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FORMULATION AND EVALUATION OF BEEF / SOY PATTIES

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ABSTRACT

This study evaluated composite beef/soy patties to ascertain the optimal level of soy flour inclusion acceptable to consumers and producers. These patties were formulated to contain 100/0%, 85/15%, 80/20%, 75/25% and 70/30% beef/soy flour respectively. This experiment was conducted 3 times as replicates. It was a randomised complete block design and a 5-point hedonic scale was adopted to measure sensory characteristics of products using a semi-trained 15-man panel. Proximate values, cooking yields and production costs were also assessed. The use of soy flour in the products exhibited good qualities acceptable to both the producers and consumers up to 25% soy flour addition. There were increased cooking yields and reduced total cost of production of the beef/soy products as compared to all-meat patties. However, the products with soy flour were rated best only in terms of colour improvement. The protein and fat content decreased, and ash content increased with increasing soy flour inclusion. These changes with increasing levels of soy flour may be responsible for a decline in sensory properties beyond 25% soy flour inclusion.

KEYWORDS: Patties, Beef, Soy flour, Acceptability.

INTRODUCTION

Typical exotic processed meat products include cured ham, corn beef, patties and almost an endless list of sausages. Each processed meat products has its own specific characteristics and method of preparation. In Nigeria, modern meat industry is still at its infancy. However, the food industry is now faced with the challenges to produce food products with reduced cost, added value, convenience and stability, given the changing life styles of Nigerians

Due to increasing demand for cheap and yet nutritious and safe snacks, patties are sometimes formulated with the inclusion of soy flour. Soybean is a rich source of quality protein, low in cholesterol and rich in unsaturated fatty acids (Singh *et al.*, 1987). In addition to its nutrient content, economy and the functionality of soybean proteins, they provide for the juiciness in processed meat (Nowacki, 1979). Availability, emulsifying capacity, sensory enhancement, and storage stability of products are among soybeans beneficial attributes. It also has the ability to improve viscosity, firmness (texture), moisture content, overall yield and fat binding capacity.

Although cattle population in Nigeria is over 14 million herds and the off-take rate is only 12% (Okojie, 1999) meaning 88% unharvested cattle and insufficient meat supply. This is the additional reason to combine beef and soy flour into cheap meat based snacks that could boost significantly the animal protein consumption status of Nigerians. Presently, the average animal protein consumption (less than 10g/h/d) in Nigeria is a far cry from the recommended one (35g/h/d) for a healthy growth of man (Igene, 1992).

The main role of plant protein in processed meat products is to reduce formulation cost (Cruz and Hedrick, 1985; Lecomte *et al.* 1993). Hence, the inclusion of soybean in patties formulation is imperative; particularly in Nigeria where all-meat products remain very expensive when made from beef. On the other hand, the functional properties and cost advantage of soy proteins were sufficient reasons for establishing acceptable pattern of usage. The objective of this study therefore was to determine the optimal level of soy flour inclusion in beef patties as it affects physiochemical parameters, acceptance and cost effectiveness.

MATERIALS AND METHODS

Source of Materials

Beef: The beef was purchased from the local abattoir at Aduwawa cattle market, Benin City. The beef (*Longissimus dorsi*) was trimmed (less than 10% non trimable fats and connective tissues). They were also practically freed from sinews, gristles, bones and cartilage particles during deboning. The beef was then minced according to Igene, *et al.* (2002). Thereafter it was washed and stored in freezer (0± 2°C) until needed.

Pork back fat: Clean pork back fat was extracted from pork in swine slaughtering unit, Oba Market, Benin City. It was stored in freezer (0± 2°C) until needed.

Soybeans: Clean pest free soybeans (about 3kg) were procured from Oba Market, Benin City. They were air tightly packaged in a clean cellophane pack and stored in freezer (0± 2°C) until needed.

Production of Soy flour

The Soybean (*Glycine max*) seeds were processed into soy flour using the procedure shown in Fig. 1.

Experimental treatments

Five different combinations of beef and soy flour were investigated as follows:

(i) 0/100%

(ii) 15/85%

(iii) 20 / 80%

(iv) 25/75%

(v) 30 / 70%

Beef /Soy flour Formulation

The beef / Soy flour patties were formulated with carefully selected ingredients as shown in Table 1.

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Table 1: **Beef/Soy Flour Patties Formulation**

		Treatments					
		1	2	3	4	5	
Levels of Soy/Beef or Chicken		0/100	15/85	20/80	25/75	30/70	**Total (g)
Ingredients	* %	%	%	%	%	%	
Soy flour		0	55.5	74	92.5	111	333
Beef	74	370	314.5	296	277.5	259	1517
Pork back fat	12	60	60	60	60	60	60
Bread Crumbs	2	10	10	10	10	10	50
Onions	2	10	10	10	10	10	50
Ginger	0.025	0.125	0.125	0.125	0.125	0.125	0.625
Salt	2	10	10	10	10	10	50
Water	1	5	5	5	5	5	25
Thyme	0.2	1	1	1	1	1	5
Curry	0.2	1	1	1	1	1	5
MSG	0.2	1	1	1	1	1	5
White Pepper	0.175	0.875	0.875	0.875	0.875	0.875	4.375
Red Pepper	0.2	1	1	1	1	1	5
Cassava Flour	5	25	25	25	25	25	125
Sugar	1	5	5	5	5	5	25
Total (g)	100	500	500	500	500	500	2500

*The percentages column shows the levels of the ingredients in the formulation.
**The totals column shows the amount (g) of the various ingredients required in the formulation and necessary for cost evaluation.

Forming

A locally fabricated mechanical former was washed thoroughly and rubbed on the inner surface with groundnut oil to prevent the patties from sticking onto it. The various ground patties were loaded into the former and covered neatly with cellophane film mechanically moulded into flat cylindrical shapes.

Grilling

The grilling was carried out with Tefa grill – 1304.31 (220V, 1600W) according to Igene *et al.* (2002) procedure.

Weight Loss and Yield Determination

$$\%\text{Weight loss} = \frac{\text{Raw patties} - \text{Grilled patties}}{\text{Raw patties}} \times 100$$

$$\%\text{Cooking yield} = \frac{\text{Cooked weight}}{\text{Raw weight}} \times 100$$

Sensory Evaluation

A semi- trained sensory panel of 15 judges assessed the five samples according to the degree of likeness (extremely desirable, moderately desirable, neither desirable nor undesirable, moderately undesirable and extremely undesirable) in term of the colour, tenderness, juiciness, flavour and overall acceptability. Samples were served with water and Kemps cracker biscuits for judges to 'rinse' their mouths between samples to prevent sensory attributes carry over effect. A 5 - point hedonic scale was used and the highest score was 5 (like extremely) while the lowest was 1 (dislike extremely) as described by Watts *et al.* (1989).

Proximate Analysis

The samples were analysed for proximate values using the AOAC method (1990).

Statistical Analysis

The data were analysed using randomised complete block design and LSD was used to separate the means.

RESULTS AND DISCUSSION

The use of soy flour in the products exhibited some qualities, which appeared acceptable to both the producer and consumer. The addition of soy flour increased the cooking yield, facial size value (FSV) and reduced production cost when compared to all meat patties. However, the products without soy flour remain the best in terms of sensory characteristics. There was no significant difference ($P > 0.05$) in the acceptability of beef/soy products up to 25% soy flour inclusion in the beef after which the acceptability started declining.

The colour score for 15%, 20%, 25% and 30% were not significantly different ($P > 0.05$) from each other but were significantly different from the control (all-meat patties). However, a decline in the colour score was observed as the soy flour increased particularly at 30%, soy flour inclusion. The 15% soy inclusion patties had the highest colour score.

In terms of tenderness, there was significant difference ($P < 0.05$) between the patties (0, 15, 20, 25 and 30). The Control (0%) products had the highest score in tenderness and it was significantly different from patties extended with soy protein. However, the 20% treatments have the highest score in tenderness among beef/soy products and a decline was thereafter observed. Soy protein is known to increase and promote strong gel upon heating (Schweiger, 1974). Also, increasing rate of surface crust formation as the level of soy flour inclusion increased enhanced the toughness products (Bigner and Berry, 2000)

The various patties were significantly different ($P < 0.05$) from each other in juiciness. The 0% (control), 15% and 20% soy flour inclusion were not significantly different. However, the control had the highest score in juiciness. A general decline was observed as the level of soy flour increased. This was in line with the work of Shamer and Baldwin (1979) who observed that apparent juiciness decreased with increased level of legume inclusion. However, texturisation process improves the juiciness performance of legumes as extenders because of the increased ability to bind fat and water (Vaisey *et al.*, 1975).

There was significant difference ($P < 0.05$) between the patties in flavour. The control (0%) and the 15% treatment

Table 2: Changes in Weight and Thickness of Beef / Soy Flour Patties 2(a) Percent Changes in Weight and Yield

Percent Inclusion (Soy flour)	0%	15%	20%	25%	30%	LSD
Before Grill	83.93	93.47	95.50	97.09	96.67	0.955
After Grill	70.19	83.14	86.27	92.16	95.75	
Weight Loss	13.74	10.33	9.33	4.93	0.92	
Yield (%)	82.65	88.95	90.34	94.92	99.09	

2(b) Percent Changes in Thickness (Facial Size Value - FSV)

Percent Inclusion Soy flour	0%	15%	20%	25%	30%	LSD
Before Grill (cm)	9.03	9.63	9.97	10.03	10.07	0.128
After Grill (cm)	5.77	8.00	9.13	9.56	9.70	
Percent Change (%)	36.10	16.93	8.43	4.69	3.67	

Table 3: **Sensory Scores For The Beef / Soy Flour Patties**

Percent Inclusion (Soyflour)	0%	15%	20%	25%	30%	LSD
Appearance	3.27^{a}	4.24^{b}	4.08^{b}	4.22^{b}	3.80^{b}	0.314
Tenderness	4.47^{a}	3.84^{a}	3.78^{bc}	3.32^{bc}	3.44^{c}	0.356
Juiciness	4.29^{a}	3.82^{a}	3.91^{ab}	3.73^{bc}	3.28^{c}	0.430
Flavour	4.15^{a}	4.29^{b}	3.83b	3.89b	3.85	0.246
Overall Acceptability	4.05^{a}	4.05^{a}	3.90^{a}	3.79^{b}	3.59^{c}	0.337

were alike in this attribute but different from the 20%, 25% and 30% beef/soy patties, which were also alike in flavour. However, the 15% treatment had the highest in flavour score among the beef/soy patties. Lecomte *et al.* (1993) in a study of soy proteins functionality as it affects the sensory characteristics of meat/soy product reported that samples containing soy proteins had lower meaty aroma than those containing pre-emulsified fats. The decline in flavour could be attributed to a decline in the fat concentration as the soy flour inclusion increased in the beef/soy composite products. A decrease in inosine monophosphate (IMP) and hypoxanthine (products of ATP breakdown) concentration in the beef/soy formula may also be responsible to the decline in flavour. Forrest *et al.*, 1975 positively correlates these compounds with meaty aroma/flavour. They also reported that fat could house the volatile aroma elements that are gradually released on heating and mastication. The gradual release enhances the intensity and the prolong feeling of the meaty flavour. So, a decrease in fat content of products could also results to a decrease in aroma/flavour.

There was a significant difference ($P < 0.05$) among the patties in the overall acceptability. The product was accepted up to 25% soy level of inclusion. Igene *et al.* (2002) reported that soy flour inclusion in beef/soy patties up to 20% was acceptable. Waggle *et al.* (1981) also reported that soy proteins contribute to the nutritional and overall eating quality of composite meat products. They also reported that it is uncommon to find reports of reformed products that are significantly preferred over the all meat control. This study showed that 25% soy inclusion is the peak of tolerability and increasing the soy level further resulted to a decline in the overall acceptability. The relationship between the acceptability and the level soy flour inclusion is a polynomial relationship, which indicated that an increase in the soy level of inclusion correspondingly decrease the acceptability.

The trend showed an increase in weight of patties as the soy flour inclusion increases. It is likely due to the increasing ability of the soy flour to bind more moisture and fat during formulation and grilling. This is consistent with the findings of Vaisey *et al.* (1975) that increase replacement of meat with legumes resulted to reduction in drip losses. This subsequently resulted to increase in cooking yield as the level

Table 4: Proximate Analysis of Raw Beef / Soy Flour Patties

Percent Levels of Inclusion	0%	15%	20%	25%	30%
Protein	39.80	35.61	33.45	30.00	28.03
Carbohydrate	29.88	29.62	31.12	40.03	44.57
Fat	27.54	31.87	31.50	26.99	24.40
Ash	2.78	2.90	2.93	2.98	3.00
Moisture	6.96	6.06	56.98	54.94	51.50

of soy flour increased. Cooking yield also reflects the retention of water and solutes during formulation and grilling (Lecomte *et al.* (1993). In an earlier study on the influence of soy level and storage time on quality characteristics of ground beef patties, Ray *et al.* (1981) observed significant ($P < 0.05$) increase in cooking yield up to 26% soy concentration.

There was significant difference ($P < 0.05$) percent change in thickness of the beef/soy patties due to grilling. A graded decrease percent in thickness as the soy flour level increases in the patties was observed. However, the 25% and 30% inclusion showed no significant difference. This was consistent with the work of Vaisey *et al.* (1975) that increased replacement of meat with legumes resulted in reduction in drip losses. Drip loss is directly proportional to shrinkage that could be observed in patties percent change in thickness. Generally, it means that the facial size value of products was better with increase in soy flour addition, which could increase the selling price. In any case, the cost per burger for treatments containing soy flour may be higher because of few number of burger from the overall formulations in this study. There is likely to be an overall economic inducement to the producer on the long run.

The protein and fat content decreased with increasing levels of soy flour, which is consistent with the work of Ray *et al.* (1981). It was observed that as the soy flour increased in the fresh samples, the percentage moisture within the fresh patties increased significantly. This was in line with the work of Roa *et al.* (1984) who observed an increase in moisture content with soy flour substitution of above 15% level in meat. The ash content increased with increasing soy flour in the sample. The increase in ash level could be a major factor responsible for a significant decline in the sensory characteristics of products containing 25% soy flour inclusion.

CONCLUSION

It is acceptable to both producers and the consumers to include soy flour up to 25% in beef/soy patties production as revealed by the products overall acceptability scores, reduced total cost of production and improved cooking yield. There was significant reduction in shrinkage as the percent inclusion of soy flour increases. It then means that the facial size value of products was better with increase in soy flour addition. Comparing this study and the previous work (Igene *et al.*, 2002) it appears 20-25% of soy flour inclusion is the acceptable range and the variation was due to perhaps the raw materials source, handling and production skills.

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