CARCASS AND ORGANOLEPTIC QUALITIES OF CHICKEN BROILERS FED MAGGOT MEAL IN REPLACEMENT FOR DIETARY FISH MEAL

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Abstract

One hundred and fifty Anak broiler chickens on a standard diet were randomly assigned at four weeks to five dietary treatments each with two replications of 15 birds per diet. In the five diets which were isonitrogenous and isoenergetic, maggot meal replaced fish meal at 0.25, 50, 75, and 100% and thus constitute 0, 1.35, 2.71, 4.07 and 5.42% of the diets respectively. Processing, carcass and organoleptic characteristics of the birds were determined after the five-week experimental feeding period. Live weights of broilers fed zero and 1.35% dietary maggot meal were similar but were both different (P<0.05) from live weights of broilers on 2.71% dietary maggot meal and above. Similar results were observed for defeathered weight. However percent bled and dressed weights were not different. Percent breast weight increased as dietary maggot meal increased reaching a plateau and significant difference (P<0.05) at 2.71% dietary maggot meal treatment. Except for the neck with a significantly low percentage of 3.04% at 5.42% treatment, all the other carcass parts and organs were similar in weight distribution. Dietary treatment had no significant effect on liver and gizzard colour scores, W.B. shear force values, organoleptic flavour, colour, overall acceptability scores and meat-to-bone ratios. However, sensory tenderness and juiciness were significantly affected (P<0.05) with highest preference scores at 1.35% and 4.07% dietary maggot meal.

Keywords: Maggot meal, Broiler chickens, Liver colour, Fishmeal, Meat-to-bone ratios

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Introduction

The conventional sources of feed protein for monogastrics in the developing countries are fish, groundnut and soya bean meals (Sarria *et al.,* 1990; Khieu and Preston, 1995). With an increasing number of large industrial poultry farms in these areas, protein feed resources are greatly challenged to the extent that small and medium scale poultry enterprises are squeezed out of access to these resources. For survival therefore, these farms are increasingly focusing attention on cheap, suitable and sustainable alternative or non-conventional protein feed resources.

Such a feasible option is the production of housefly larvae (*Musca domestica*) or maggot meal from recycling poultry droppings as a control measure for environmental pollution by the poultry industry. In Africa South of the Sahara where two out of every five people live in poverty (Okunmadewa, 1999), it is also an avenue for employment generation as a means of alleviating poverty. Maggots are ready for harvesting in 5 to 6 days. In deed a 10,000 capacity poultry farm has been projected to have the capacity for generating 1.5 tonnes of housefly larvae monthly (Atteh, 2002). Housefly maggots are rich in protein and energy (Atteh and Ologbenla, 1993) and as a dietary ingredient supplies more than the required amino acid complements for broiler chicks (Teotia and Miller, 1973). They can completely replace groundnut cake in broiler diet without any deleterious effect on bird performance (Atteh and Oyedeji, 1994). While several studies have been executed investigating the effect of dietary maggot meal on growth and performance of broiler chicken (Atteh and Ologbenla, 1993; Atteh and Oyedeji, 1994 and Adejinmi *et al.*, 1998) few reports abound on the organoleptic traits of such broiler chicken. This study attempts to bridge that gap.

Materials and Methods

One hundred and fifty Anak broiler chicks previously reared on a standard broiler starter diet for four weeks were used for this investigation. The birds were randomly assigned to five treatment groups at 30-birds per diet and further subdivided into two replicate groups of 15-birds per diet. Routine management practices were followed. The dietary compositions of the five experimental diets are as shown in table 1. Maggot meal replaced fish meal qualitatively at 0, 25, 50, 75 and 100% levels and thus constitutes 0, 1.35, 2.71, 4.07 and 5.42% of the diet respectively. The crude protein content of the diets remained constant at 20.59±0.32% while the metabolic energy value was 3.05±0.15 kcal/gm. The procedure used in producing maggots from poultry droppings has been described by Soukossi (1992). Feed and water were supplied ad-libitum. At the end of the five week feeding experiment, one bird was taken randomly from each of the replicates for carcass analysis on three consecutive days giving a total of six birds per dietary treatment. The birds were fasted overnight with access to water prior to slaughtering. The live weights and weights at each processing step were taken. Data obtained included the bled and defeathered weights, dressing percent, eviscerated and organ weights. The liver and gizzard were immediately visually assessed on colour basis following the procedure of Okubanjo and Babalola (1981). They were scored 1, 2 or 3 based on their yellow, light mahogany or mahogany colouration as an indirect indication of high, medium or low fat deposition in these organs.

The eviscerated carcasses were chilled overnight at 3 ± 1^0C, then assessed for quality grades the grade A carcasses scored as 1 and grade D carcasses scores as 4. Each carcass was disjointed into 6 cut-up parts following the procedure of Okubanjo and Babalola (1981) and weighed.

Each cut-up part was tagged and individually wrapped in aluminum foil. Cut-up parts from the same carcass were packed into a steam pressure cooker and allowed 25 minutes cooking time. The parts were air cooled, mopped dry and reweighed to determine cooking loss. Each cooked cut-up part was then separated into meat (including skin) and bone, weighed and the meat-to-bone ratio determined A3cm x 3cm thick strip was taken along the fiber direction from the breast meat and sheared three times to determine the objective tenderness values on the Warner Bratzler Shear Press. The remaining breast meat was cut into bite size samples. They were subjected to sensory evaluation by a five member organoleptic panel on a nine point hedonic scale with 1 representing disliked extremely and 9 presenting liked extremely.

Data obtained were subjected to analysis of variance (Steel and Torrie, 1980) and where necessary, means were separated using. Duncans Multiple Range and Multiple F test (Duncan, 1955).

Table 1: Composition of Finisher Diet

	Finisher			Diets	
Maggot meal %	A	B	C	D	E
Ingredients	0	1.35	2.71	4.07	5.42
Maize	56.00	55.77	55.54	55.3	55.08
Full fat Soyabean	24.00	24.00	24.00	24.00	24.00
Fish meal	4.50	3.38	2.25	1.13	-
Maggot meal	-	1.35	2.71	4.07	5.42
Blood meal	3.00	3.01	3.00	3.00	3.00
Corn Bran	5.20	5.20	5.20	5.20	5.20
Bone meal	3.50	3.50	3.50	3.50	3.50
Oyster shell	1.50	1.50	1.50	1.50	1.50
Vitamin/mineral premix*	1.00	1.00	1.00	1.00	1.10
Salt	1.00	1.00	1.00	1.00	1.00
Methionine	0.30	0.30	0.30	0.30	0.30
	100.00	100.00	100.00	100.00	100.00
Chemical Analysis					
Crude Protein	20.74	20.36	20.48	20.64	20.74
Metabolisable Energy (kcal/gm)	3.01	3.15	3.04	3.09	3.13

* To provide the following per kg of feed = Vit A, 66000iu, vit, D_3 1000_{in}; Vit E, 3.6_{iu}; Vit K, 1.25mg; riboflavin, 2mg; pantothenic acid, 4mg; niacin 15mg, choline, 2mg Vit B_{12}, 0.06mg; folic acid, 2.67mg; Mn, 0.06mg; Zn, 0.33mg; iodine, 0.67mg; Co, 0.8mg; Cu, 6.6mg, Fe, 6.6mg.

Results and Discussion

While live weight is of economic importance to the poultry farmer, the consumer is more interested in the yield of the dressed broiler carcass and those offal's which are directly edible. Data presented in Table 2 show the final live weight to vary from 1.60 to 1.82kg. No significant live weight difference (P>0.05) was observed between broilers fed 0 and 1.35% dietary maggot meal on one hand and among those fed 2.71 to 5.42% dietary maggot meal in replacement for fish meal on the other. However, the two groups differed significantly from each other (P<0.05) with the final live weight decreased with the higher levels of dietary maggot meal. Blood loss varied from 5.58% in the broilers fed 1.35% dietary maggot meal to 6.43% in broilers fed dietary maggot meal at 4.07% level. These values were rather low compared with the 10% expected yield of blood from the body of young chickens (Ockerman and Hansen, 2000). The defeathered weight varied from 86.30 to 88.78% of the live weight giving a feather yield of from 5.63 to 7.40%. Feather yield were similar at 2.71% maggot meal level and above but were significantly higher (P<0.05) than the feather yield at the lower levels of replacements. Thus it would appear that dietary maggot meal above 2.71% enhanced feathering at the expense of fleshiness.

The dressing percent varied from 74.14% in broiler fed diet with 5.42% maggot meal to 76.85% in broilers fed diet containing 2.71%. These values are comparable with values of 71.46 to 75.91% obtained by Jegede *et al* (2006) in broilers fed variously processed shrimp waste meal. They are also in consonance with previous observation by Ravinder *et al* (1996) that dietary effect were insignificant on dressing percentage of Cobb broilers. However, the present values were all higher than the dressing percent obtained by Sunusi *et al* (2007) who replaced the more expensive fish meal with graded levels of grasshopper meal. All the dressed chicken carcasses were graded. (score of 2).

Significant differences (P<0.05) in carcass composition were observed in the breast, foreback and neck cuts as well as in the liver percentage. Relative weights of the breast meat were similar at 0, 1.35 and 4.07% dietary maggot meal. However, except for that of 4.07% level, these were significantly lower than the percentage breast cuts of broilers on 2.71 and 5.42% dietary maggot meal. All the other cut-up parts and organ weights were not affected by the inclusion of maggot meal in replacement for fishmeal in the diet. The combined percentage of the breast, thigh and drumstick varied from 42.16 to 47.2% increasing as the level of dietary maggot meal inclusion increased to 4.07% with a slight decline to 45.91% at 5.42% level of dietary maggot meal inclusion. Since these three cuts are the most valued cuts to the processor, the fast food operator and the consumer, an improvement in meatiness and economic value would be expected when up to 4.07% maggot meal is included in the diet.

Table 2: Processing Characteristics of Experimental birds

	Dietary Treatments					
	A	B	C	D	E	SEM
Maggot meal%	0	1.35	2.71	4.07	5.42	
Liver wt (kg)	1.82[b]	1.78[b]	1.60[a]	1.66[b]	1.70[a]	0.10
%	100.00	100.00	100.00	100.00	100.00	100.00
Bled wet %	93.68	94.42	93.70	93.53	94.41	0.36
Defeathered wt %	88.05	88.78	86.30	86.73	87.74	0.89
Feather yield %	5.63[a]	5.64[a]	7.40[b]	6.80[b]	6.67[b]	0.69
Dressed wt %	76.08	76.64	76.85	75.31	74.14	0.98
Carcass relative composition %						
Breast	18.22a	18.75a	21.38b	19,06ab	21.16b	1.50
Thighs	13.18	12.66	12.32	14.90	12.68	0.93
Drumstic	10.76	11.66	11.74	13.28	12.07	0.81
Hind back	8.35	8.76	9.53	8.95	10.32	0.68
Fore back	9.06bc	8.26ab	7.50a	8.67b	9.81c	0.77
Wings	11.47	10.47	9.86	10.80	10.34	0.53
Head	3.29	3.19	3.34	3.54	3.26	0.12
Shanks	5.43	4.93	5.15	5.97	5.24	0.94
Neck	5.58b	5.18bc	5.43c	5.68c	3.04a	0.94
Heart	0.57	0.68	0.61	0.59	0.67	0.04
Liver	2.46bc	2.68c	2.22ab	2.00a	2.28ab	0.23
Gizzard	3.05	2.70	3.00	2.77	2.62	0.32
Abdominal fat	1.08	1.09	1.11	1.12	1.12	0.17

ab Means on same row with different superscripts vary significantly ($P<0.05$).

The slight but non-significant (P>0.05) increases in abdominal fat content of the broilers as maggot meal content of the diet increased could not confirm the observed significant increase in abdominal fat content observed by Atteh and Ologbenla (1993) in broilers fed maggot meal based diets nor that of Adejinmi *et al* (1998) as soldier fly larvae meal content increased in broiler diet.

Table 3: Objective and subjective assessments of broiler meat

	Dietary Treatments					
	A	B	C	D	E	SEM
Maggot meal%	0	1.35	2.71	4.07	5.42	
Liver colour score	2.0	2.33	2.67	3.00	2.33	0.34
Grizzard colour score	3.0	3.00	3.00	3.00	3.00	0.00
Cooking loss %	17.58^{a}	24.73^{ab}	22.33^{ab}	22.12^{ab}	27.788	3.36
Shear force	3.60	3.49	3.72	4.79	3.01	0.59
Sensory scores flavour	6.13	7.07	6.33	6.37	6.93	0.37
Tenderness	6.13^{ab}	7.00^{b}	5.47^{a}	7.07^{b}	5.73^{a}	0.65
Juiciness	5.67^{a}	6.73^{b}	5.00^{a}	6.47^{b}	5.73^{ab}	0.60
Odour	6.53	7.13	6.13	6.33	7.07	0.39
Overall acceptability	6.07	7.00	6.07	6.80	7.07	0.44
Meat to bone ratio						
Thigh	2.47:1	3.13:1	2.70:1	2.67:1	2.80:1	0.21
Drumstick	2.40:1	2.43:1	2.46:1	2.11:1	2.93:1	0.26
Wing	2.26:1	2.27:1	2.01:1	1.77:1	1.87:1	0.21
Breast	5.09:1	4.83:1	5.07:1	4.20:1	4.01:1	0.45
Fore back	1.24:1	1.66:1	1.36:1	1.20:1	1.54:1	0.15
Hind back	1.55:1	1.77:1	1.96:1	1.65:1	1.89:1	0.15

ab Means on same row with different superscripts vary significantly (P<0.05).

Data presented in Table 3 indicate no significant difference (P>0.05) in the colour scores of the liver and gizzard arising from the treatments. That all the gizzards were rated as mahogany coloured with a score of 3 indicate that the gizzard has a low potential for fat deposition. The variation from light mahogany to mahogany colour in the liver however indicate variable deposition of fat. In deed Wolford and Polin (1972) established some degree of correlation between visually scored liver lipid and chemically extracted lipid component. However, the non-significant difference (P>0.05) in liver colour score indicates that the incorporation of maggot meal in broiler diet is not likely to cause fatty liver syndrome, which is often associated with certain strains of laying hens.

The cooking loss percent varied from 17.58% in broiler fed dietary fishmeal alone to 27.78% in broiler fed dietary maggot meal alone. These values were significantly different (P<0.05) from each other. They were however, not significantly different (P>0.05) from the cooking loss of broiler meat from the mixed dietary treatments.

Tenderness is a very important quality attribute by which consumers judge meat quality (Ashie *et al.,* 2002). Based on the objective tenderness values as measured with the Warner Bratzler shear press, no significant difference (P<0.05) could be observed in the tenderness of breast meat of broilers from all the different dietary treatments. The range of shear values of from 3.01 to 4.79 observed in this study fell within the range of 3.0 and 4.9 which Miller *et al* (2001) established as the consumer threshold shear value boundaries for intermediate level of tenderness in beef.

Except for the organoleptic tenderness and juiciness scores which showed higher values at 1.35 and 4.07% dietary maggot meal treatment, all the other organoleptic traits were similar indicating no substantial dietary maggot meal effect on broiler meat eating qualities. Previous observation by Ayanwale *et al* (2003) indicates that dietary effect of their treatments on colour, texture, juiciness, flavour and tenderness of broiler chicken was not significant. Data presented for the meat-to-bone ratio shows no dietary treatment effect on this trait in all the cut-up parts examined. However, the breast meat was shown to be the most meaty while the fore back and hindback were the least meaty with the thigh, drumstick and wing being of average meatiness.

In conclusion, the lack of significant difference in most of the data here reported in response to increasing level of replacement of fish meal with maggot meal would seem to suggest the cheaper and easily culturable maggot meal could economically replace the more expensive fish meal in broiler diet without any deleterious effect on the carcass values and eating quality of broiler chicken meat. However, a 2.71% dietary level of maggot meal replacement would appear to favour the highest dressing percentage while 4.07% dietary maggot meal inclusion would enhance higher yield of the combined breast, thigh and drumstick.

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