statistical Analysis

A completely randomized design was used for this study and replicated three times. Data collected from the study were subjected to analysis of variance (ANOVA) using (SAS 2002). The significant differences among the means were separated with Duncan's Multiple Range Test (DMRT) of the same software.

RESULTS AND DISCUSSION

Table 1 shows the modified version of formulation of Okara powder (Turhan *et al.*, 2007) used for beef filling of patties in this study, while Table 2 shows pastry formulation Treatment 0 (Control) had 300g All Purpose Flour (APF) and represented 0% inclusion of Cowpea Flour (CF). Treatment 1 had 270g APF and 30g CF and represented 10% CF inclusion. Treatment 2 had 240g APF and 60g CF that represented 20% CF inclusion; treatment 3 had 210g APF and 90g CF as 30% CF inclusion; Treatment 4 had 180g APF and 120g CF representing 40% CF inclusion, while treatment 5 had 150g APF and 150g CF and represented 50% CF inclusion respectively. Other components of the pastry had the same quantity across all the treatments. Table 3 shows the physical properties of beef patties extended with CF. Water Holding Capacity (WHC) of beef patties increased with increasing levels of cowpea flour, probably because CF had ability to keep the moisture content in the patties matrix intact. The highest ($p<0.05$) WHC was observed in treatment 5 with the mean value of 50.52%, while treatment 1 had the lowest ($p<0.05$) mean WHC of 20.50%. These results were in agreement with the reports of Kassama *et al* (2003) and Turhan *et al* (2007) who reported that addition of soy and okara powder improved the WHC of meat patties. There were significant ($p<0.05$) differences in cooking loss of beef patties across the treatments in this study. Treatment 3 had the lowest ($p<0.05$) cooking loss of 6.87% while treatment 0 (control) had the highest ($p<0.05$) with 10.02%. It was observed that cooking loss decreased up to 30% CF inclusion in the patties and increase to 7.91% at 40% and 8.82% at 50% inclusion. This could be attributed to rehydration effect of cowpea protein during patties formulation (Turhan *et al.*, 2007). There were significant ($p<0.05$) differences in cooking yield of beef patties in this study, which is the percentage weight of the product. Treatment 3 had the highest ($p<0.05$) cooking yield of 93.13% while treatment 0 (control) had the least ($p<0.05$) (89.98%). It was observed that cooking yield of beef patties in this study decreased at levels higher than 30% CF inclusion, an indication that further inclusion of CF beyond this level resulted in decreasing cooking yield. This could be due to loss in weight of the product during cooking. This result was contrary to the findings of (McWatters and Heaton, 1999) who reported interrupted increased yield of beef patties extended with 5% cowpea flour. Thermal shortenings of beef patties in this study were significantly ($p<0.05$) different among the treatments. It increased steady from 10% CF inclusion to 50% compared with treatment 0 (Control). Treatment 5 had highest ($p<0.05$) value of 8.13% while treatment 0 had the lowest ($p<0.05$) value of 7.06%. These results could be due to shrinkage in the product during cooking (Dzudie *et al.*, 2002). Chemical analysis of beef patties extended with CF (Table 4) showed that moisture content of the patties had no significant ($P>0.05$) differences among the treatments. However, treatment 0 had numerically lowest moisture content, while treatment 5 had the highest. These results could be due to rehydrating effects of

CF protein on the patties as most of the moisture contents of patties might have been contributed by the CF included in the patties (Serdaroglu, 2006). This result agreed with the findings of Modi *et al* (2003) who reported that legume proteins utilized in meat additives have the ability to bind moisture in ground meat formulations. There were significant ($p<0.05$) differences in the crude protein (CP) of beef patties extended with CF in this study. Crude protein of cooked beef patties increased ($p<0.05$) as the CF inclusion increased but treatments 3 and 4 had the same ($p>0.05$) CP though the CF inclusion increased. These could be due to contribution of protein from CF to the patties as it increased since it was reported to be rich in protein between 25 – 28.5% depending on the cultivar (Prinyawiwatkul *et al.*, 1997). Increase in protein levels of beef patties in this study after cooking could be attributed to changes in the product weight and length–cooking loss and thermal shortening (Dzudie *et al.*, 2002). The results obtained in this study was at variance with those reported by Turhan *et al* (2007) who opined that cooked beef patties extended with okara decreased as the level of okara increase probably okara and CF defer in chemical composition. Fat contents of beef patties were not significantly ($p>0.05$) different from each treatment but increased numerically as the level of CF inclusion in the patties increased. These results were similar to those reported by Turhan *et al* (2007). There was no significant ($p>0.05$) difference observed in crude fibre of beef patties in this study however, the values differed numerically with treatment 0 (Control) having the lowest value of 3.45% while treatment 5 had the highest value (3.96%). These results could be due to addition of more fibre into the product because of increase in levels of CF which was reported to be more fibrous in nature them meat (Phillips *et al.*, 1998). Ash content of beef patties in this study increased numerically by addition of more levels of CF across the treatments but no significant ($p>0.05$) differences were observed. This could be due to high ash content of CF (1 – 2%) CF that was added to the patties as similar results were obtained by Dzudie *et al.* (2002) who reported that addition of 2.5% common bean flour (CBF) in beef sausage formulation had no significant effect on ash content of the product. Cooking slightly increased the pH in the patties formations in this study, but there was no significant ($p>0.05$) difference observed between the treatments as the level of CF increased. Treatment 5 had the highest pH of 6.62, while treatment 0 had the lowest value (6.29). These results were similar to those reported by Turhan *et al.* (2007) and Serdaroglu (2006). They noted that although the pH values increased, but there were no significant difference ($p>0.05$) between the treatments as rice, okara and oat flours were increased in ground beef patties. The results showed that Nitrogen Free Extract (NFE) contents of the patties were significant ($p<0.05$) with treatment 0 having the highest value of 7-20%, while treatment 5 had the lowest ($p<0.05$) with 1.07%. The NFE decreased as CF inclusion level in beef patties increased. This could be due to increase in protein fat and ash contents of the product. This result was similar to those reported by Alakali *et al.* (2010) and Turhan *et al* (2007) for beef patties formulated with bambara groundnut seed flour and low-fat beef patties formulated with different levels of wet okara respectively. Table 5 shows the taste panel scores for sensory attributes of beef patties extended with CF. The panel scores for colour of beef patties in this study revealed that colour score increased ($p<0.05$) as the level of CF inclusion in the patties increased. Treatment 0 had the lowest ($p<0.05$) colour score of 2.30 and increased to 4.90 in treatment 3, 5.50 in treatment 4 and 5.75 in treatment 5 which were statistically the same ($p>0.05$). These results could be due to the dilution of the pastry with more CF. Similar findings were reported on colour by Naveena et al, (2006) for chicken patties formulated with finger millet flour, Serdaroglu (2006) for beef patties extended with oat flour and Turhan *et al* (2007) for beef patties extended with wet okara. The flavour score for beef patties with CF in this study showed that it increased as CF inclusion level increased up to 30% with 6.35 score and decreased to 4.30 at 40% and 3.25 at 50% CF inclusion levels respectively. The panelists results for tenderness, juiciness and texture showed that the scores for the three parameters increased as the level of CF inclusion in the beef patties increased. The scores for tenderness in this study could be attributed to the increased in the quantity of CF as similar results were obtained by Prinyawiwatkul *et al* (1997) in chicken nuggets containing fermented cowpea and peanut flours. There was increase in juiciness as the level of CF increased as a result of increase in moisture that accompanied higher levels of CF inclusion. This result was similar to that obtained by Hung and Carpenter (1997), Gujral *et al*, (2000) and Serdaroglu (2006) who reported that addition of 4% oat flour to patties and Frankfurters formulations significantly increased the juiciness scores of the products. The beef patties texture score followed the same pattern with those of tenderness and juiciness, however, the texture score was highest ($p<0.05$) at 30, 50% CF inclusion in the patties which could be attributed to the fine nature of CF that might have improved the textural configuration of the patties as CF level increased. The overall acceptability score results showed that the panelists' acceptability of beef patties increased up to 30% CF inclusion and decreased from 40% to 50% CF inclusion. Turhan *et al* (2007) reported similar trend in acceptability score of beef patties extended with okara. The highest ($p<0.05$) overall acceptability score obtained in treatment 3 could be due to many factors including high colour, flavour fine texture and moderate tenderness and juiciness scores. Gujral *et al* (2002) noted that overall acceptability scores of baked patties increased with an increase in texture of the patties extended with soy protein.

Table 3: Physical Properties of beef patties extended with cowpea flour

	Treatments						
	T0	T1	T2	T3	T4	T5	SEM
Variables	0%	10%	20%	30%	40%	50%	
Water Holding Capacity %	20.50[f]	27.50[e]	30.00[d]	37.50[c]	42.50[b]	50.25[a]	4.08
Cooking Loss (%)	10.02[a]	7.72[c]	7.25[c]	6.87[d]	7.91[b]	8.82[b]	1.89
Cooking yield (%)	89.98[b]	92.28[b]	92.75[b]	93.13[a]	92.09[b]	91.18[b]	1.65
Thermal shortening (%)	7.06[c]	7.31[b]	7.36[b]	7.45[b]	7.50[b]	8.15[a]	1.24

abcdef: Means on the same row with different superscripts are statistically significant ($P<0.05$).

Table 4: Chemical Composition and pH of beef patties extended with cowpea flour

	Treatments						
	T0	T1	T2	T3	T4	T5	SEM
Variables	0%	10%	20%	30%	40%	50%	
Moisture (%)	56.75	56.70	56.60	56.40	56.35	56.20	0.97
Crude Protein (%)	22.02[e]	24.06[d]	25.13[c]	26.20[b]	26.30[b]	27.35[a]	0.20
Crude Fat (%)	11.49	11.96	12.03	12.10	12.21	12.25	0.26
Ash (%)	2.54	2.67	2.73	2.79	3.04	3.13	0.14
Crude Fibre (%)	3.45	3.56	3.66	3.74	3.89	3.96	0.35
NFE (%)	7.20[a]	4.61[b]	3.51[c]	2.51[d]	2.10[d]	1.07[e]	0.69
pH	6.29	6.33	6.39	6.42	6.57	6.62	0.16

abcde: Means on the same row with different superscripts are statistically significant ($P<0.05$).

Table 5: Sensory characteristics of beef patties extended with cowpea flour

	Treatments						
	T0	T1	T2	T3	T4	T5	SEM
Variables	0%	10%	20%	30%	40%	50%	
Colour	2.30[c]	3.35[b]	4.05[b]	4.90[a]	5.50[a]	5.75[a]	0.21
Flavour	2.25[e]	4.30[c]	5.30[b]	6.35[a]	4.30[c]	3.25[d]	0.25
Tenderness	2.15[d]	3.20[c]	3.35[c]	3.60[c]	6.20[b]	7.30[a]	0.20
Juiciness	2.35[e]	3.45[d]	4.65[c]	4.70[c]	6.25[b]	7.40[a]	0.34
Texture	2.25[d]	3.45[c]	4.50[b]	5.55[a]	5.70[a]	5.77[a]	0.41
Overall Acceptability	3.10[d]	4.25[c]	5.45[b]	6.75[a]	4.40[c]	4.20[c]	0.17

abcde: Means on the same row with different superscripts are statistically significant ($P<0.05$)

CONCLUSION

Beef patties extended with CF up to 30% resulted in improved physical, chemical and sensory characteristics of the meat product. Owing to low protein intake of people in developing countries, Nigeria inclusive, consumption of beef patties extended with CF should be encouraged as the results from this study revealed that CF as a cheap source of protein increased the protein content of beef patties.

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