Effect of Crude Soy Lecithin with or without Lipase on Performance and Carcass Traits, Meat Keeping Quality and Economics of Broiler Chicken

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Abstract

The experiment was conducted using four hundred commercial day old (Vencobb) broiler chicks for 42 days. The experiment was designed to evaluate the effect of crude soy lecithin with or without lipase on performance, carcass traits and keeping quality of meat of broiler chickens. The birds were divided into four dietary treatments with four replicates of 25 birds each. The treatment groups comprised of A (control- basal diet) without soy lecithin and Lipase while B basal diet with lipase, C Basal diet with 50% soy lecithin and D Basal diet with 50% soy lecithin and lipase. The data obtained were subjected to Analysis of variance in a completely randomized Design. The significant (P<0.01) influence of soy lecithin alone or in combination with lipase enzyme on cumulative weight gain, feed consumption and FCR was observed. The edible carcass yield percent was found significant (P<0.05) higher in lecithin alone or lipase enzyme supplemented groups. The higher livability was recorded in soy lecithin alone or in combination with lipase enzyme compared to control groups. The TBA values of broiler meat on 15th day of storage showed significant (P<0.05) difference between the treatment groups. The findings concluded that dietary supplementation with soy lecithin alone and in combination with lipase enzyme influenced oxidative stability in breast and thigh muscle. Supplementation of crude soy lecithin alone or in combination with lipase enzyme enhanced the net profit per kg of live weight. It is concluded that the supplementation of soy lecithin alone or in combination with lipase enzyme through feed in broilers is beneficial for bird's performance, carcass traits, improved oxidative stability, and thereby increasing shelf life of meat during refrigerated storage and profitability.

Key words: Crude Soy Lecithin, Lipase Enzyme, Supplementation, Broiler, Performance, Economics

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Introduction

Crude soy lecithin (CSL) is the by-product of soybean oil refinery which is available commercially and can be incorporated in the diet as an alternative source of energy. Soy lecithin is utilized in a wide variety of food and industrial applications. Lecithin is a combination of naturally-occurring phospholipids namely phosphatidylcholine (PC), phosphatidylethanolamine (PE) and phosphotidylinositol (PI). Soy-lecithin not only provides energy to broilers but also serves as an emulsifier and has the potential to enhance utilization of dietary fat by animals. Higher cholesterol present in the carcass makes it prone to oxidative changes, while soy lecithin have ability to reduce cholesterol level to which indirectly increases the stability of meat. Different oils due to their varying degree of non-saturation, affect the fatty acid composition of neutral lipids and to some extent the fatty acid composition of phospholipids, which in turn influence the oxidative stability of meat during storage. Fat is emulsified by detergent action of the bile salts and hydrolyzed by lipase into fatty acids and mono- and di-glycerides. Transport of fat and mono- and di-glycerides occurs in the form of micelles: Soy lysolecithin is an excellent emulsifier for food and has been prepared by pancreatic phospholipase A2-catalyzed hydrolysis of soy lecithin. The emulsion with soy lysolecithin is stable in various conditions. Soy lysolecithin is also a good solubilizer. The soy lecithin can be used in broiler diet as substitute for commercial oil for better performance of broiler in finisher stage (Azman and Ciftci 2004). The supplementation of lecithin at 0.5% and 1.0% in broiler diets was beneficial in improving digestibility of dry matter, protein and fat with more improvements evident in young chicks (Wang *et al.*, 2008). Soy-lecithin and soy-oil in a proportion of 25:75 had the highest growth performance in broiler (Huang *et al.*, 2007).

It is well known that fat digestion is facilitated by the combined action of bile acids, lipase, and colipase. The digestibility fat is limited in young chickens, as the lipase they secret is not adequate. It has been demonstrated that the physiological functions necessary for efficient fat digestion in young chickens are immature and continue to develop for several weeks after hatching. The present research was undertaken to study effect of crude soy lecithin with or without lipase enzyme through feed on body weight gain, feed consumption, FCR, mortality, carcass quality, keeping quality of meat and economics of broiler production.

Materials and Methods

Experimental Site

The experiment was carried out at the Broiler unit of Department of poultry Science, College of Veterinary and Animal Science Parbhani Maharashtra Animal and Fishery science University Nagpur (MS), India.

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Procurement of Ingredients

A basal diet was prepared with maize and soybean meal having uniform nutrient composition, except for supplementation of crude soy lecithin and lipase enzyme (Table 1). Treatment group A was control (without crude soy lecithin and lipase enzyme), B was fed with lipase enzyme @100000 IU/ton of feed, C was fed with crude soy lecithin@ 50% replacement of commercial oil and D was fed with lipase enzyme @ 100000 IU/ton of feed + crude soy lecithin @ 50% replacement of commercial oil(Table 2). Soya lecithin was obtained from reputable soy processing plant, Aurangabad. The good quality feed ingredients were procured from local market for preparation of experimental diets.

Table 1: Percent Ingredient and Nutrient of Different Dietary Composition of Prestarter, Starter and Finisher Rations of Experimental Groups

Feed Ingredients	**Prestarter**	**Starter**	**Finisher**
Maize	53.2	54.0	58.5
Vegetable oil	3.0	4.2	4.9
Soybean meal	41.0	39.0	33.8
Dicalcium phosphate	1.5	1.5	1.5
Limestone powder	1.0	1.0	1.0
Salt	0.3	0.3	0.3
Total	100	100	100
Protein	23.05	22.02	20.05
M.E. Kcal/Kg	3011.16	3100	3202.22
E : P ratio	130.63:1	140.78:1	159.71:1
Supplements/additives (g/100 kg)			
* Mineral mixture	300	300	300
** Vitamin mixture	150	150	150
Methionine	180	190	160
Lysine	170	130	100
Choline chloride	60	60	60
Crude soy lecithin	#	#	#
Lipase enzyme	#	#	#

 # The crude soy lecithin and lipase enzyme were incorporated in the treatment groups as described in treatment detail. ***** *Mineral Mixture: - Copper, ferrous, zinc, iron.*
***** *Vitamin Mixture: -Vit.A, D, E, K & Vit B complex (Riboflavin, thiamine, Choline, pantothenic acid, niacin, pyridoxine, biotin, cynocobalamine).*

Experimental Birds and Management

The experiment was carried out on 400 day old Vencobb commercial straight run broilers for a period of 42 days. On arrival, the chicks were weighed and distributed randomly into four treatment groups viz, A, B, C and D with four replicates of 25 chicks each (Table 2). The brooding was carried out with electric hover brooders as source of heat and light. The brooding was continued until 2 weeks of age in the respective pen of each replication and treatment group. The live body weights of all birds were recorded

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replicate wise at weekly interval. The prestarter, starter and finisher ration were offered from 1-8 days, 9-20 days and 21 to 42 days, respectively.

Table 2: Experimental Design Used For Housing of Broilers

Sr. No	Treatment groups	No. of birds/pen/ replication	No. of replications	Total number of birds
1	**Control A-** Basal Diet (commercial oil)	25	4	100
2	**Group B-**Basal diet + Lipase enzyme	25	4	100
3	**Group C-** 50% oil from basal diet replaced with crude soy lecithin	25	4	100
4	**Group D-** Basal Diet + 50% oil from basal diet replaced with crude soy lecithin + Lipase enzyme	25	4	100
	Total Birds		16	400

Data Collection

Data were collected on weekly weight changes was determined by weighing the birds on weekly basis and weight gain was calculated by subtracting the weight of the previous week from that of the current week. The feed intake was determined by subtracting the left-over feed from the feed offered, while feed conversion ratio was calculated as average feed intake divided by average weight gain. At the end of the experiment, four birds from each treatment group; one bird from each replicate was randomly selected for carcass evaluation studies. The birds were fasted for a period of ten hours prior to slaughter. For obtaining edible carcass yield, the carcass was weighed after removal of feathers, viscera, head and legs by keeping the skin intact with the carcass. The percent weight of edible carcass and abdominal fat pad weight were calculated over live weight. Edible carcass yield was calculated by adding the weight of carcass, neck, giblet and expressed as percentage of edible carcass yield of live weight. The weight of abdominal fat was recorded by separating it from carcass and expressed as percent abdominal fat of the total carcass yield. The cost of rearing the chicks for complete experiment was calculated by taking into consideration the cost of chick, cost of total feed consumed by bird, cost of litter, vaccination, medication expenses.

Statistical Analysis

All the generated data were subjected to statistical analysis (ANOVA) by using Complete Randomized Design by Snedecor and Cochran, (2002). The treatment means were compared by critical differences (CD) and Analysis of Variance.

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Results and Discussion

Weight Gain

The analysis of variance for cumulative weight gain showed significant (P<0.01) differences among the treatment groups (Table 3). Significant improvement in weight gain for Treatment groups C, D compared to Treatment group A, B inferred important role of lecithin in feed utilization and improved digestion and assimilation of fat. Similarly, Azman and Ciftci (2004) concluded that during grower period a moderate significant increase of weight gain was reported for soy lecithin group. Also, Huang et *al*. (2007) reported Soy lecithin and soy oil in proportion of 25:75 had highest growth performance. Many other authors reported significant effect of soy lecithin on growth rate (Kim *et al.*, 2008, Roy *et al.*, 2008, Wang *et al.*, 2008, Zhu *et al.*, 2008, Attia *et al.*, 2009, Melegy *et al.*, 2010, Mahmoudi *et al.*, 2015 and Akit *et al.*, 2016). In contrast, to present findings, Meng *et al.*, 2004 revealed no effect of lipase addition on chicken performance and nutrient utilization.

Feed Intake

The significant (P < 0.01) differences were recorded for supplementation of crude soy lecithin alone or in combination with lipase for feed intake. A. Significant improved feed intake in the present study supports the conclusion that an increased feed intake might have resulted in (Table 3) better utilization, digestion, absorption, and metabolism of supplied feed nutrients specifically, protein in terms leading to increased body weight. Similarly, Suresh *et al.*, 2010 reported significantly (P<0.01) higher feed intake in bird fed lipase and soy lecithin supplemented diet during finisher phase as well as cumulatively. Also, Mahmoudi *et al* (2015) reported significantly higher feed intake by supplementation of soy lecithin. On other hand Azman and Ciftci (2004) showed feed intake was slightly and significantly decreased during starter period and more remarked reduced during grower period in soybean lecithin mixture. Roy *et al.* (2008), Kim *et al.* (2008) observed non-significant difference in control and treatment group.

Feed Conversion Ratio

Significant (P<0.01) influence of crude soy lecithin alone or in combination with lipase enzyme indicated enhanced feed utilization and nutrient absorption due to its bio surfactant property (Table 3) and better utilization and absorption of nutrients and fat in the body of broilers. These results were in close agreement with previous data. Indeed, Azman and Ciftci (2004), Roy *et al.*, 2008, Wang *et al*., 2008, Kim *et al*., 2008 and Melegy *et al.*, 2010 also reported similar findings. Mahmoudi *et al* (2015) reported that FCR was improved significantly with supplementation of soy lecithin in broilers. However, Haung *et al.* (2007) reported contrast findings to present findings.

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Carcass Traits

Significant (P<0.05) improvement (Table 3) observed for edible carcass yield in soy lecithin alone and in combination with lipase enzyme inferred excellent digestibility of fat and availability of energy and other nutrients in the feed resulting in increased edible carcass yield. Roy *et al.* (2008) reported that at the end of 39 days feeding time, carcass fat content increased 42 %. Zhu *et al.* (2008) also reported that Soy lecithin supplementation with 10 gm / kg in ration had best effect on carcass characteristics in female broiler chicken. Huang *et al.* (2008), Suresh *et al.* (2009), Suresh *et al.* (2010) and Melegy *et al.* (2010) reported contrast findings to that of present study. The numerical lower abdominal fat percent were observed for soy lecithin alone and in combination with lipase enzyme but the differences were non-significant among treatment groups. Similar findings were also reported by Suresh *et al.* (2009). Mahmoudi *et al* (2015) reported non- significant effect of supplementation of lecithin on carcass traits of broiler.

Livability

Livability was higher (Table 3) in soy lecithin alone and in combination with lipase enzyme groups compared to that of control group implies that soy lecithin was tolerated, non-toxic and might be totally metabolize: These results are in good agreement with Attia *et al.* (2009), who concluded that higher livability in soy lecithin supplemented compared to un-supplemented control group in hen. Aman and Ciftci (2009) also observed similar findings.

Oxidative Stability (TBARS values – mg malondialdehyde /kg tissue)

The TBA values of broiler meat on 0^{th} day showed significant (P < 0.01) differences between the treatment groups (Table 3). The treatment group A differed significantly from rest of treatment groups; however, the differences between treatment groups B, C, and D were non-significant. The TBA values of broiler meat on 15^{th} day of storage showed significant (P<0.05) difference between the treatment groups. The superior TBA values were recorded by treatment group D followed by C, B and A. These findings concluded that dietary supplementation with soy lecithin alone and in combination with lipase enzyme influence oxidative stability in breast and thigh muscle during storage at 15^{th} day. The supplementation of soy lecithin resulted in lower TBA values which would retard oxidative processes associated with lipid oxidation. Significantly lower TBA values indicated supplementation of soy lecithin improved meat quality and its stability substantially against oxidative deterioration during refrigerated storage condition. Similar findings were observed by Cox *et al.* (2008). They indicated that soy lecithin at low level may have processing benefit in production of meat emulsion. Dani Preetha (2011) reported that TBA value of fresh meat was significantly lower in group fed diet containing soy lecithin. The non-significant

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differences between the treatment groups (Table 3) for pH of breast and thigh meat at 0day of storage of broilers fed with crude soy lecithin alone or along with lipase were recorded. The highest mean p^H value was observed for the treatment group A followed by treatment group D, B and C. However, contrast findings were reported by Dani Preetha (2011) in broilers and Collin *et al.* (2011) in pigs. The purge loss value for soy lecithin alone or in combination with lipase enzyme supplemented group showed minimum purge loss compared to control group at 15^{th} day of storage. It concluded that supplementation of soy lecithin maintained the integrity of cell membrane thereby reduce higher purge loss. Similar findings were reported by Kim *et al.* (2008) in pigs.

Table 3: Effect of Soy Lecithin with or Without Lipase Enzyme on Various Parameters of Broiler Chicken

Parameters	**A**	**B**	**C**	**D**	**SE ±**	**CD**	**CV %**
Cumulative weight gain (g)	1757.6^b	1856.8^b	1996.8^a	2049.7^a	33.866	104.20	3.536
Cumulative weight gain (g)	3508.3^b	3416.1^b	3595.4^{ab}	3810.1^a	75.08	231.02	4.191
Cumulative fcr	1.99^a	1.84^b	1.80^b	1.85^b	0.0281	0.0866	3.005
Edible carcass yield (%)	73.62^b	74.88^b	76.00^{ab}	77.64^a	0.836	2.573	2.214
Abdominal fat (%)	1.78	1.72	1.56	1.64	0.154	0.011	6.933
Mortality (%)	7%	4%	3%	3%	-	-	-
Tbars values at 0 day	0.0700^a	0.0475^b	0.0375^b	0.0325^b	0.00414	0.0127	1.768
Tbars values at 15 days	0.1350^a	0.1250^{ab}	0.1200^{bc}	0.1125^c	0.0043	0.0133	6.94
P^h of breast and thigh meat 0^{th} day	5.875	5.600	5.550	5.650	0.0774	0.2322	2.730
P^h of breast and thigh meat 13^{th} day of storage	6.075	5.075	5.825	5.925	0.0582	0.1746	1.969
Purge loss value (%) 15 day of storage	8.037^a	5.500^b	5.737^b	6.002^b	0.6168	1.897	19.522
Net profit/kg Live weight	5.20	8.62	10.63	9.81	---	--	--

Note: - Means In Columns Not Sharing A Common Superscript Differ Significantly

Economics of Broiler Production

The data from economics of broiler production (Table 3) concluded that supplementation of crude soy lecithin alone or in combination with lipase enzyme significantly enhanced the net income per bird. The present findings are in close agreement with that reported by Haldaand and Ghosh (2010) and Suresh *et al*. (2010). The overall results obtained lead to conclusion that supplementation of soy lecithin alone or in combination to lipase enzyme through broiler feed resulted in improving body weight, superior FCR,

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increase feed intake, low abdominal fat and higher carcass yield. Significantly lower TBA values indicated supplementation of soy lecithin leads to improved meat quality and its stability substantially against oxidative deterioration during refrigerated storage condition. The economics of broiler production evidenced that soy lecithin alone or in combination with lipase enzyme supplementation groups are more profitable compared to control group. Hence, it is concluded that the supplementation of soy lecithin alone or in combination with lipase enzyme through feed in broilers is more beneficial from bird's performance, improved shelf life of meat during refrigerated storage and economical benefit.

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