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Carcass traits of chicken broilers on sodium sulphate and fish oil supplementation in fish meal free diet

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ABSTRACT

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The present study attempts to analyze the effect of supplementation of Sodium Sulphate (SS) and Fish Oil (FO) in fish meal free ration on the carcass traits of chicken broiler. One hundred and eighty, day-old unsexed broiler chicks were distributed on the basis of completely randomized design in four groups with three replicates, each consisting of 15 broilers. The treatment groups included the T_0 (negative control), T_1 (control), T_2 (T_0 + 0.35% SS) and T_3 (T_0 + 0.35% SS + FO). Standard feeding and all other management practices were followed during the experimental period of 42 days. After completion of the experiment, three birds from each replicate were sacrificed for estimation of carcass attributes, and proximate analysis of thigh and breast meat. The carcass attributes (Dressing %, Eviscerated %, Drawn % and Inedible offals %) and proximate analysis of the breast (DM%, CP%, EE% and ASH%) and thigh (DM%, CP% and EE%) meat of T_3 group recorded significant ($P<0.05$) improvement as compared to T_0, T_1 and T_2 group. However, giblets percentage and thigh percentage varied non-significantly among the treatments. This experiment concludes that fish meal can be replaced by SS alone, and combination of SS with FO without any adverse impact on chicken broiler's performance.

Keywords: Broiler, Carcass traits, Fish meal, Proximate analysis

INTRODUCTION

Broilers are among the fastest growing component of worldwide meat demand. India is experiencing rapid climb in its poultry sector which is not only supporting the economic progress of country but also providing a proteinaceous animal food to consumers. But, a major constrain thampering the rapid progress of broiler industry is increasing cost of feedstuffs. Feed represents the major cost of poultry production, constituting roughly up to 70 percent of the total recurring cost of production. So it becomes essential to provide not only balanced but cost effective feed for further betterment of broiler industry.

Fish meal is valued by poultry farmers and nutritionists for its highly digestible crude protein, essential amino acids, fat, vitamins and minerals. But a large amount of fish meal is required to be added in ration to meet out demands of essential amino acids like methionine and lysine. Limited availability, lack of uniformity, higher cost relative to plant sources and storage issues due to its oxidizable nature responsible for rancidity are some strong reasons to find substitutes for fish meal in broiler diets. Availability and quality issues of fish meal further aggravated during tough times of COVID pandemic. So, there is a need to formulate isocaloric isoproteinic fish meal free ration to reduce the feed cost. Various alternates of fish meal have been experimented in various studies such as inorganic sulphate (Rahimi *et al.*, 2005), fish oil (Panda *et al.*,2016), shrimp waste meal protein (Mounica *et al.*, 2020) etc.

To maintain the amino acid balance in ration of broilers, use of certain substances which can possibly spare the inclusion of certain essential amino acids upto some extent is desired. Sodium Sulphate (SS) helps in sparing methionine through conversion to cystine. 18% of recommended methionine can be replaced with 0.1% SS (Rahimi *et al.*, 2005). Incorporation of SS and methionine in all vegetable rations appears to provide sulphur containing amino acids from sulphate and replaces fish meal respectively in vegetable protein diet (Vidyadharan *et al.*, 2006 and Akpet*et al.*, 2009). The broilers fed 0.5% SS were significantly better performing than that of control group (Ali *et al.*, 2016). But, Ali *et al.* (2019) reported that no significant differences existed in carcass percentage values of control and 0.5% SS supplemented chicken broilers.

Fish Oil (FO), an important source of omega-3 polyunsaturated fatty acids (PUFA) has several advantages like reduction of feed dust, reduction in the rate of feed passage through GI tract (Poorghasemi *et al.*, 2013), improvement in hydrolysis and absorption of the lipoproteins that supply fatty acids (Nobakht *et al*, 2011), enhance the nutrient absorption (Poorghasemi *et al.*, 2013), increase diet palatability, improve the utilization of the consumed energy etc. Elzobier *et al.* (2016) recorded increased carcass weight of broilers that were fed 3% FO in comparison to control diet. Panda *et al.*

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(2016) reported that the relative carcass attributes such as dressed yield, breast meat, liver and giblet were not compromised due to incorporation of 2% or 3% FO in the broilers diet.

Keeping in view the constraints and need of poultry industry, the present investigation was planned to estimate the carcass characteristics of chicken broilers with SS and FO supplementation in fish meal free ration.

MATERIALS AND METHODS

The present investigation was conducted in the poultry shed of the Department of Livestock Production Management, College of Veterinary Sciences, Lala Lajpat Rai University of Veterinary and Animal Sciences (LUVAS), Hisar. The experiment was approved by the Institutional Animal Ethics Committee held in the month of March, 2021(Registration No- 1669/GO/ReBiBt-S/Re-L/12/CPCSEA).

Experimental birds and design

For the present experiment 180 one-day-old broiler chicks of Ven-Cobb-400 were purchased from a reputed local hatchery. The chicks were individually weighed, wing banded and randomly distributed into four treatment groups with three replicates of 15 birds each (Table 1) as per experimental design of Completely Randomized Design (CRD).

Table 1: Dietary Treatments used in experimental trial

GROUP	TREATMENTS
T_0	Basal ration feeding without Fish Meal (NEGATIVE CONTROL GROUP)
T_1	Basal ration feeding with Fish Meal (CONTROL GROUP)
T_2	T_0 + 0.35% Sodium Sulphate
T_3	T_0 + 0.35% Sodium Sulphate + Fish Oil

Diet formulation

All feed ingredients, additives and supplements used in the experiment for diet formulation were procured in one lot before the start of the experiment. Diet of each treatment group was formulated for three growth periods i.e. pre-starter, starter and finisher. Feed ingredients used for ration formulations were examined for proximate nutrients (AOAC, 2013). The measured values after examination of the ingredients including the chemical makeup (% DM basis) of the diets under experimentation have been depicted in Table 2. Each group was fed with rations formulated as per BIS (2007) specifications.

Housing and management

Standard management practices including brooding, proper lighting, raking of litter, cleaning of feeders, waterers, etc. were followed throughout the experiment.

Carcass traits

For carcass evaluations, nine birds per dietary treatment (three birds per replicate) were selected randomly, at the end of 6th week. The birds were kept off feed for 12 hours but water was provided *ad libitum* prior to their sacrifice. Weight of the birds, both before and after fasting was recorded. Immediately after recording their live weights, the birds were slaughtered and weight of blood, feathers, head, shank, skin, viscera, heart, liver, gizzard, breast and thigh portion was recorded. By using these recorded weights, following parameters were calculated:

- Dressed weight = Live weight – (blood+ feathers+ head+ shank+ skin)
- Eviscerated weight = Dressed weight – weight of viscera
- Drawn weight = Eviscerated weight + weight of giblets
- Giblets weight = Heart + Liver + Gizzard weight

Then, all the above mentioned parameters were calculated as percent of live weight i.e. dressing percentage, eviscerated percentage, drawn percentage, giblet percentage, breast percentage and thigh percentage.

Nutritional quality parameters of carcass

From each of the slaughtered birds, breast and thigh muscle samples were collected. and stored in deep-freeze separately for further analysis. These samples were analyzed for dry matter, protein, ether extract and ash as per AOAC (2013) and expressed as percentage of the sample taken.

Statistical analysis

Data obtained were subjected to statistical analysis as per Snedecor and Cochran (1994) using CRD. All the data were subjected to one way ANOVA using the SPSS software (version-16). Duncan's multiple range tests were used to separate the mean differences among different treatments. Consequently, a level of ($P<0.05$) was used as the criterion for statistical significance (Duncan, 1955).

RESULTS AND DISCUSSION

The literature reveals scanty work done on the impact of supplementation of SS and FO on the broilers' performance, but no work has been found on combination of supplementation of SS with FO. So the research work available on the impact of supplementation of SS and FO alone in the diet of chicken broilers has been used in support of results obtained in the present study.

Carcass characteristics

The impact of SS and FO on mean carcass attributes of broiler chicken is depicted in Table 3. The dietary supplementation of SS alone (T_2) and SS with FO (T_3) significantly ($P<0.05$) improved dressing percentage, eviscerated percentage, drawn percentage, inedible offals percentage and breast percentage of

Table 2: Quantity of ingredients and chemical composition (% DM basis) of experimental diets (kg/100 kg feed)

Ingredients	**Quantity**											
	Pre-starter (0-1 weeks)				**Starter (2-3 weeks)**				**Finisher (4-6 weeks)**			
	T_0	**T_1**	**T_2**	**T_3**	**T_0**	**T_1**	**T_2**	**T_3**	**T_0**	**T_1**	**T_2**	**T_3**
Maize	55	54	54	54	55.2	55.2	54.65	54.65	58	58	57.35	57.35
Soybean meal	23	20	26.15	26.15	23	19	23	23	13.7	10	13.5	13.5
Ground nut cake	18	14.5	15	15	16	12.8	16	16	20.3	17	20.8	20.8
Fish meal	-	7	-	-	-	7	-	-	-	7	-	-
Mineral mixture	2	2	2	2	2	2	2	2	2	2	2	2
Sodium Sulphate (99% Anhydrous)	-	-	0.35	0.35	-	-	0.35	0.35	-	-	0.35	0.35
Vegetable oil	2	2.5	2.5	-	3.8	4	4	-	6	6	6	-
Fish Oil	-	-	-	2.5	-	-	-	4	-	-	-	6
Chemical composition	**Pre-starter**				**Starter**				**Finisher**			
Crude Protein %	23.49	23.91	23.52	23.54	22.67	22.87	22.58	22.61	20.57	20.87	20.61	20.63
Ether Extract %	4.62	5.48	5.06	5.09	6.39	6.99	6.55	6.57	8.63	9.03	8.58	8.61
Crude Fibre %	3.39	3.08	3.23	3.25	3.24	2.95	3.24	3.23	3.31	3.01	3.32	3.30
Total Ash %	3.46	4.87	3.37	3.39	3.31	4.71	3.29	3.31	3.15	4.56	3.15	3.17
Metabolizable Energy (MJ/Kg)	12.30	12.35	12.34	12.34	12.79	12.80	12.78	12.79	13.54	13.50	13.47	13.49

Feed additives @ g/100kg of feed: 1) Intermix Regular @ 10g (Each gram contained Vitamin A– 82,500 IU, Cholecalciferol– 16,500 IU, Riboflavin– 50 mg and Vitamin K–10 mg). 2) Intermix BE @20g (Each gram contained Thiamine– 8 mg, Pyridoxine – 16 mg, Cyanocobalamine – 80 mg, Vitamin E – 80 mg, Niacin – 120 mg, Folic acid – 6 mg and Calcium pantothenate – 80mg). 3) Coxicheck-WS @ 20g (Each gram contained Amprolium – 200mg and Menadione–10 mg). 4) Choline chloride @ 80g (contains 60% Choline chloride). 5) Lysine @ 50g (contains 98% lysine). 6) DL- methionine @ 80g (contains 98% methionine).

carcass of chicken broilers as compared to control group (T_1) and negative control group (T_0), however giblets percentage and thigh percentage differed non-significantly among all treatment groups. In comparison to T_2 group, T_3 group revealed significant ($P<0.05$) improvement in dressing percentage, eviscerated percentage, drawn percentage and inedible offals percentage. Similar trend was also observed in T_1 on comparison with T_0 group. The improved carcass characteristics in present study might be owed to better utilization of inorganic sulphate to meet out sulphur requirements of body along with higher n-3 PUFA, EPA and DHA content of FO which results better digestion of feed, thereby resulting in better carcass characteristics.

These findings were similar to those obtained by Ali *et al.* (2016). They recorded improved carcass characteristics due to SS supplementation in chicken broilers in comparison to control group. Giblets percentage was also non-significant similar to our study. The dressing percentage and breast yield were improved ($P<0.05$) by FO supplementation than control group (Hassanein *et al.*, 2021 and Ibrahim *et al.*, 2018). Similar to our study, Safamehr *et al.* (2008) found no discernible variations in weight of thighs of chicken broilers among the treatments. Analogous to present study, Elzobier *et al.* (2016) and Bahman Navidshad (2009) recorded improved carcass weights due to supplementation of FO in diets of chicken broilers.

Table 3: Effect of Sodium Sulphate and Fish Oil on mean carcass characteristics of chicken broilers

Particulars	**TREATMENTS**			
	T_0	**T_1**	**T_2**	**T_3**
Live weight (grams)	1761.67^{a}±16.68	1890.89^{b}±17.04	1959^{c}±27.12	2105.56^{d}±14.25
Dressing Percentage	74.17^{a}±0.16	75.46^{b}±0.19	76.09^{c}±0.18	77.42^{d}±0.17
Eviscerated percentage	60.87^{a}±0.28	61.73^{b}±0.19	63.27^{c}±0.23	64.52^{d}±0.23
Giblets percentage(Edible Offals)	5.69±0.07	5.74±0.08	5.84±0.13	5.98±0.074
Drawn percentage	66.56^{a}±0.21	67.48^{b} ±0.17	69.12^{c}±0.21	70.51^{d}±0.18
Inedible Offals percentage	33.43^{d}±0.21	32.51^{c} ±0.18	30.87^{b}±0.21	29.48^{a}±0.19
Breast percentage	15.38^{a}±0.50	15.75^{a} ±0.43	17.57^{b}±0.39	18.24^{b}±0.45
Thigh percentage	18.46±0.10	18.57±0.18	18.81±0.19	18.69±0.14

Each value is a mean of three replicates (n=9).

Means bearing different superscripts differ significantly ($P<0.05$) row wise.

In contrary to present finding, Ali *et al.*(2011 and 2019) recorded no significant differences in carcass characteristics due to SS supplementation in chicken broilers. Hassanein *et al.*(2021) and Ibrahim *et al.*(2018) recorded improved thigh yield in chicken broilers due to FO supplementation in comparison to control group. Dressing percentage was lower (P <0.05) in birds fed FO than fed with vegetable oil (Shoaib *et al.* 2021).According to research by Safamehr *et al.* (2008), there were no significant differences observed in the weight of the heart, gizzard, liver, breast, or carcass yield among the treatments. According to Saraee *et al.* (2014) and Panda *et al.* (2016), there was no significant effect on the dressing percentage and breast yield due to FO supplementation in diets of chicken broilers. However, Saraee *et al.* (2014) recorded non-significant effect in thigh yield due to FO supplementation which corresponded to our findings. Attia *et al.* (2020) recorded similar dressing percentages in broilers fed FO or any other vegetable oil source. The giblets percentage was reported non-significant by Panda *et al.* (2016) which were contrary to present study.

Proximate analysis of breast and thigh meat

The effect of SS and FO on mean proximate analysis of breast and thigh meat of broiler chicken is presented in Table 4. The dry matter percentage, crude protein percentage, ether extract % and total ash percentage of breast meat was significantly (P<0.05) improved in T_3 group in comparison to T_2, T_1 and T_0 group. Also, T_1 and T_2 recorded significant (P<0.05) improvement in crude protein %, ether extract % and total ash % of breast meat than T_0 group. As compared to T_0, T_1 and T_2, T_3 recorded significant (P<0.05) improvement in dry matter %, crude protein %, ether extract% in thigh meat. Except T_0, all other treatment recorded significantly higher total ash content in thigh meat, but it varied non- significantly among themselves. T_1 and T_2 varied non-significantly with each other in all the proximate parameters of thigh and breast meat.

The present results of ether extract of breast meat were similar to those obtained by Bahman Navidshad (2009) who reported lower levels of ether extract in breast meat due to 4% FO supplementation in diets of chicken broilers. Yang *et al.* (2010) also recorded improved carcass quality in chicken broilers due to FO supplementation. In contrary to present findings, Bahman Navidshad (2009) reported increased levels of ether extract in thigh meat of broilers due to 4% FO supplementation. Also, Kalakuntla *et al.* (2017) noted that there was no significant effect of FO on protein percentage in breast and thigh meat.

CONCLUSION

Based on the findings of this study, it can be claimed that supplementing SS with FO for the 42 days that the birds were raised under investigation was beneficial for the carcass characteristics and proximate analysis of the meat of thigh and breast. Further research is necessary to ascertain the optimal dosage and source of SS and FO use in order to assess the impact on broiler performance and production economics.

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DECLARATION OF CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

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Table 4: Effect of Sodium Sulphate and Fish Oil on mean proximate analysis of breast and thigh meat of chicken broilers

Particulars		TREATMENTS			
		T_0	T_1	T_2	T_3
BREAST	DM %	24.95^{a} ±0.44	26.59^{b}±0.41	26.03^{ab}±0.10	28.18^{c}±0.46
	CP %	19.25^{a} ±0.20	20.71^{b}±0.21	21.08^{b} ±0.22	23.04^{c}±0.21
	EE%	5.12^{b} ±0.31	4.86^{b}±0.24	4.89^{b} ±0.25	4.01^{a}±0.22
	ASH %	1.65^{a}±0.02	1.73^{b}±0.02	1.74^{b}±0.02	1.85^{c}±0.02
THIGH	DM %	22.28^{a} ±0.10	23.03^{a}±0.29	23.28^{a} ±0.57	25.67^{b}±0.53
	CP %	16.97^{a}±0.15	18.43^{b}±0.14	18.72^{b}±0.15	20.01^{c}±0.21
	EE%	7.78^{b}±0.46	7.38^{b}±0.41	7.31^{b} ±0.53	6.77^{a}±0.37
	ASH %	1.32^{a}±0.04	1.55^{b}±0.04	1.57^{b}±0.04	1.65^{b}±0.03

Each value is a mean of three replicates (n=9).

Means bearing different superscripts differ significantly (P<0.05) row wise.

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