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Research Article

Effect of replacing soybean meal with different levels of processed droppings meal on carcass and meat quality of spent layers

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Abstract

This study investigated the effect of feeding diets containing layers droppings meal in replacement of soybean meal on carcass and meat quality of spent Silver Brown layers. A total of 105 chickswere purchased from avian specialist hatchery at Ibadan, Oyo state and reared on the Teaching and Research Farm of Olabisi Onabanjo University, Ayetoro Campus. They were fed Animal Care Konsult® concentrate up to point of lay and were allotted to 5 treatments and placed on basal diet T0=0% dried layers dropping meal (DLDM) the test diets T_1=25% DLDM, T_2=50% DLDM, T_3=75% DLDM and T_4=100% DLDM inclusion with 3 replicates of 7 birds per replicate. At the end of 18 months lay, 15 birds from each treatment were randomly selected and slaughtered. Carcass and meat characteristics were determined in a completely randomized design experiment and data analysed at p=0.05. Birds fed T_1 furnished higher dressing percentage (72%), cut-up parts, cooking yield (90.41%), crude protein (21.6%) andorganoleptic properties, while cooking and drip losses as well as thermal and cold shortenings were lower compared to other treatments. It was concluded that diet T_1 (25% DLDM) inclusion was better and was recommended.

Introduction

Poultry production is unique in that is a major employer of thousands of people and offers the quick return of income in Nigeria and most countries of the world (Apata and Oke, 2012; Rahman et al., 2022; Sultana et al., 2023). This is mainly because of the ease to enter into the business as fairly moderate capital outlay is required to start (Oluwanbe, 2002). However, in the world over, there is rising operational cost, which tends heavily towards feeding of birds to the toll of about 60% of the cost (Sanni et al, 2000; Sarker et al., 2022; Sultana et al., 2023). Silver Brown are the world most prolific egg layers producing over three hundred and thirty rich brown eggs within eighteen months and are adaptable to tropical environment (Parkhaurst and Mountney, 2004), but they consume more for them to produce the desired eggs in terms of number and size as well as furnish considerable dressing yield. In other to provide adequate feeding for the birds in the face of dwindling feedstuff resources non-conventional feed ingredients is daily gaining ground in developing countries of Africa among which is soybean meal that is used in replacement of fish meal (Samocha et al, 2004; Islam et al., 2022). The search for other non-conventional ingredients for feeding poultry becomes imperatives as the use of soybean by humans increased, therefore, the feeding trials of dried layers droppings meal for poultry and other animals as the layer droppings were waste which pollute the environment and are readily available are therefore, highly recommended for conversion into feed (Akangbe and Adeleye, 2002; Awoniyi et al, 2003; Onimisi et al, 2006; Aro and Tewe, 2007). This study was conducted therefore, to determine the consequences of dried layers droppings on carcass, meat and organoleptic properties of silver brown spent layers.

Materials and methods

Location of study

This study was carried out at the Poultry Unit of the Teaching and Research Farm (T&RF) and the Meat Science Laboratory of the Olabisi Onabanjo University, Ayetoro Campus Ogun State, Nigeria.

Experimental birds

A total of 105 chicks were purchased from Avian Specialists Ibadan and reared to the point-of-lay (POL) (16 weeks) with a reputable commercial feed Animal Care Konsult(R) before they were allotted randomly into 5 treatments with 3 replicates of 7 birds per replicate.

Processing of layers droppings

Accumulated layers droppings at the poultry unit of the Teaching and Research Farm of Olabisi Onabanjo University were collected on daily basis and spread on the concrete floor to dry in the sun with constant turning to effect proper drying for 10 days. The dried poultry, droppings meal (DLDM) were bagged and later incorporated into the tested diets (Mountney and Parkhaurst, 2007) as shown in Table 1.

Table 1. Ingredient composition of experimental diets

Ingredients (kg)	Treatment Diets				
	T_0 0% DLDM	T_1 25% DLDM	T_2 50% DLDM	T_3 75% DLDM	T_4 100% DLDM
Maize	500.00	500.00	500.00	500.00	500.00
SBM	220	165.00	110.00	55.00	-
DLDM	-	55.00	110.00	165.00	220.00
Wheat offal	140.00	140.00	140.00	140.00	140.00
Bone meal	23.00	23.00	23.00	23.00	23.00
Limestone	90.00	90.00	90.00	90.00	90.00
Fish meal (65%)	20.00	20.00	20.00	20.00	20.00
Layer premix	03.00	03.00	03.00	03.00	03.00
Salt	02.00	02.00	02.00	02.00	02.00
Toxin binder	01.00	01.00	01.00	01.00	01.00
Superliv	01.00	01.00	01.00	01.00	01.00
Total	1000.0	1000.00	1000.0	1000.0	1000.0

DLDM = Dried layers droppings meal, SBM = Soybean meal

Experimental procedures

The birds were randomly allotted to 5 treatments of diets viz: 25% DLDM (T_1), 50% DLDM (T_2), 75% DLDM (T_3), 100% DLDM (T_4) and control No DLDM inclusion (T_0). There were 3 replicates of birds with 7 birds per replicate. The birds were fed ad-libitum with access to abundant water for 18 months. All hygiene and medication management were carried out during the experiment.

Slaughter of birds

At the end of 18 months feeding trial and expected laying life span of the birds; 75 birds were randomly selected, 5 from each treatment and slaughtered. The birds were fasted for 8 hours, weighed and bled. The carcasses were scalded, singed and eviscerated.

Chilling and fabrication of carcasses

Carcasses were chilled immediately after dressing in the refrigerator at 4^{o}C for 24 hours and were weighed, fabricated following the procedures of Parkhaurst and Mountney (2004) into primal cuts which included thigh, drumstick, breast, wing, and back.

Carcass and meat characteristics

The carcass attributes determined included fasted live, bled, dressed weights and dressing percentage. Meat properties measured were physical variables that included cooking and drip losses, cooking yield, thermal and cold shortenings as well as shear force following the procedures of (Honikel, 1998). The proximate composition of meat was determined according to (AOAC, 2005) procedures while the organoleptic evaluation of the meat was carried out according to the procedures of (AMSA, 2015). A semi-trained taste panel of 10 members was used to evaluate the meat for colour, tenderness, flavour, juiciness, texture and overall acceptability on a 9-point hedonic scale on which 1=dislike extremely and 9=like extremely.

Experimental Design and Statistical Analysis

The experiment was carried out using completely randomized design (CRD) and data analysed using (SAS, 2002), while means were separated with Duncan multiple range test of the same software.

Results and Discussion

The results of carcass characteristics of Silver Brown spent layers fed tested diets indicated that live bled and dressed weights as well as dressing percentage were higher ($p<0.05$) in carcass of birds fed diet (T_1) with 25% DLDM inclusion compared with control (T_0) Table 2.

These results (Tables 1-4) were in agreement with the findings of (Kessler et al, 2000) who reported that increasing the level of non-conventional ingredient in the diet of poultry decreased the carcass composition and yield of broiler chickens. The results obtained in Table 4 were in agreement with (Mountney and Parkhaurst, 2007) who reported similar results on broiler chickens fed graded levels of DLDM supplemented with methionine and lysine. Cooking loss and thermal shortening are very crucial in that they affects the yield of meat therefore any ingredient inclusion in the diet that would affect cooking loss and thermal shortening and the yield must be controlled so that the effect would not be drastic so that processors may benefit from the proceed. In the same vein drip loss and cold shortening affect the keeping value of meat as they reduce the weight hence the yield of meat that may be preserved using cold method, as a result would affect the shear force value of the meat as observed in the result of this study and reported by the same authors.The results indicated in table 5 that protein content of the meat had inverse relationship with moisture content, therefore inclusion of DLDM in the diet for spent silver Brown layers should be controlled in such a way that protein which is the major desirable component of meat would be obtained (Apata, 2011).The meat taste panelists preferred and accepted meat of Silver Brown spent layer fed diet T_1 (Table 6) than meat samples from other treatments with 8.1 score. Acceptability of any food, meat or meat products depends on colour, flavor, juiciness, sometimes texture and often than not tenderness especially in most developing countries where meat is consumed as supplement to carbohydrate food (Okubanjo, 1990; Apata et al, 2011). The results revealed further that acceptability of meat from Silver Brown spent layers fed graded levels of DLDM decreased as the percentage of the test diet increased hence meat from birds fed diet T_4 furnished the lowest acceptability score of (3.0). These results were in tandem with the findings of (Apata, 2011) who reported that addition of non-conventional ingredient in the diet of birds decreased the consumers preference for the meat as the addition of the ingredient increased above a tolerable level and would therefore, not be necessary to include the test ingredient beyond the level at which the meat was most preferred and accepted.

Table 2. Carcass characteristics of Silver Brown spent layers fed test diets

Variable	Treatment Diets				
	T_0 0% DLDM	T_1 25% DLDM	T_2 50% DLDM	T_3 75% DLDM	T_4 100% DLDM
Live weight (g)	$1374.0^b\pm116.5$	$1463.0^a\pm160.6$	$1360.0^b\pm147.3$	$1286.0^c\pm144.0$	$1260.0^c\pm140.3$
Bled weight (g)	$1352.0^b\pm170.3$	$1455.0^a\pm127.0$	$1350.0^b\pm165.2$	$1248.0^c\pm171.0$	$1242.0^c\pm171.2$
Dressed weight (g)	$950.0^b\pm225.7$	$1055.0^a\pm287.4$	$870.0^c\pm280.0$	$750.0^d\pm130.1$	$725.0^d\pm127.0$
Dressing (%)	$69.1^b\pm11.4$	$72.1^a\pm10.2$	$63.9^c\pm11.7$	$58.3^d\pm11.6$	$57.5^d\pm8.2$

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

Similar results were obtained in Table 3 that shows primal cut weights of birds. The least ($p<0.05$) weights were observed in cuts from carcasses of birds fed diets T_3 and T_4 while higher ($p<0.05$) primal cut weights were observed in carcasses of birds fed diet T_1 with 25% DLDM inclusion followed by that of control (T_0).

Table 3. Primal cut weight of Silver Brown spent layers carcass fed test diets

Variable	Treatment Diets				
	T_0 0% DLDM	T_1 25% DLDM	T_2 50% DLDM	T_3 75% DLDM	T_4 100% DLDM
TH (g)	$56.2^b\pm4.67$	$65.6^a\pm11.3$	$52.3^b\pm8.2$	$45.9^c\pm7.4$	$43.7^c\pm7.1$
DS (g)	$56.7^b\pm6.0$	$67.7^a\pm4.9$	$54.5^b\pm5.4$	$48.6^c\pm6.1$	$46.4^c\pm6.0$
BT (g)	$173.4^b\pm37.6$	$184.6^a\pm28.4$	$166.5^c\pm25.0$	$158.5^d\pm21.4$	$156.3^d\pm28.2$
WG (g)	$62.6^b\pm5.3$	$70.8^a\pm2.8$	$60.7^a\pm8.1$	$58.9^d\pm4.7$	$56.5^d\pm11.0$
BK	$96.6^b\pm23.2$	$139.0^a\pm19.3$	$92.1^b\pm33.3$	$87.5^c\pm35.1$	$84.8^c\pm36.3$

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

TH = Thigh, DS = Drumstick, BT = Breast, WG=Wing, BK = Back

The physical characteristics of Silver Brown spent layers results are presented on Table 4. The cooking, drip losses as well as thermal and cold shortenings were very high ($p<0.05$) in meat of birds fed diets T_3 and T_4 with 75 and 100% DLDM inclusion, while these variables were lower ($p<0.05$) in meat of birds fed diet T_1 (25% DLDM) inclusion followed by that of control (T_0), while cooking yield was higher ($p<0.05$) in meat from birds fed diet T_1.

Table 4. Physical characteristics of Silver Brown spent layers' meat

Variable	Treatment Diets				
	T_0 0% DLDM	T_1 25% DLDM	T_2 50% DLDM	T_3 75% DLDM	T_4 100% DLDM
Cooking loss (%)	$12.2^d\pm9.0$	$9.6^e\pm8.3$	$13.5^c\pm6.0$	$20.7^b\pm5.1$	$22.6^a\pm4.2$
Cooking yield (%)	$87.8^b\pm6.0$	$90.4^a\pm3.6$	$86.5^b\pm6.1$	$79.3^c\pm7.3$	$77.4^c\pm7.8$
Drip loss (%)	$5.9^d\pm11.0$	$3.7^e\pm11.8$	$7.2^c\pm9.2$	$8.6^b\pm9.8$	$10.3^a\pm7.6$
Thermal shortening (%)	$6.1^c\pm0.5$	$3.2^d\pm0.8$	$8.3^b\pm0.3$	$8.5^b0.3$	$9.8^a\pm0.2$
Cold shortening (%)	$6.7^d\pm0.4$	$5.1^e\pm0.3$	$7.4^c\pm0.6$	$8.7^b\pm0.5$	$10.1^a\pm0.1$
Shear force ($kgcm^3$)	$2.1^c\pm0.6$	$2.3^c\pm0.6$	$3.3^c\pm1.8$	$4.5^a\pm2.2$	$48^a\pm2.0$

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

The proximate composition of silver Brown layers fed graded levels of DLDM results are presented on Table 5. There were significant ($p<0.05$) differences in the moisture and protein contents of the meat. Moisture was lower ($p<0.05$) n meat from carcasses of birds fed diet T_1 and higher ($p<0.05$) in meat from those fed diets T_3 (70.8) and T_4 (71.2) respectively, while protein (21.6%) content was higher than in treatments T_2-T_4. There were no significant differences ($p>0.05$) in ash and fat contents of the meat except the nitrogen free extract (NFE) with control (T_0) having the higher ($p<0.05$) value of 15.2%.

Table 5. Proximate composition of Silver Brown spent layers' meat

Variable	Treatment Diets				
	T_0 0% DLDM	T_1 25% DLDM	T_2 50% DLDM	T_3 75% DLDM	T_4 100% DLDM
MC	$58.2^c\pm0.3$	$55.5^c\pm0.3$	$65.7^b\pm0.4$	$70.8^a\pm0.2$	$71.2^a\pm0.2$
CP	$20.1^b\pm0.1$	$21.6^a\pm0.1$	$19.3^c\pm0.3$	$18.2^d\pm0.5$	$18.0^d\pm0.5$
FE	7.5±0.1	7.3±0.1	7.4±0.1	7.6±0.1	7.8±0.1
Ash	1.6±0.3	1.8±0.2	1.5±0.4	1.4±0.3	1.3±0.4
NFE	$15.2^a\pm0.1$	$10.8^b\pm0.1$	$6.1^c\pm0.2$	$2.0^d\pm0.1$	$1.7^d\pm0.0$

Means on the same row with different superscripts are statistically significant ($p<0.05$), MC= Moisture Content, CP= Crude Protein, EE= Ether Extract, NFE= Nitrogen Free Extract

The results of the organoleptic properties of meat from Silver Brown spent layers fed graded levels of DLDM showed that meat from birds fed diet T_1 furnished higher ($p<0.05$) scores for all the sensory variables with exception of tenderness which was higher ($p<0.05$) in T_3 and T_4. All the sensory variables except tenderness decreased as the level of DLDM increased beyond 25% inclusion which indicated that the meat became tender beyond the tolerance level of the taste panelists which also affected the meat texture.

Table 6. Organoleptic properties of Silver Brown spent layers' meat

Variable	Treatment Diets				
	T_0 0% DLDM	**T_1 25% DLDM**	**T_2 50% DLDM**	**T_3 75% DLDM**	**T_4 100% DLDM**
Colour	$6.2^b±1.0$	$7.8^a±0.8$	$5.3^c±0.9$	$4.2^d±1.5$	$4.0^d±1.5$
Flavor	$5.6^b±0.6$	$7.0^a±0.9$	$4.6^c±1.3$	$3.4^d±1.6$	$3.1^d±1.6$
Tenderness	$4.3^d±0.9$	$5.5^c±0.7$	$6.5^b±0.4$	$7.7^a±0.1$	$7.9^a±0.1$
Juiciness	$6.0^b±0.8$	$7.2^a±0.5$	$5.6^c±0.3$	$4.5^d±0.0$	$4.2^d±0.0$
Texture	$6.2^b±0.5$	$7.3^a±0.1$	$5.6^c±0.5$	$4.3^d±1.5$	$3.1^e±2.1$
OA	$7.0^b±0.3$	$8.1^a±0.0$	$5.5^c±0.7$	$4.1^d±1.7$	$3.0^e±2.8$

Means on the same row with different superscripts are statistically significant ($p<0.05$), OA = Overall acceptability

Conclusion

The results from this study indicated that including dried layers droppings meal (DLDM) in the diets of Silver Brown spent layers had significant effects on carcass, yield on physicochemical and organoleptic characteristics of the meat. It was observed that inclusion of DLDM at 25% (T_1) elicited higher and better carcass physical chemical and sensory values than it were obtained in other treatments. Therefore, DLDM inclusion in the diets for Silver Brown spent layers at 25% was recommended.

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