

## Effect of Using Saturated and Unsaturated Fats in Broiler Diet in its Performance and Blood Parameters

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### ABSTRACT

*A trial for 42 days on 360 Cobb-500 broiler was conducted on CRD design with six treatments, four replicates of fifteen birds per experimental unit consisted of isocaloric and isonitrogenous diets containing 21% C.P. and 3008 Kcal ME in starter, 19% C.P. and 3086 Kcal ME in grower and 18% C.P. and 3167 Kcal ME in finisher. The inclusion of 6% mustard oil (T1), 1.5 % tallow and 4.5% mustard oil (T2), 3% mustard oil and 3% tallow (T3), 4.5 % tallow and 1.5% mustard oil (T4), and 6% tallow (T5) were used, the control diet did not contain any fat (T0). The studied parameters were feed consumption, feed conversion ratio, body weight gain, carcass characteristics, blood parameters, economical analysis. Fat levels and sources significantly ( $p < 0.05$ ) influenced the body weight gain, feed consumption, feed conversion ratio. Feed consumption decreased significantly ( $p < 0.05$ ), FCR decreased significantly ( $p < 0.05$ ), body weight increased significantly ( $p < 0.05$ ) in all treatments except T0. The carcass characteristic did not differ significantly ( $p > 0.05$ ) in all treatments. High benefit-cost ratio was showed by diet containing 3% tallow and 3% mustard oil. There was linear decrease in serum glucose, serum cholesterol compared to control (T0) diet. Albumin: Globulin ratio was lowest in all treatments except T0. It can be concluded that saturated and unsaturated fat not only increased the performance but also decreased the heat stress and increased the immune response.*

**Keywords:** Blood parameters; Cobb-500; Mustard oil; Performance; Tallow

### INTRODUCTION

The livestock and poultry sectors are an integral part of Nepalese economy and lifestyle. Livestock and poultry populations have continuously been increasing in the last decade in Nepal and are likely to follow that trend as the interests in this field is growing (Poudel et al., 2020). Chickens tolerate a very narrow range of climatic variation, and therefore, it is essential to determine the most suitable climatic area and weather for broiler production in open-house systems (Osti et al. 2017). Mainly Carbohydrates are used in poultry diet for energy supply but fats and oils give 2.25 times more energy than Carbohydrates. In poultry production system, energy is the most expensive item. Source of energy contributed about 60 to 80 % of total cost in ration. The biological impact and economic efficiency of a feeding system is in fact determined by dietary energy level and its relation with other nutrients. The possibility to increase its production to the level of potential output by improving technical efficiency which is done by ensuring high quality inputs both physical and technical to the poultry farms (Pradhan et al. 2019).

In tropical countries Environmental temperature is one of the major stresses for poultry (Reddy et al., 2002). It is also known that the apparent digestibility of fat is 95 to 100% if it is low in waxes and chlorophyll, and has boiling point less than 60 degree centigrade. Fat produces highest calories as compared to other nutrients. For instance, fat, protein and carbohydrates yields 9.455, 5.65 and 4.2 kcal/gm (Church and Pond, 1988). If adequate amount of fat is not present in the diet, the function of fat soluble vitamins will decrease and animal show fat soluble vitamins deficiency symptoms (Church and Pond, 1988). Poultry growth performance is not only inherited, but it is also greatly affected by the environment (Babinszky et al., 2011).

Saturated fatty acid has higher energy density but lower metabolisable energy than unsaturated fatty acid. Absorbability of saturated fatty is lower as compared to unsaturated fatty acid. If saturated and unsaturated fatty acid is combined, then metabolisable energy will be higher than the sum of the individual fatty acid. This is called as Fatty Acid Synergism. Mohammadi, *et al.* (2011) who reported that the chicks feed diet supplemented with 6 % tallow or soyabean oil and 3% tallow + 3% soyabean oil had the most body weight gain and the best value for feed conversion ratio ( $P < 0.01$ ). The aim of this study was to evaluate the effect of the different inclusion level of mustard oil and tallow on the performance and blood parameters of Cobb-500 broilers.

## MATERIALS AND METHODS

A feeding trial was conducted at Mahalaxmi Poultry Farm, Bhandara-09, Chitwan from 30<sup>th</sup> April 2017 to 10<sup>th</sup> June 2017. The experiment was aimed to evaluate the performance of Cobb-500 broiler fed diet containing saturated and unsaturated fat alone or in combination. A completely randomized experimental design with six treatments, four replicates of 15 birds per experimental unit was applied. Altogether 360 Cobb-500 broiler chickens were reared. The treatment consists of isocaloric and isonitrogenous diets containing 21% C.P. and 3008 Kcal ME in starter, 19% C.P. and 3086 Kcal ME in grower and 18% C.P. and 3167 Kcal ME in finisher. The inclusion of 6% mustard oil (T1), 1.5 % tallow and 4.5% mustard oil (T2), 3% mustard oil and 3% tallow (T3), 4.5 % tallow and 1.5% mustard oil (T4), and 6% tallow (T5) in basal diet were used, the control diet did not contain any fat (T0). Birds were provided with the general management of ad libitum feeds and water. Experimental diets were based on corn and soybean meal, and each oil source was added as above mentioned inclusion level except for the control diet, which did not have any fat included. Feeds were formulated to supply nutritional requirements of broilers according to the recommendation of the Cobb 500 manual guide, 2008.

Parameters like cumulative feed consumption (gm), average daily feed consumption (gm), mean cumulative body weight (gm), weekly body weight gain (gm), daily body weight gain (gm), dressing percentage, feed conversion ratio, economics of broiler production, blood parameters, etc. were collected. Data obtained from experimental trial were tabulated in Microsoft excel 2007. One way analysis variance was performed for significance test at 1 and 5 probability level. The data were analyzed using statistical program MSTAT-C version 1.5, treatments means difference were compared by Least Significant Difference (LSD  $p < 0.05$ ) and Duncan's Multiple Range Test (DMRT  $p < 0.05$ ).

## RESULTS

### Feed conversion ratio

Table 1. Mean feed conversion ratio of broiler fed diets with different levels of saturated and unsaturated fat alone or in combination at Mahalaxmi Poultry Farm, Bhandara-09, Chitwan from 30 April 2017 to 10 June 2017.

Treatment	Mean feed conversion ratio						Overall FCR
	1 <sup>st</sup> Week	2 <sup>nd</sup> Week	3 <sup>rd</sup> week	4 <sup>th</sup> Week	5 <sup>th</sup> week	6 <sup>th</sup> week	
T0	2.11 <sup>a</sup>	1.91 <sup>a</sup>	1.73 <sup>a</sup>	1.92 <sup>a</sup>	2.25 <sup>a</sup>	2.30 <sup>a</sup>	2.04 <sup>a</sup>
T1	1.86 <sup>ab</sup>	1.89 <sup>a</sup>	1.81 <sup>a</sup>	1.92 <sup>a</sup>	2.14 <sup>ab</sup>	2.16 <sup>a</sup>	1.96 <sup>a</sup>
T2	1.76 <sup>ab</sup>	1.84 <sup>ab</sup>	1.67 <sup>abc</sup>	1.80 <sup>ab</sup>	2.00 <sup>ab</sup>	2.01 <sup>ab</sup>	1.85 <sup>ab</sup>
T3	1.26 <sup>b</sup>	1.53 <sup>b</sup>	1.44 <sup>c</sup>	1.52 <sup>c</sup>	1.67 <sup>c</sup>	1.69 <sup>b</sup>	1.52 <sup>c</sup>
T4	1.84 <sup>ab</sup>	1.84 <sup>ab</sup>	1.69 <sup>ab</sup>	1.81 <sup>ab</sup>	1.92 <sup>b</sup>	1.82 <sup>b</sup>	1.82 <sup>ab</sup>
T5	1.41 <sup>ab</sup>	1.54 <sup>b</sup>	1.46 <sup>bc</sup>	1.56 <sup>bc</sup>	2.01 <sup>ab</sup>	2.01 <sup>ab</sup>	1.66 <sup>bc</sup>
F-value	1.948 <sup>ns</sup>	2.872*	3.819*	4.622**	6.447**	4.561**	4.826**
Probability	0.1360	0.0445	0.0156	0.0069	0.0013	0.0073	0.0057
CV %	26.40	11.69	9.30	9.31	7.81	10.26	9.59
LSD	0.67	0.30	0.23	0.24	0.23	0.30	0.26
SEM	0.23	0.10	0.08	0.08	0.08	0.10	0.09

Result of the study showed that overall mean feed conversion ratio of birds at the end of the experiment was significantly poor (2.24) of birds fed diet without supplementation of fats and oils (T0) and superior of birds (1.66) fed diet with 3% mustard oil and 3% tallow (T3). No significant difference in feed conversion ratio of birds was observed in between T3 and T5 of birds during the experimental periods. This results are in agreement with Mohammadi *et al.* (2011) who reported that the chicks feed diet supplemented with 6 % tallow *or* soyabean oil and 3% tallow + 3% soyabean oil had the most body weight gain and the best value for feed conversion ratio ( $P < 0.01$ ). The better weight gain in unsaturated fat based diet might be due to the fact that vegetable oils contain high amount of polyunsaturated fatty acids which were more soluble (into micelles) and ultimately more digestible in the intestine than the saturated fatty acids from animal fat and there by unsaturated fats provides the highest dietary apparent metabolizable energy value in broilers.

### Carcass characteristics

Table 2. The average dressing percentage and relative percentage of organs on different treatments of cob-500 poultry fed with saturated and unsaturated fat alone or in combination at Mahalaxmi Poultry Farm, Bhandara-09, Chitwan from 30<sup>th</sup> April 2017 to 10<sup>th</sup> June 2017.

Parameter	T0	T1	T2	T3	T4	T5
Empty Gizzard	2.37	2.66	2.83	2.89	2.50	3.23
Liver	2.20	2.15	2.55	2.30	2.27	2.40
Heart	0.57	0.47	0.61	0.59	0.61	0.61
Giblet weight	5.14	5.28	5.99	5.79	5.39	6.25

Spleen	0.08	0.08	0.14	0.07	0.09	0.09
Neck	5.57	6.58	6.17	5.24	5.90	5.17
Shank	5.06	4.27	4.77	4.92	4.39	5.00
Leg Piece	22.24	21.99	22.20	22.85	22.46	22.63
Back	12	12.35	11.28	11.87	12.60	12.08
Chest	22.40	19.69	20.04	20.57	20.01	20.41
Wings	8.72	8.78	8.50	9.02	8.45	8.69
Abdominal Fat	0.93	1.17	1.67	0.95	1.28	1.49
Head	2.75	2.44	2.61	2.71	2.57	2.76
Dressing %	74.9	75.83	75.85	76.42	76.2	76.19

The highest(76.42)dressing percentage was found in bird fed with diet T3 containing 3% mustard oil and 3% tallow and lowest (74.9) with diet T0 containing no added fat and oil. The lowest percentage of abdominal fat was observed in the bird fed with diet T0 (0.93) and the highest in the bird fed with diet T2 (1.67). There were no significant differences in the dressing percentage and its carcass characteristics.

These findings are in agreement with Mohammadi *et al.*(2011) where there was no significant difference between carcass characteristics due to dietary treatments containing fats. However, the use of an unsaturated fat source to reduce lipid accumulation could negatively affect carcass quality characteristics due to the excessively low melting point of the deposited fat (Hrdinka *et al.*, 1996). It had also been previously reported that broilers fed isoenergetic diets rich in polyunsaturated fatty acids showed lower abdominal fat deposition compared with those fed diets containing saturated fat (Barroeta, 1989) which concurs to finding of this trial. The use of fatty acids in the diet increased the accumulation of abdominal fat and increased carcass (Hrdinka *et al.*, 1996) which was similar to our finding.

### Economics of broiler production

Table 3. Economic analysis of Cobb 500 broiler Fed with saturated and unsaturated fats alone or in combination in diet at Mahalaxmi Poultry Farm, Bhandara-09, Chitwan from 30<sup>th</sup> April 2017 to 10<sup>th</sup> June 2017.

Commodity	T0	T1	T2	T3	T4	T5
Expenditure (Rs.)						
Chick cost	30	30	30	30	30	30
Feed cost	151.75	158.16	149.59	145.65	147.15	140.17
Equipment	27	27	27	27	27	27
Labor	31	31	31	31	31	31
Medicine & Vaccination	12.77	12.77	12.77	12.77	12.77	12.77
Total cost	252.52	258.93	250.36	246.42	247.92	240.94
Income (Rs.)						
Live weight	303.28	308.45	325.65	378.53	367.29	326.71
Net profit	50.76	49.52	75.29	132.11	119.37	85.77
Benefit Cost Ratio	1.20	1.19	1.30	1.53	1.48	1.35

The total expenditure was highest in the bird fed with T1 diet (Rs. 243.52) which contained 6% mustard oil and lowest in T5 diet (Rs. 225.94) which contained 6% tallow. However, the total income was highest (Rs. 378.53) in T3 diet that contained 3% mustard oil and 3% tallow. The net benefit was highest (Rs. 147.11) in T3 which contained 3% mustard oil and 3% tallow and lowest (Rs. 64.52) observed in T1 diet containing 6% mustard oil. The benefit cost ratio was greater (1.63) in the treatment diet containing 3% mustard oil and 3% tallow and lowest (1.26) in diet containing 6% mustard oil.

### Blood parameters

Table 4. Effect of using saturated and unsaturated fats alone or in combination in broiler diets on some blood metabolites and mineral concentration in Mahalaxmi Poultry Farm, Bhandara-09, Chitwan from 30<sup>th</sup> April 2017 to 10<sup>th</sup> June 2017.

Treatment	Glucose (mg/dl)	Cholesterol (mg/dl)	Protein (g/dl)	Albumin (g/dl)	Globulin (g/dl)	Alb: Glob
T0	261	123	3.5	1.2	2.3	0.52
T1	240	102	3.2	1.0	2.2	0.45
T2	228	112	3.7	1.1	2.6	0.42
T3	204	88	3.6	1.1	2.5	0.44
T4	194	106	2.4	0.9	1.8	0.50
T5	212	80	2.9	0.9	2.0	0.45

The birds consuming diet T0 had highest (123) cholesterol value that contained no added fats which decreased linearly and the lowest (80) in the birds consuming diet T5, diet containing 6% tallow. The birds consuming the diet T2 had the highest (3.7 g/dl) protein level that contained 4.5% mustard oil and 1.5% tallow and the lowest (2.4 g/dl) in T4 that contained 1.5% mustard oil and 4.5% tallow. Similarly the birds consuming the diet T0 that contained no added fats had highest (1.2 g/dl) albumin concentration in serum whereas birds consuming the diet T4 that contained 1.5% mustard oil and 4.5% tallow and T5 that contained 6% tallow had the lowest (0.9 g/dl). Similarly the bird consuming the diet T2 had highest (2.6 g/dl) globulin concentration whereas the bird consuming diet T4 that contained 1.5% mustard oil and 4.5% tallow had lowest (1.5 g/dl) globulin concentration in serum. The Albumin: Globulin ratio was highest in T0 (0.52) that contained no added fats and lowest in the bird consuming diet T2 (0.42) that contained 4.5% mustard oil and 1.5% tallow. The birds receiving diet T0 that contained no added fats had highest (261 mg/dl) serum glucose level and lowest in the bird receiving diet T4 (194mg/dl) that contained 1.5% mustard oil and 4.5% tallow.

### DISCUSSION

The results showed that the dietary fat improves the feed conversion rate because of cholecystokinin hormone secretion and prolonged gastrointestinal transit time of food and thus increased the rate in activity of bile and pancreatic lipase secretion which results in digestion and

absorption. According to the Tawfeek *et al.* (2014) states that the heat stress condition significantly increase serum cholesterol, glucose and malondialdehyde and decreased protein and glutathione peroxidase. In the research using saturated and unsaturated fat alone or in combination had low serum cholesterol as compared to diet containing no any oil or fat, this indicated that fat containing diet reduced the heat stress.

Sah (2013) stated that the increased amount of the globulin suggested increased level of immunoglobulin which ultimately results the increased immunity. The albumin: globulin ratio indicated that lower the ratio, higher the globulin amount which indicated the immunity power. So, this result indicated that birds consuming diet T2 had higher immunity than others.

Donkoh (1989) reported reduced plasma protein concentration during heat stress where as in the research done using saturated and unsaturated fats the serum protein was highest in T2 as compared to others which indicated that diet T2 reduced the heat stress following T3, T0, T1, T5 and T4. According to the Khan *et al.* (2002) states that birds exposed to heat showed increased ( $P < 0.01$ ) level of blood glucose in respect to increase temperature.

Similar finding also given by Tawfeek *et al.* (2014) who states that blood glucose level significantly increased in heat stress condition. In this research using saturated and unsaturated fat had low blood glucose level which showed that fat in diet reduced the heat stress.

## CONCLUSION

The result of the study showed that during the period of heat stress, inclusion of fat and oils in the diet of birds positively affect the production performance. Inclusion of a correct ratio of unsaturated: saturates is important for optimum utilization and hence better production. It is also concluded that saturated and unsaturated fats have some immune-enhancing properties and also reduced the heat stress. Further research should be carried out in this regard in future. Hence, the poultry growers are suggested to use fats and oils in the diet of broilers when the temperature and humidity are high.

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