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DEVELOPMENT OF HAMBURGER USING FULL FAT SOYBEAN FLOUR

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ABSTRACT

This study determined the level of soy flour appropriate for hamburger (beef patties) production. They were formulated to contain 0%, 10%, 15% and 20% of soy flour respectively with some flavouring agents. A 5-point hedonic scale was used to investigate the sensory characteristics of products in terms of juiciness, colour, flavour, tenderness and overall acceptability. There were no significant differences between various products but were readily accepted up to 20% level of inclusion. This provides opportunity for a further critical evaluation of the limit of soy flour inclusion in beef patties formulation. There was increasing yield as the level of soy flour in the product increased. The unit costs of product decreased with increasing soy flour inclusion

KeyWords: Soyflour, beef patties, inclusion, product.

INTRODUCTION

As world population increases, there exists a greater need for a deliberate and direct consumption of plant products in simulated meats, possessing-meat-like nutritive value as well as its aesthetic and ogarnoleptic appeal. More recently, advances in Food Science and Technology, resulting in the development of a variety of edible soy/meat products with characteristics that resemble specific types of meat, have caused increased soy/meat consumption in developing countries. This is a welcome development in Nigeria where animal product and quality vegetable protein consumption is considerably low. The average consumption of animal protein in Nigeria is 3.245g/h/d and allowing for a 20% rise due to additional consumption of fish and bush-meat is 3.894g/h/d (Okojie, 1999). This is far below FAO recommended level of 34/h/d of animal protein consumption (Okojie, 1999). Previously, Olayide et al., (1972), FMEDR (1975), Obioha (1976) and Igene (1992) reported 14.9, 7.0, 8.25 and below 10.0g/h/d of animal protein consumption respectively in Nigeria.

The soy protein content is superior; with substantial levels of most essential amino acids. The oil is highly digestible, high in unsaturated fatty acids and contains no cholesterols (Singh et al., 1987). It is also important to recognize that certain of the soy proteins in soy flour have specific functions in composite meat food systems, such as in texture forming, gellation, fat and water binding, emulsification and its stabilization. These attributes contribute to the nutritional and the overall eating quality (Waggle et al., 1981). Soy flour products make a significant addition to the world's food supply by replacing or extending more expensive animal products in developing countries. In addition, the unit costs of such composite food products are lowered.

Two basic areas of soy product utilization are in traditional foods and in new foods. They have been the most successful in traditional products especially when traditional foods

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characteristics are to be maintained. However, changes in food consumption pattern, which are strongly embedded in the culture of a people require considerable length of time and education (Waggle et al., 1981) to occur

Again, cattle population in Nigeria is over 14 million herds and the off-take rate is only 12% (Okojie, 1999). The unutilized matured cattle could be processed into meat-based snacks (e.g. hamburgers and sausages) that could boost significantly animal protein consumption status of Nigerians.

Hamburgers are steaks, finely chopped beef made up into patties (burgers), fried or grilled. They are put in between bread with other accessories such as lettuce, cabbage, sliced tomatoes or ketchup, depending on the choice of a consumer.

This study was conducted to determine the level of soy flour (full fat) appropriate for hamburger (beef patties) production. Physiochemical characteristics and relative cost of producing various products were also evaluated.

MATERIALS AND METHOD

The experiment was conducted in faculty of Agriculture laboratory, University of Benin, Nigeria.

Experimental Materials:

Meat: Beef round steak was procured from an abattoir at Aduwawa cattle market. It was freed of connective tissues, washed thoroughly and stored in freezer at 1±1° C till needed. The beef was thawed at room temperature (26±2°C) and washed again. This was minced with meat grinder (Monlinex, Model HV6). The quality needed was weighed out into different containers with pre-weighed processing ingredients and together passed again through the meat grinder for thorough mixing.

Soybeans: The beans were purchased from New Benin Market and processed into soy flour (full fat). The beans were roasted in a hot sand bed at a temperature between 150°C and 170°C for 5min. The hot sand bed containing soybeans was allowed to cool to room temperature (26±2°C) and was then sieved to separate sand from beans. The soybeans were milled (3 times) into soy flour (full fat).

Former: The locally fabricated wooden former was washed thoroughly and rubbed on the inner surface with groundnut oil to prevent burgers from sticking onto it. The various ground patties were loaded into the former and carefully covered with cellophane film.

Experimental Treatments:

Four different combinations (Soy flour/Beef) in three replicates were investigated as shown in table 1.

i. 0/100%Soy flour/Beef
ii. 10/90%Soy flour/Beef
iii. 15/85% Soy flour/Beef
iv. 20/80%Soy flour/Beef

Grilling:

Tefa grill - 1304.31 (220V, 1600W) was set on for 10 min before loading. It was then increased to maximum (mark 3) and patties were grilled for 5 min to internal temperature of 72±2°C. It was allowed to cool to room temperature (26±2°C).

Weight Loss and Yield Determination:

The weights of raw and grilled patties were taken and the weight loss (%) calculated:

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

$$\text{Yield} = (100 - \text{Weight loss})\ \%$$

Sensory Evaluation:

A Semi-trained Sensory panel (10 judges) evaluated the four samples according to degree of likeness in term of the colour, tenderness, juiciness, flavour and overall acceptability. Samples were served with water and craker biscuits for judges to "rinse" their mouth to prevent sensory attributes carry over effect before assessing the next sample. A 5-point hedonic scale was used. The highest score was 5 (like extremely) while the lowest was 1 (disliked extremely) as described by Watts et al., (1989)

Table 1: HAMBURGER FORMULATION (BEEF/SOY BURGER)

	TREATMENTS					
	%	1	2	3	4	
INGREDIENTS	**Levels**	**0/100%**	**10/90(%)**	**15/85(%)**	**20/80(%)**	**Total (g)**
Soy flour)	80.00	0.000	20.000	30.000	40.000	90.000
Beef)		200.000	180.000	170.000	160.000	160.000
Corn flour	8.05	20.125	20.125	20.125	20.125	80.125
Pork back fat	7.00	17.500	17.500	17.500	17.500	17.500
Sal (NaCl	2.00	5.000	5.000	5.000	5.000	5.000
Sugar	1.00	2.500	2.500	2.500	2.500	2.500
Water	1.00	2.500	2.500	2.500	2.500	2.500
White Pepper	0.10	0.250	0.250	0.250	0.250	0.250
Red Pepper	0.20	0.500	0.500	0.500	0.500	0.500
Thyme	0.20	0.500	0.500	0.500	0.500	0.500
Curry	0.20	0.500	0.500	0.500	0.500	0.500
Ginger	0.05	0.125	0.125	0.125	0.125	0.125
MSG	0.20	0.500	0.500	0.500	0.500	0.500
Total	100.00%	250.000g	250.000g	250.000g	250.000g	**1000.000g**

Proximate Analysis:

The samples were analyzed for fat, ash, moisture, protein and carbohydrate using AOAC method (1990).

Statistical Analysis:

The data were statistically analyzed using randomized complete block design (RCBD) and Turkey's Honestly Significant Difference tests.

RESULTS AND DISCUSSION

The tenderness of products at 0% level of soy flour inclusion were significantly different ($P<0.05$) from those at 15% level as shown in table 2. This is likely due to the high gellation capacity of soy flour proteins. Such proteins could enhance the protein matrix formation and setting of final product. Soy flour proteins also have the capacity to absorb and bind free fat (Kinsella, 1979). Forest et al., (1975) also reported that association of fat with meat product structure could affect tenderness. These factors may increase toughness of final product as soy flour inclusion increased.

There was a decrease in juiciness scores as soy flour increased though not significant ($P>0.05$). The moisture loss from final products increased as soy flour inclusion increased. Forest et al., (1975) reported that major contributor to sensation of juiciness is the amount of water remaining in cooked products. Kinsella (1979) also reported that soy proteins absorb fat or bind free fat in food systems. The reduction of free fat and decrease in absorption of moisture by soy flour negates juiciness.

Flavour scores were not significantly different ($P>0.05$). However, flavour values increased as soy flour inclusion increased. This may be due to flavour binding properties

Table 2: MEANS FOR SENSORY EVALUATION FOR BEEF BURGERS

	SAMPLES			
PARAMETERS	0%	10%	5%	20%
Colour	3.767^{a}	4.000^{a}	4.167^{a}	4.000^{a}
Tenderness	4.367^{a}	4.167^{ab}	3.767^{b}	3.867^{ab}
Juiciness	4.300^{a}	3.933^{a}	3.900^{a}	3.767^{a}
Flavour	3.833^{a}	4.133^{a}	4.133^{a}	4.238^{a}
Overall Acceptability	4.100^{a}	4.067^{a}	4.100^{a}	4.133^{a}

^{a,b} Means within the same row with different superscripts are `significantly different ($P<0.05$).

Table 3: PROXIMATE ANALYSIS OF BEEF BURGERS

	SAMPLES			
PARAMETERS	0%	10%	15%	20%
Ash	01.05	01.43	01.36	0131
Protein	23.66	55.18	27.50	30.90
Carbohydrate	00.10	01.04	00.97	01.06
Fat	03.27	10.56	23.50	07.20
Moisture	40.00	10.07	25.00	23.42

Table 4: WEIGHT LOSS AND YIELD OF FINAL PRODUCT

SAMPLES	Weight Before Grilling (g)	Weight After Grilling (g)	Weight Loss (g)	Loss (%)	Yield (g)
00.00	255.50	212.85	42.65	16.69	83.31
10.00	263.13	228.95	34.18	12.99	87.01
15.00	261.18	228.83	32.35	12.39	87.61
20.00	254.42	232.24	22.18	8.72	91.28

(absorption and entrapment) of soy flour in simulated meat products (Kinsella, 1979).

The colour scores of various meat products were not significantly different ($P>0.05$). In spite of its high meat pigments (e.g. haemoglobin and myoglobin) content at 0% formulation, the products were still poorest in terms of colour. Forest, et al., (1975) reported that reaction of meat pigment with any of several materials in meat could result in colour changes. It is likely that soy flour kept the iron in meat pigments in their ferrous state that could make them readily oxidized.

The various soy products were not significantly different (P>0.05) from each other in overall acceptability. This indicated that soy flour inclusion (up to 20%) in hamburger production was acceptable. Waggle et al., (1981) reported that soy proteins contribute to nutritional and overall eating quality of composite meat products. They also reported that it is not uncommon to find reports of reformulated meat products that are significantly preferred over all meat control.

There was no uniform trend in results of the proximate analysis (table 3) of products, but presented interesting pattern. At 10% inclusion of soy flour in the reformed meat products, it showed significantly, a considerably loss of moisture. At 15% and 20% inclusion, the moisture holding capacities (MHC) of products increased up to a half of all meat-products (control). The ability of soy proteins to form gels, swell and provide a structural soy matrix to hold moisture may be responsible. However, the MHC tends to decrease from 20% level of soy flour inclusion. It appears that further increase of soy flour (above 20%) in products decreases MHC.

There was a significant (P>0.05) increase in fat content of products as soy flour inclusion increased up to 15% level. The fat content dropped significantly at 20% level of inclusion. The increase in fat content may be due to high fat entrapment and uniform emulsion formation capacity of soy proteins thereby reducing drip loss (Forest, et al., 1975; Kinsella, 1979 and Ikeme, 1995).

The ash level in products did not vary significantly. However, all-meat patties (0%-control) were lowest while 10% were highest in ash values. The ash contents were higher in patties containing soy flour but presented a gradual decrease as soy flour increased in products. Water retention improves as soy flour inclusion increased. This may be responsible for slight and gradual decrease of ash level as soy flour inclusion increased. The higher estimates of ash in patties containing soy flour may be due to high ash level (5%) of full-fat soy flour (Singh et al., 1987)

There was no significant difference (P>0.05) in yield among various products as shown in table 4, though they gradually increased from 0% to 20% soy flour inclusion. This may be attributed to the amount of soy flour (protein) added which

Table 5: COST ANALYSIS OF BURGER PRODUCTION

	SAMPLES			
INGREDIENTS	0%	10%	15%	20%
Soy flour	00.00	01.30	01.95	02.00
Beef	40.00	36.00	34.00	32.00
Corn flour	02.01	02.01	02.01	02.01
Pork back fat	24.50	24.50	24.50	24.50
Salt (NaCl)	02.00	02.00	02.00	02.00
Sugar	02.50	02.50	02.50	02.50
Water	00.25	00.25	00.25	00.25
White Pepper	01.25	01.25	01.25	01.25
Red Pepper	01.25	01.25	01.25	01.25
Thyme	01.25	01.25	01.25	01.25
Curry	01.25	01.25	01.25	01.25
Ginger	00.03	00.03	00.03	00.03
MSG	01.25	01.25	01.25	01.25
Total (Naira)	N74.29	N71.59	N70.24	N68.89

improves moisture and fat binding and subsequently yield in products. There was a significant (P>0.05) percentage fall in cost of production (7.29%) as soy flour inclusion in beef burgers increased as demonstrated in table

CONCLUSION

It is viable to include soy flour up to 20% in hamburger (beef patties) production as revealed by product overall acceptability, reduced cost of production and improved yield. However, this provides opportunity for a further critical evaluation of the limit of soy flour inclusion in beef patties formulation.

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