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Research Article

Nutritional and sensorial evaluation of egg-meat loaves for quality and consumers acceptability as functional food

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Abstract

This study was conducted to evaluate the nutritional, sensorial and acceptability characteristics of egg-meat loaves as functional food. 2kg of beef and 1.5kg of eggs were purchased and used for this study. The beef was minced and the eggs cracked, they were mixed out and apportioned into four treatments of T₁ = 400g beef + 375g egg; T₂ = 425g beef + 350g egg; T₃ = 45g beef + 325g egg; T₄ = 475g beef + 300g egg loaves and baked in pre-heated oven for 30mins at 180°C to 71°C doneness and cooled, to 27°C. Data were collected on available minerals and vitamins composition as well as on the sensorial attributes of the products and analysed using analysis of variance (ANOVA). Egg-meat loaves in T₃ elicited highest (P<0.05) vitamins and minerals content followed by Egg-meat loaves in T₂. Also vitamin A (95.67ug/100g) and Calcium (93.33 Ca⁺) were numerically higher in T₃ than in other treatments in the same vein T₃ furnished the highest (P<0.05) Sensorial traits followed by T₂. Flavour (7.67%) and texture (8.30%) were significantly higher in T₃ than in other treatments. It was concluded from the results obtained in this study that varying the proportions of beef and egg in Egg-meat loaf significantly impacted on the quality and acceptability of the product. However, T₃ with 450g beef + 350g egg combination emerged the best in quality and mostly accepted, hence the Egg-meat combination in T₃ was recommended for both meat products processors and the consumers alike in this study.

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Introduction

Meat and meat products form a critical component of diets of many populations around the globe and contribute significantly to both dietary and nutritional diversity and adequacy (Mostafa et al., 2025; Liza et al., 2024; Apata, 2011; Hou et al., 2017). As a core component of diets owing to its high quality protein, essential amino acids, vitamins and minerals meat is often preferred and utilized in diets across various cultures due to its contribution to growth, development and maintenance of body functions (Adebowale et al., 2020). Eggs on the other hand are universally acknowledged for their nutritional value often termed as a nutrient-dense food as they are excellent source of high quality protein containing all the essential amino acids, rich in vitamins especially A, D, E and K as well as minerals and other bioactive compounds such as lutein and zeaxanthin (FAO, 2013). However, the differential characteristics between meat and eggs lie primarily on their nutritional compositions, while both are excellent protein sources, the type of fat they contain differs, for instance, meat contains more saturated fats, whereas, eggs have higher proportion of unsaturated fats (Kumar et al., 2018). Furthermore, eggs provide significant quantities of Choline which is essential for brain health and it is less, prevalent in meat (Tomasula and Kozempel, 2018). These differences in meat and eggs, composition create a compelling case for incorporating both eggs and meat into a diet to leverage their complementary nutritional benefits to humans.

Meat loaf is the most popular amongst the ready-to-eat street foods due to its nutrients density and savory ingredients, therefore, incorporating eggs into meat loaf can enhance the dishes nutritional value that caters for the nutritional need quality and sensory satisfaction of consumers (Fatola et al., 2011) as meat supplementation contributes to improving growth, cognitive and behavioral outcomes of consumer (Naumann, 2007). Past studies had examined meat and egg based products separately, but research and investigation especially focusing on their combination in the form of an Egg-Meat loaf is very limited and scarce particularly regarding the quality, and consumers acceptability of Egg-Meat loaf remain under explored (Fuller, 2011; (Tuorili and Hartmann, 2020). Thus, this study was undertaken to fill the gap necessary for in-depth evaluation of Egg-Meat loaf for Nutritional, quality and acceptability as a functional food product of animal source.

Materials and Methods

Egg and Meat Samples Procurement

Beef from the thigh cut of a healthy White Fulani, spent cow weighing 1.75kg was purchased at the local abattoir in Ayetoro, Ogun State, Nigeria and chilled at 4°C for 24hrs before further processing (Apata *et al.*, 2018). Eggs of Nicholas Brown layers weighing 1.35kg (45 crates) were purchased from the Teaching and Research farm of the College of Agricultural Sciences, Olabisi Onabanjo University, Ago – Iwoye, Ayetoro Campus, Ogun State, Nigeria. They were cleaned and chilled at 4°C for 24hrs before use.

Egg-Meat Samples Preparation

The 1.75kg beef was removed from the refrigerator, thawed and divided into 4 parts of 400.00, 425.00, 450.00 and 475.000g respectively. Also 1.35kg eggs were divided into 4 parts of 375.00, 350.00, 325.00 and 300g. Each beef and egg parts were mixed with other ingredients as the composition of Egg-Meat loaves thus:

T₁ = 400 beef + 375 egg (g)

T₂ = 425beef + 350egg (g)

T₃ = 450 beef + 325 egg (g)

T₄ = 475 beef + 300 egg (g)

As shown in Table 1 below

Table 1: Ingredients composition of Egg-meat loaves

Ingredients (g)	Treatments			
	T ₁	T ₂	T ₃	T ₄
Beef	400.0	425.0	450.0	475.0
Egg	375.0	350.0	325.0	300.0
Bread crumbs	200.0	200.0	200.0	200.0
Salt	15.0	15.0	15.0	15.0
Pepper	10.0	10.0	10.0	10.0
Total	1000.0	1000.0	1000.0	1000.0

Source: Apata *et al.* (2025)

Grinding of beef and cracking of eggs

Beef sample in each treatment was weighed using Ohaus balance (Model No SKX 22, USA) and was minced with Bosch Model No: MFW67440 USA) to the desired texture and uniformity into a clean bowl. All eggs in each treatment were cracked gently with a knife into a clean bowl to avoid inaccurate weight of the egg due to spillage. The eggs were swirled thoroughly for uniformity.

Mixing of minced beef and swirled cracked eggs

Minced beef and cracked eggs in each treatment were mixed thoroughly in a large bowl and other ingredients were added to make 1000g Egg-Meat loaves (Onwuka, 2018).

Cooking/Baking of Egg-Meat loaves

Baking pans were washed clean and oven dried at 190°C for 15min. They were removed and cooled to room temperature of 27°C, 25g of Egg-Meat mixture in each treatment was transferred into 40 baking pan greased with vegetable oil totaling 4 x 40 = 160 Egg-Meat loaves prepared.

The baking pans containing Egg-Meat loaves were transferred into a pre-heated oven (Scanfrost CK9426NE Electric Nigeria) at 180°C and baked for 30mins and turned at 10 mins interval of baking until the loaves turned golden brown color to an internal doneness temperature of 71°C (Beefits, 2024). The baking pans containing Egg-Meat loaves were removed from the Oven and were allowed to cool to room temperature 27°C in a table food desiccator/dehydrator overnight to disallow contamination of the product before analysis.

Data Collection

Raw Egg-Meat Loaves Color

The subjective color of raw Egg-Meat loaves was measured using a 10-man visual panel following the procedures of AMSA (2012). The Egg-Meat in each treatment were displayed in a tray for the panelists to evaluate using a colour scale of 1 – 8 on which 1 = very low intensity and 8 = very high intensity.

Nutritional Characteristics of Egg-Meat loaves

Vitamins and minerals profiles of Egg-Meat loaves were determined following the procedures of AOAC (2005) cited by Eke *et al.* (2013) and the concentration of some minerals was determined with an Atomic Absorption Spectrophotometer (AAS Model, Perkin Elmer 2380, USA).

Sensorial Evaluation of Egg-Meat loaves

The evaluation of sensorial characteristics of Egg-Meat loaves was conducted using 10-member semi-trained panel following the procedures recommended by Lawless and Heymann (2010) and AMSA (2015). The taste panelists were drawn from both students and staff in the Department of Animal Production of the College of Agricultural Sciences, Ayetoro Campus. Egg-Meat loaf samples were presented sequentially to the taste panelists on clean saucers during which biscuits and water were given to the panels in between the samples to wash down the previous samples. The panelists rated the Egg-Meat loaf samples on a 9-point Hedonic scale on which 1 = Dislike extremely and 9 = Liked extremely for color, flavor, Juiciness, tenderness, texture and overall acceptability (Iwe, 2010).

Statistical analysis

Data collected from this study were subjected to analysis of variance (ANOVA) for a completely randomized design experiment using (SAS 2010). The observed significant differences in the treatments means were separated with the Duncan's Multiple Range Test of the same software.

Results and Discussion

Vitamins and Minerals Composition of Egg-Meat loaves

Table 2 presented the results of some vitamin and mineral composition of Egg-Meat loaves. There were significant ($p < 0.05$) differences in the mineral and vitamin composition of the Egg-Meat loaves prepared except in Niacin across the treatments with T₃ having the highest values of the minerals and vitamins analyzed in the Egg-Meat loaves followed by T₂ and least in T₁ and T₄. The results obtained in T₃ and T₂ could be attributable to increased mineral and vitamin presence in the egg and meat especially calcium as well as haem Iron, Phosphorus, thiamine and riboflavin. The results observed in this study align with the findings of the previous researchers (Anderson et al., 2011; Dinh et al., 2011; Ross et al., 2011; Rucker et al., 2012; Olson, 2014; Bender, 2018) who reported that both egg and meat are rich in minerals and vitamins and that the combination of the two would synergise to complement any of the elements lacking in each other which makes Egg-Meat loaves a mineral-vitamin stable food excellent for human consumption.

Table 2: Some available Minerals and Vitamins Composition of Egg-Meat loaves

Variables (mg/100g)	Treatments				SEM	P-Value
	T ₁	T ₂	T ₃	T ₄		
Calcium (Ca ⁺)	88.33 ^c	90.00 ^b	93.33 ^a	85.00 ^d	1.35	0.170
Iron (Fe ⁺)	5.27 ^b	6.30 ^a	6.40 ^a	6.00 ^b	0.07	0.001
Phosphate (PO ⁴)	56.67 ^d	61.33 ^b	63.67 ^a	60.00 ^c	1.14	0.201
Ascorbic acid (Vitc)	0.80 ^b	0.90 ^a	0.97 ^a	0.70 ^c	0.04	0.091
Vitamin A (ug/100g)	85.00 ^d	93.33 ^b	95.67 ^a	91.00 ^c	1.52	0.071
Thiamme (Vit B1)	0.12 ^d	0.15 ^b	0.16 ^a	0.14 ^c	0.01	0.032
Riboffavin (Vit B2)	0.11 ^c	0.12 ^b	0.13 ^a	0.12 ^b	0.004	0.250
Niacin (Vit B3)	1.33	1.34	1.39	1.29	0.01	0.002

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

SEM = Standard error of the means

Sensorial evaluation of Egg-Meat loaves

Table 3: presents the results of the sensorial evaluation of the prepared and analyzed Egg-Meat loaves. The results showed that the color of the Egg-Meat product was similar across all the treatments except in T₃ which has the highest ($p < 0.05$) color value of 7.00 which is significantly different from the values obtained for other treatments. These results tallied with those of Troy and Kerry (2010) who reported color variations in meat products with similar ingredient matrices. The flavor scores ranged from 5.83 to 6.35 in T₁, T₂, T₄ while Treatment T₃ elicited 7.65 value higher ($p < 0.05$) than those obtained for other treatments indicating that ingredients proportion in Egg-Meat product sufficiently maintained the appropriate flavor profiles across the treatments. This result implies that both beef and egg contributed complementarily to the flavour of the product; however the beef and egg combination ratio in T₃ favour more an intense flavor (Kamenik et al., 2014; Apata et al., 2022). The Egg-Meat loaves elicited the same values for tenderness as observed by the taste panels in T₁ (7.67) and T₂ (7.00) which are significantly higher ($p < 0.05$) than those values obtained for T₃ (6.30) and T₄ (5.67). These results could be attributed to lower moisture recorded for T₃ and T₄ which was good enough for the product to avoid spoilage and to obtain product stability necessary for consumers' acceptability in conjunctions with juiciness that was higher in T₃ with the value of 7.33. These results were in line with the report of Williams and Phillips (2006); Singh et al. (2019). Also, there was a variability in the texture of Egg-Meat loaves with T₃ having the highest ($p < 0.05$) value of 8.30 than other treatments in this study and T₄ having the least value of 5.37. This suggested that the proportion of beef to egg in formulation favours the textural value obtained for the product in T₃ according to Szczesniak (2002). The overall acceptability of Egg-Meat loaves was rated by the taste Panelists to be higher in T₃ (7.67) than in other treatments. This high rating for T₃ could be as the result of higher values for color, flavor, juiciness, texture and considerable value for tenderness which are the main determinants of any food product acceptability for consumption as observed in Egg-Meat loaves in T₃ due to the favorable beef and egg mixing ratio of the product as reported by Meilgaard et al. (2007) and Xiong (2014) respectively.

Table 3: Sensorial attributes of Egg-Meat loaves

Variables	Treatments				SEM	P-Value
	T ₁	T ₂	T ₃	T ₄		
Colour	6.00 ^b	6.00 ^b	7.00 ^a	6.00 ^b	0.24	0.945
Flavor	5.83 ^b	6.00 ^b	7.67 ^a	6.33 ^b	0.39	0.915
Tenderness	7.67 ^a	7.00 ^a	6.30 ^b	5.67 ^b	0.28	0.003
Juiciness	6.00 ^b	5.67 ^b	7.33 ^a	6.30 ^b	0.39	0.861
Texture	6.20 ^b	6.27 ^b	7.30 ^a	5.20 ^c	0.33	0.003
Overall- acceptability	5.30 ^b	6.50 ^b	7.65 ^a	5.33 ^b	0.22	0.208

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

SEM= Standard error of the means

Conclusion and Recommendation

It can be concluded from the results obtained in this study that varying the proportions of beef and egg in Egg-Meat loaf significantly impacted on its quality and acceptability across the measured parameters of the product which included, nutritional, and sensorial attributes. Treatment 3 which comprised 450.0g beef and 350.0g egg emerged as the best in quality and acceptability and it is therefore, recommended for both the meat products processors and consumers of Egg-Meat product.

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