EFFECTS OF FERTILIZATION AND BOILING DURATION ON NUTRITIONAL COMPOSITIONS AND ORGANOLEPTIC PROPERTIES OF SHIKA-BROWN EGGS

K. O. IDAHOR*†, B. O. MATTHEW†, E. A. ADGIDZI‡, N. ISAH††, O. H. OSAIYUWU ‡‡ AND O. A. SOKUNBI ‡‡

†*Department of Animal Science, Nasarawa State University, Keffi, Shabu-Lafia Campus.*
‡*Department of Home Science, Nasarawa State University, Keffi, Shabu-Lafia Campus.*
††*Department of Aquaculture and Fisheries Management, Nasarawa State University, Keffi, Shabu-Lafia Campus.*
‡‡*Animal Science Department, Faculty of Agriculture and Forestry, University of Ibadan, Ibadan.*
*ceCorresponden: omokingida@yahoo.com

ABSTRACT

Avian eggs fertility and boiling duration may influence the nutritional compositions and organoleptic properties but little is known about this hence this study. A total of 100 Shika-brown eggs (1 fertilized : 1 unfertilized) were boiled at 10, 20, 30, 40, 50, 60 minutes and used to evaluate the nutritional compositions and organoleptic properties. Results indicated that both fertilized and unfertilized eggs were evaluated "like slightly" and "like moderately" by the semi-trained taste panelists. Crude protein value ranged between 12.93% (30 minutes treatment) to 16.38% (50 minutes treatment) in fertilized eggs, similar to 12.26% (20 minutes treatment) and 15.83% (60 minutes) in unfertilized eggs. The gross energy value varied from 1.66 to 1.79Kcal in both eggs. Calcium content was as high as 130mg in fertilized eggs (60 minutes treatment) close to 127mg recorded in unfertilized eggs at 30 minutes treatment. Iron and copper values were between 1.6 and 2.65mg; 0.35 and 0.85mg respectively in both eggs. Although, the fertilized eggs values appeared to be better in most of the parameters evaluated there was no particular trend in the differences. Consequently, egg fertility and boiling duration may not effectively influence the nutritional compositions and organoleptic properties of Shika-brown eggs hence, could be used in the proposed school feeding program.

Keywords: Avian egg, boiling, fertilization, nutrients, organoleptic.

INTRODUCTION

The formation of avian eggs occurs gradually over a period of about 24 to 26 hours in the oviduct, following the release of the yolk with blastoderm from the ovary. Although, two sets of ovaries and oviducts are present during embryonic development, only the left set fully develop in chickens. According to ISA (2015) the right ovary and oviduct regress at about 6 to 7 days of hatching. At this age, the chick's ovary has up to 4,000 tiny ova (reproductive cells), out of which some full-sized yolks may develop into shelled eggs as the hen matures. With only the left ovary functional, a hen has the potency to lay about 240 to 300 eggs per annum. The feed taken in by hens are metabolized into the various substances that become parts of the egg which are mainly the shell (10%), albumen (58%) and yolk (32%). Besides these main parts, an egg consists of chalaza, pores, airspace, vitelline membrane, cuticle and blastoderm. Although, only the albumen and yolk are widely consumed, the shell could be ground and used as feed/food additive to provide calcium or used industrially. It was demonstrated that every part of avian egg is edible and it is a good source of high quality protein, iron, vitamins and phosphorus but low in calcium (Schaafsma and Beelen, 1999; King'ori, 2012).

Avian egg is comparatively affordable, accessible and relished by many hence it could be best described as "poor masses cheapest source of animal protein" that present day governments could use to alleviate malnutrition especially among the children. Unfortunately Cantani (2008) reported that the commonest food allergy in infants is egg, but they could grow out of it during their childhood if exposure is minimal. Allergic reactions against the albumen were reported to be commoner than reactions against the yolk. More often than not, the avian eggs commonly consumed are unfertilized yet the biological value was rated highest among other foodstuff of animal origin like milk that is

generally believed to be the best animal product in nature (Hoffman and Falvo, 2004; IsoNova, 2016). However, Wikipedia (2016a; b) found out that raw egg nutritional values were seemingly of better quality than hard-boiled avian egg and it was reported that fresh egg contains antinutritional factors like avidin that bind some vitamins such as biotin (Eggcyclopedia, 2016a). Interestingly, it was reported that only when about 24 raw eggs are consumed that the avidin content would be sufficient to act as an antinutrient and that boiling denatures it.

If unincubated fertilized egg according to ISA (2015) has approximately 50,000 more cells than unfertilized egg and hard boiling to denature avidin could reduce the nutritional quality. It becomes imperative to examine the effects of egg fertility and boiling duration on the Nigerian most revered Shika-brown eggs quality as a way forward to tackle emerging malnutrition among Nigerian children.

MATERIALS AND METHODS

A total of 100 eggs (1 fertilized : 1 unfertilized) laid by Shika-brown at 29 months of age, were bought from Ahmadu Bello University, Zaria, boiled and distributed in a completely randomized design to two main treatments: fertilized and unfertilized which were further split into six sub-treatments: 10, 20, 30, 40, 50 and 60 minutes representing the boiling duration. Twenty-four of the eggs were sent to the Institute of Agricultural Research and Training, Moore Plantation, Ibadan for nutrients determination according to AOAC (2000). The other 76 eggs were offered to semi-trained taste panelists made up of students, academic and nonacademic staff of both genders for organoleptic evaluation using 9-point Hedonic scales (Wichchukit and O'Mahony, 2014). Data collected were analyzed according to GenStat (2008) and the mean values were separated using least significant difference of the same software package.

RESULTS AND DISCUSSION

Organoleptic properties of the fertilized and unfertilized Shika-brown eggs are expressed in Table 1. There were significant differences ($P<0.05$) in the mean values of appearance, taste, colour and overall acceptability across the treatments but aroma, mouth feel and after taste did not differ statistically ($P>0.05$). Fertilized eggs aroma, taste, colour, mouth feel and overall acceptability supremacy at 30 to 60 minutes treatments is not clear but could probably be due to the extra 50,000 more cells in fertilized eggs as given by ISA (2015).

Presented in Table 2 are the nutritional compositions of fertilized and unfertilized Shika-brown eggs. There were significant differences ($P<0.05$) in all the mean values of the nutrients determined. At 10 minutes treatment, fertilized eggs values in all the parameters were greater than the unfertilized eggs except ash (1.4%), carbohydrates (15.5%) and gross energy (1.7 Kcal/100g). At 20 minutes treatment, fertilized eggs values were superior in crude protein (14%), crude fat (11.4%) and ash (1.5%) whereas, it was inferior at 30 minutes treatment in crude protein, crude fat, total cholesterol, high density lipid and low density lipid. At 40 minutes treatment, ash, carbohydrates and gross energy values of the fertilized eggs were higher than that of unfertilized eggs but were lower in carbohydrates (14%), gross energy (1.6Kcal/100g) and triglycerides (167.8mg) at 50 minutes. Fertilized eggs values were noticed to be better in ash (1.6%), carbohydrates (17.5%), gross energy (1.7Kcal/100g), high density lipid (236.7mg) and low density lipid (358.4mg) at 60 minutes. Values of all the nutrients determined in the treated eggs were similar to the reports of Wikipedia (2016a; b) in poultry eggs thus, corroborated the report of Eggcyclopedia (2016b) that fertilized and unfertilized eggs nutritional contents were quite similar.

Table 3 shows the mineral constituents of boiled fertilized and unfertilized Shika-brown eggs. There were significant differences ($P<0.05$) in all the mean values of the minerals determined except in phosphorus, iron and sodium whose values ranged from 193.4 to 224.8mg/100g, 1.6 to 2.4mg/100g and 79.1 to 92.6mg/100g in fertilized and 198.2 to 211.4mg/100g, 1.7 to 2.6mg/100g and 81.4 to 88.5mg/100g in unfertilized accordingly. The values recorded in all the minerals determined were similar to the reports of Wikipedia (2016a; b) in poultry eggs.

CONCLUSION

Fertilized and unfertilized Shika-brown eggs boiled and evaluated in this study apparently indicated that there were probably no

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disintegration of the nutritional quality and organoleptic properties hence, could be used in the proposed school feeding program.

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Table 1: Organoleptic evaluation of fertilized and unfertilized Shika-brown eggs boiled at varying duration.

Parameters	Main Treatments	Sub-treatments: boiling duration (Minutes)						Statistics		
		10	20	30	40	50	60	Mean	LSD	Prob.
Appearance	Fertilized	6.90	6.85	7.50	7.20	7.85	7.65	7.33	1.91	0.028
	unfertilized	7.70	7.10	7.05	7.15	6.80	7.00			
Taste	Fertilized	6.35	6.75	7.25	7.00	7.50	7.60	7.10	1.76	0.001
	unfertilized	7.65	7.35	6.80	7.45	6.45	6.90			
Colour	Fertilized	6.50	6.35	7.40	6.95	7.30	7.10	6.95	1.92	0.034
	unfertilized	7.10	6.90	6.50	7.45	6.45	6.85			
Aroma	Fertilized	6.70	6.80	7.25	7.20	7.15	7.15	7.04	1.59	0.306
	unfertilized	6.95	6.80	6.80	7.30	6.70	6.70			
Mouth feel	Fertilized	6.80	6.65	7.50	7.10	7.25	7.30	7.11	1.71	0.344
	unfertilized	7.30	6.65	6.70	7.20	7.05	6.90			
After Taste	Fertilized	6.40	6.30	6.65	6.85	6.65	7.45	6.70	1.87	0.123
	unfertilized	6.90	6.80	6.30	6.75	6.90	6.50			
Overall acceptability	Fertilized	6.95	6.35	7.40	6.95	7.30	7.10	7.36	1.91	0.030
	unfertilized	7.25	6.90	6.50	7.45	6.45	6.85			

Hedonic scale used: 9 = like extremely, 8 = like very much, 7 = like moderately, 6 = like slightly, 5 = neither like nor dislike, 4 = dislike slightly, 3= dislike moderately, 2 = dislike very much and 1 = dislike extremely.

Table 2: Nutritional compositions of fertilized and unfertilized Shika-brown eggs boiled at varying duration.

Nutrients	Main Treatments	Sub-treatments: boiling duration (Minutes)						Statistics		
		10	20	30	40	50	60	Mean	LSD	Prob.
Egg weight (g)	Fertilized	59.00	56.00	49.00	52.00	60.00	53.00			
	Unfertilized	53.00	45.00	58.00	57.00	48.00	58.00	54.00	0.000	0.000
Crude protein (%)	Fertilized	14.44	14.06	12.93	13.23	16.38	13.54			
	Unfertilized	13.43	12.26	15.05	14.31	12.53	15.83	13.99	0.073	0.001
Crude Fat (%)	Fertilized	11.77	11.39	11.13	11.38	12.68	11.25			
	Unfertilized	11.55	10.27	12.12	11.87	10.54	12.46	11.53	0.004	0.010
Ash (%)	Fertilized	1.39	1.47	1.45	1.52	1.56	1.59			
	Unfertilized	1.54	1.43	1.34	1.50	1.36	1.30	1.50	0.007	0.010
Moisture content (%)	Fertilized	56.88	55.11	55.65	54.56	55.45	56.13			
	Unfertilized	54.88	56.31	55.39	56.59	54.77	54.37	55.51	0.002	0.001
Carbohydrates (%)	Fertilized	15.53	18.03	18.83	19.33	14.02	17.53			
	Unfertilized	15.62	19.80	16.12	15.74	20.82	10.05	17.53	0.004	0.010
Gross Energy (Kcal/ 100g)	Fertilized	1.72	1.74	1.78	1.74	1.66	1.74			
	Unfertilized	1.76	1.77	1.71	1.68	1.79	1.69	1.73	0.001	0.010
Total Cholesterol (mg)	Fertilized	765.80	749.75	742.60	753.60	795.30	785.70			
	Unfertilized	751.45	769.40	791.50	778.80	736.25	789.50	767.47	0.003	0.001
HDL (mg)	Fertilized	225.70	218.80	213.60	226.00	251.45	236.65			
	Unfertilized	224.75	227.80	243.80	226.65	211.50	234.25	228.13	0.014	0.001
LDL (mg)	Fertilized	348.80	337.60	332.95	339.35	376.05	358.35			
	Unfertilized	338.75	341.50	341.50	339.75	329.65	356.45	347.23	0.021	0.001
Triglycerides (mg)	Fertilized	191.30	195.85	196.05	188.25	167.80	190.70			
	Unfertilized	188.45	200.10	180.15	212.40	195.10	198.80	192.08	0.283	0.001

LSD: Least significant difference; Prob.: Probability; HDL: High density lipid; LDL: Low density lipid.

Table 3: Mineral constituents of fertilized and unfertilized Shika-brown eggs boiled at varying duration.

Parameters (mg/100 g)	Main Treatments	Sub-treatments: boiling duration (Minutes)						Statistics		
		10	20	30	40	50	60	Mean	LSD	Prob.
Calcium	Fertilized	107.00	110.00	124.00	105.00	111.00	130.00	116.71	0.652	0.001
	Unfertilized	112.50	122.50	127.00	120.00	116.00	115.00			
Phosphorus	Fertilized	197.90	196.25	207.57	193.36	194.70	224.80	202.43	0.424	0.980
	Unfertilized	198.24	198.17	211.36	205.19	201.70	199.85			
Iron	Fertilized	1.86	1.60	2.37	1.81	2.03	2.91	2.08	0.024	0.397
	Unfertilized	1.76	2.23	2.65	2.05	1.93	1.80			
Magnesium	Fertilized	11.26	11.40	11.97	11.18	11.43	12.15	11.66	0.021	0.001
	Unfertilized	11.46	11.94	12.07	11.90	11.64	11.57			
Potassium	Fertilized	132.70	137.30	148.40	129.95	139.25	155.50	142.11	0.450	0.001
	Unfertilized	140.00	140.60	153.35	145.55	141.60	141.15			
Sodium	Fertilized	79.05	80.25	87.00	84.95	81.05	92.60	84.24	0.253	0.618
	Unfertilized	81.35	85.45	88.45	85.55	82.80	82.40			
Zinc	Fertilized	3.50	3.00	2.800	4.35	5.20	3.80	4.14	0.024	0.001
	Unfertilized	3.50	5.65	5.050	5.50	2.50	5.00			
Copper	Fertilized	0.58	0.44	0.41	0.47	0.83	0.35	0.57	0.005	0.001
	Unfertilized	0.56	0.86	0.53	0.81	0.83	0.70			
Selenium	Fertilized	0.04	0.03	0.03	0.05	0.06	0.04	0.05	0.001	0.001
	Unfertilized	0.04	0.06	0.05	0.06	0.03	0.05			
Manganese	Fertilized	0.15	0.10	0.07	0.23	0.25	0.27	0.19	0.001	0.001
	Unfertilized	0.21	0.19	021	0.28	0.13	0.16			

LSD: Least significant difference; Prob.: Probability.