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Preliminary Studies on the Development of Meat Balls

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ABSTRACT: The increasing level of urbanization in Nigeria calls for development of improved versions of convenient food products. Meat ball is a value-added meat product made from beef. Three different types of meat balls: Cured Spiced Fried Ball (CSFB), Uncured Spiced Fried Ball (USFB) and Uncured Unspiced Fried Ball (UUFB) were developed all from beef, with variation in spices used and weighing from 17.67g to 18.03g respectively. The three products were evaluated by sensory evaluation panel. The three samples were tested for significant difference in taste, colour and overall likeness. The result showed that there was significant difference between the colour of CSFB and the other two samples (USFB and UUFB) ($p<0.05$) with CSFB rated highest. There was however no significant difference in the taste of the three samples ($p>0.05$). Analysis of overall likeness revealed that UUFB was significantly preferred to CSFB and USFB. The UUFB sample was rated highest in terms of overall likeness and may economically complement some of the existing popular meat-based snacks in Nigeria. The significance of the study is discussed. @JASEM

Key terms: Meat, Meat ball, Quality, Product development

Meat is an important source of high-value animal protein in many regions of the world. Around the globe, the diets of a relatively more urbanized population are characterized by a high content of meat, poultry and other animal proteins than less diversified diets of rural communities (WHO, 2003; Igene, 2009). Meat comprises of roughly 10-20% of energy intake in most meat-consuming countries (FAO, 2002; WHO, 2003). The combined share of energy from meat, meat products and composite food containing meat is larger because of other energy-rich ingredients used in preparing those foods. Meat also contains other essential nutrients like iron, zinc and vitamin $B_{12.}$ Just about 28g of meat can provide an adult with 10% of their daily energy requirement and a large quantity of essential nutrients (Lawrie, 1971; Thatcher, 1987).

Meat products are components of a mixed and healthy diet which contains important and essential micronutrients. According to Bresalski (2005), adequate intake is recommended to ensure normal functioning of the immune system as sufficient intake ensures that body needs are met whenever the need arises. In the underdeveloped countries, the consumption of meat and meat products is affected by various factors, the most important ones are product characteristics (sensory and food habits), availability, safety, price, access and convenience (Jimenez-Colmenero, 2001; Igene, 2009). Quality is tightly linked to product development because it generates the products on which consumers base their choices. In relation to meat and other food products, it is a main determinant of product choice (Grunert *et al.,* 1996). The most important quality aspects of meat and meat products are good taste, tenderness, juiciness, freshness and nutrition. In the United States, consumers' concerns were related to cholesterol, calorie content and artificial ingredients, convenience, characteristics and price (Grunert, 1997). Similar consumers' concern about meat and meat products also prevail in developing countries. To develop meat products effectively, one must therefore evaluate consumer perception and understand consumer preferences. It is noted that due to increased level of urbanization in Nigeria, interest in convenient meat products has grown rapidly (Igene *et al*, 2006). To sustain such growth, it is necessary to continually seek to develop improved versions of convenience products. This study was therefore undertaken to develop acceptable meat balls that could diversify available meat products.

MATERIALS AND METHODS

Meat Material: The lean portion of longissimus dorsi (LD) muscle with all the fat content trimmed off was purchased from a meat store in Benin City. It was then ground into bits using a meat mincer (Hobart meat grinder, UK).

*Description of Samples***:** Three experimental treatments, all from minced beef were formed with some variations in the ingredients used in their development (see tables 1-3). They were then coded thus:
CSFB: Cured Spiced Fried Ball; USFB: Uncured Spiced Fried Ball; UUFB: Uncured Unspiced Fried Ball

*Preparation of Samples***:** *Preparation of CSFB***:** The ingredients and their inclusion levels are as summarised in table 1 below. The measured quantities of salt, sugar and nitrite were added to the minced

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meat and mixed thoroughly. The mixture was stored in a freezer at -5^{0}C for 48 hours to ensure full curing. The mixture was later removed and allowed to thaw. The spicing ingredients (ground fresh onions, dried thyme, monosodium glutamate and red pepper) and two beaten whole eggs were added and mixed with the cured mixture. The meat was formed into small balls of 2.2cm to 3cm in diameter. Each ball was coated with wheat flour and steamed for about 10 minutes. They were then deep fried in vegetable oil until they were golden brown.

Table 1: Composition of Cured Spiced Fried Meat Ball (CSFB)

Ingredient	Quantity (g)	Weight (%)
Minced meat	1000.00	92.38
Salt	10.00	0.92
Sugar	10.00	0.92
Nitrite	0.50	0.05
Thyme	2.50	0.23
Red pepper	2.00	0.19
Fresh Onions	5.00	0.46
Monosodium glutamate	2.50	0.23
Beaten Whole Eggs	50.00	4.62
Total	1082.50	100.00

Preparation of USFB: The ingredients and their inclusion levels are summarized in table 2 below. The minced meat, monosodium glutamate, beaten whole eggs, salt, thyme and red pepper were mixed thoroughly and formed into meat balls. Each ball was coated with wheat flour, steamed for 10 minutes and deep fried in hot groundnut oil until they were golden brown.

Table 2: Composition of Uncured Spiced Fried meat Ball (USFB)

Ingredient	Quantity (g)	Weight (%)
Minced meat	1000.00	93.28
Beaten Whole Eggs	50.00	4.66
Monosodium Glutamate	2.50	0.23
Salt	10.00	0.93
Fresh Onions	5.00	0.48
Thyme	2.50	0.24
Red Pepper	2.00	0.19
Total	1072.00	100.00

*Preparation of UUFB***:** The ingredients and their inclusion levels are as summrised in table 3 below. The minced meat, beaten whole eggs and salt were mixed thoroughly and formed into meat balls they were then steamed for 10 minutes and deep fried in hot groundnut oil unto they turned golden yellow.

Table 3: Composition of Uncured Unspiced Fried Meat Ball (UUFB)

Ingredient	Quantity (g)	Weight (%)
Minced meat	1000.00	94.34
Salt	10.00	0.94
Beaten Whole Eggs	50.00	4.72
Total	1060.00	100.00

A 20-man consumer panel made up of undergraduate students of the Department of Animal Science was set up. The evaluation was conducted in a well lit laboratory to avoid bias in evaluation in colour of the samples. The sensory test session for each panelist consisted of three parts- the first was the evaluation of the CSFB sample, followed by USFB and finally UUFB. The panelists rinsed their mouths and ate biscuits after tasting each sample.

The samples were distributed such that one-third of the panelists received CSFB first, another one-third received USFB first and the last set received UUFB first. The sample were evaluated for odour, taste and overall likeness on a 9-point hedonic scale (1=dislike extremely, 9=like extremely) according to Larmond (1982). An RCBD experimental design with three treatments was used. Three replicates of the complete study were performed. Three replications of the evaluation were carried out.

Statistical Analysis: All data were analyzed using analysis of data (ANOVA) and significant differences between samples were analyzed by the use of Duncan's Multiple Range Test using 5% level of significance. The interaction between treatments was tested for significance using Genstat software.

RESULTS

Table 4: Average Hedonic Rating of the Samples for Colour

Replication	CSFB	USFB	UUFB
1	7.23	6.90	6.77
2	8.35	5.55	5.80
3	7.57	5.43	6.43.
Total	23.15	17.88	19.00
$\bar{X}$	7.72	5.96	6.33

Table 4 shows the average hedonic rating according to colour for cured, spiced, fried ball (CUSB), uncured, spiced fried ball (USFB) and uncured, unspiced, fried ball (UUFB) samples. CUSB was most preferred for its bright, cherry-red colour, the highest mean value of 7.72. USFB had was ranked least with an average value of 5.96

Table 5: Average Rating of the Samples for Taste

Replication	CSFB	USFB	UUFB
1	7.59	7.68	8.00
2	7.70	6.95	6.95
3	6.00	6.14	7.15
Total	21.29	20.77	22.09
$\bar{X}$	7.10	6.92	7.36

Table 5 shows the average rating by panelists according to taste for cured, spiced, fried ball (CUSB), uncured, spiced fried ball (USFB) and uncured, unspiced, fried ball (UUFB) samples. The figures

indicate that UUFB was rated highest of the three samples with a mean value of 7.36 with USFB rated the lowest, having a mean value of 6.92

Table 6: Average Rating of the samples for Overall Likeness

Replication	CSFB	USFB	UUFB
1	7.77	7.68	8.14
2	7.75	7.10	6.85
3	6.79	5.86	7.00
Total	21.81	20.64	21.99
$\ddot{X}$	7.27	6.88	7.33

$\ddot{X}$=mean

Table 6 shows the average rating by panelists testing for the overall likeness parameter of cured, spiced, fried ball (CUSB), uncured, spiced fried ball (USFB) and uncured, unspiced, fried ball (UUFB) samples. UUFB appeared more appealing and thus had the highest rating (average of 7.33) and USFB ranked lowest with an average value of 6.88

Table 7: Summary of Means

Sample	Colour	Taste	Overall likeness
CSFB	7.63^{a}	7.19^{a}	7.29^{ab}
USFB	5.90^{b}	6.87^{b}	6.90^{a}
USFB	6.26^{b}	7.40^{a}	7.40^{b}
Grand Mean	6.60	7.16	7.20
SEM	0.20	0.20	0.15
Variance	2.40	2.34	1.54
%CV	23.50	21.40	17.20

Note that samples with the same alphabetical superscript are not significantly different. SEM is Standard Error of Mean; CV, Coefficient of Variation

Table 7 shows a summary of the grand means, standard errors of the means (SEMs), variance measured as well as the coefficient of variation (CV) across the various parameters (colour, taste and overall likeness) so considered by the panelists for all three samples in this study [cured, spiced, fried ball (CUSB), uncured, spiced fried ball (USFB) and uncured, unspiced, fried ball (UUFB)]. The %CV value of colour (23.5) indicates a close relationship between the ratings

Table 8: Average Weight (g) and Yield (%) of Meat balls

sample	before steaming	after steaming	after frying	Yield (%)
CSFB	18.03	19.07	18.63	97.69
USFB	17.87	18.81	18.39	97.34
UUFB	17.67	18.93	18.61	98.31

Table 8 shows the yield (%) obtained from the three samples considered [cured, spiced, fried ball CUSB), uncured, spiced fried ball (USFB) and uncured, unspiced, fried ball (UUFB)] having measured the weights before steaming, after steaming and after frying. Weights obtained after steaming were slightly higher than those after frying due to loss of water molecules via frying. UUFB and USFB were shown to have the highest and lowest (%) yield values respectively.

The grand mean for the colour rating for the three samples was 6.60, suggesting that colour of the three samples was generally accepted. Duncan's Multiple Range Test showed that there was no significant difference between USFB and UUFB while there was significant difference between CSFB and the other two samples (see table 4). The difference between CSFB and the other two samples was due to the inclusion of nitrite in CSFB as it improves colour of meat products (Igene *et al.,* 1985a,b). The colour of the UUFB sample was rated higher than USFB, suggesting that addition of spices to meat during processing leads to a further reduction in the redness in the colour of processed meat. The %CV of colour of the three samples (23.5) indicates a close relationship between the ratings.

The mean score for taste (likeness) for the three samples was 7.16 (table 7), indicating that there is high acceptability of the products. The ANOVA showed significant differences between the tastes of the three samples ($p<0.05$). This was also confirmed when the three samples were compared with each other using Duncan's Multiple Range Test (table 7). The presence of nitrite in CSFB imparted a taste while the absence of nitrite in UUFB gave it a somewhat natural taste. The rating of the three samples was almost equal and this could be attributed to the consumers' preference for natural meat.. Comments of the consumers on the hedonic scale indicated that 33% preferred the sharp taste of CSFB, 37% for the natural taste of UUFB and 30% for unspicy taste of UUFB.
The grand mean for overall likeness of the three samples (7.20), suggesting that there was high level of acceptance of the samples. The ANOVA showed significant difference between the samples ($p>0.065$). Comparism of the mean only indicated significant difference between USFB and UUFB (table 7). It must also be noted that these results could be attributed to the fact that there is no available meat product of this type in the study area (Ugbowo, Benin City).

The consumption of meat balls is rather foreign to most Nigerians just as the consumption of nitrite cured met. For student and particularly for the generality of Nigerian consumers, processed meat: such as sausages, bacons or ham and particularly meat balls appear alien to the traditional habits of simply cooking and/or frying meats. One would have expected that

CSFB which has nitrite would have been least preferred in all respects and not UUFB.

From the preliminary study, it appears that nitrite cured taste in meat balls may not seem important and which adds conditional reason to eliminate nitrite in the Nigerian food system, given the challenges which nitrite has an additive could pose to human health as a potential carcinogen (Igene *et al*., 1985b). While there is further need to explore the use of other natural ingredients in the formulation of meat balls; this study probably also indicates the need for moderate use of spices in meat balls; otherwise, how can one explain the reason why uncured and unspiced meat balls would be best rated by panelists.

The high levels of acceptance of these products also require that further work be undertaken to popularize the use of processed meat balls in Nigeria. So much of noodles including indomie and spaghetti are currently being consumed in Nigeria. The use of meat balls in noodle products preparation is particularly popular in the developed economies of the world. Addition of meat balls in noodles particularly for children and youths who lack sufficient animal proteins in their diets could significantly improve their level of nutrition. A wide variety of noodle-based foods containing limited animal protein is consumed by children and youths in Nigeria and similar countries in Africa. Addition of meat balls to sauces used in noodles, rice and related food products could bring about significant improvement in nutrition whilst reducing the prevailing high incidence of malnutrition in sub-Saharan Africa

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