



Feeding value of simaruba (*Simarouba glauca*) fat in broilers

N C BEHURA¹, P K DEHURI², S K MISHRA³ and S K DAS⁴

Orissa University of Agriculture and Technology, Bhubaneswar, Odisha 751 003 India

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ABSTRACT

The effects of simaruba fat (SF) use was studied on day-old broiler chicks (500). The chicks were distributed into 5 groups, each having 5 replicates. Test diets, viz. T₁ (control), T₂ (2.5% SF), T₃ (5% SF), T₄ (7.5% SF) and T₅ (10% SF) were tried. The body weight gain and feed consumption were recorded. The serum biochemical, enzyme activity and histopathological examinations were done at the end of experiment. The sixth week average body weight in T₁, T₂, T₃, T₄ and T₅ were 1854, 1845, 1836, 1829 and 1818g, respectively. The sixth week body weight of different groups did not differ significantly. The feed conversion ratio (FCR) of T₁, T₂, T₃, T₄ and T₅ were 1.92, 1.90, 1.90, 1.88 and 1.87, respectively. The mean serum triglycerides, cholesterol, HDL cholesterol, total protein, albumin, globulin, serum urea nitrogen, and serum uric acid values of the broilers fed different levels of SF did not differ significantly from the control. There was no significant difference in the mean serum ASAT, ALAT and ALP activities between the groups. Histopathology examination revealed that in T₅, there was moderate to marked vascular congestion of the portal veins and sinusoidal distention with increased activity of Kupffer cells. The cost of broiler production was reduced with the increase in the level of SF in the diet. The experimental results revealed that the expeller pressed SF could be incorporated in the broiler ration up to 7.5% without any deleterious effect on growth and FCR.

Key words: Broiler, FCR, Growth, Simaruba (*Simarouba glauca*) fat

Fats of vegetable and animal origin are used in high-energy broiler ration. India imports huge quantity of vegetable oil every year to meet the domestic demand. Simaruba (*Simarouba glauca*) a medium size evergreen plant belonging to the family Simaroubaceae and Genus *Simarouba*, a native of El Salvador was introduced to India in 1960s by the ICAR. The simaruba oil is used for edible purpose in El Salvador and other Central American countries (Anonymous 2004). The SF is viscous in consistency at room temperature and has a mild but characteristic odour (Armour 1959). Oleic, stearic, and palmitic acids constitute a major proportion of SF, similar to palm oil (Sahoo *et al.* 2003). The physico-chemical properties of SF envisage that it could be used for edible purpose but after thorough investigation (Rao 2003). According to Rao and Alli (2002), feeding of SF, obtained by solvent extraction as well as refining to rats in a 13-week feeding experiment, showed no adverse effect. The fat digestibility was also found to be more than 94%. No

abnormalities in the histopathological examination of visceral organs were observed showing that simaruba oil can be used safely for edible purpose. The apparent metabolizable energy (AME) and nitrogen corrected metabolizable energy (AMEn) values of SF was reported to be 6730 and 6484 kcal/kg, respectively (Behura 2007). Taking into consideration, the availability, ME value and non-toxic effect on rats, the present experiment was designed to study the effects of using SF as an energy source in broiler diet and the economics of broiler production.

MATERIALS AND METHODS

To study the effects of using SF as energy source in broilers, a feeding experiment was conducted with day-old broiler chicks (500). The chicks were distributed into 5 groups, each having 5 replicates of 20 numbers. Completely randomized design was followed. Five experimental diets (BIS 1992), viz. T₁ (control), T₂ (2.5% SF), T₃ (5% SF), T₄ (7.5% SF) and T₅ (10% SF) were assigned to each treatment. The % composition and proximate compositions of the experimental starter and finisher diets has been presented in Tables 1 and 2, respectively. Feed and water were given *ad lib*. Weekly individual body weight and group-wise feed consumption were recorded. The experiment continued for

Present address: ¹Associate Professor (e mail: ncbehura@gmail.com), Department of Poultry Science; ²Dean (e mail: dehuripk@gmail.com); ³Associate Professor (e mail: sumantkmishra@gmail.com), ⁴Professor (e mail: sushantadas57@rediffmail.com) Department of Animal Nutrition, College of Veterinary Science and Animal Husbandry

Table 1. Percentage composition of experimental diets

Ingredients/ Starter diet	T ₁	T ₂	T ₃	T ₄	T ₅
Jowar	0	4.5	17.5	17.5	17
Crushed maize	48	35	20	10.5	5
Soya bean oilcake	35	34.5	34	33	30
Deoiled rice bran	7	13.5	13.5	21.5	25
Simaruba fat	0	2.5	5	7.5	10
Fish meal	7	7	7	7	10
Mineral mixture	2.5	2.5	2.5	2.5	2.5
Common salt	02	02	02	02	02
Vitamin premix (g/q)	250	250	250	250	250
Zinc (g/q)	50	50	50	50	50
Weshol-50 (g/q)	100	100	100	100	100
Cost (₹/q)	831.75	814.13	801.25	787.25	783.25
<i>Finisher diet</i>					
Jowar	0	3.5	16.5	23	30.5
Crushed maize	58	48.5	33	20	7
Soya bean oilcake	29	26	26	26	26
Deoiled rice bran	5	9.5	9.5	13.5	16.5
Simaruba fat	0	2.5	5	7.5	10
Fish meal	5	7	7	7	7
Mineral mixture	2.5	2.5	2.5	2.5	2.5
Common salt	02	02	02	02	02
Vitamin premix (g/q)	250	250	250	250	250
Zinc (g/q)	50	50	50	50	50
Weshol-50 (g/q)	100	100	100	100	100
Cost (₹/q)	809.25	805	793.75	782.75	773.25

Table 2. Proximate composition of experimental diets
(% on DM basis)

Nutrient composition	T ₁	T ₂	T ₃	T ₄	T ₅
<i>Starter diet</i>					
Crude protein	23.16	23.21	23.08	23.09	23.15
Crude fibre	4.65	5.51	5.6	6.25	6.47
Ether extract	2.73	5.11	7.24	9.98	12.32
Total ash	8.24	9.17	7.8	8	7.58
Acid insoluble ash	3.12	2.67	2.93	2.1	2.65
Nitrogen free extract	61.21	57	56.28	52.68	50.48
Calcium	1.42	1.53	1.32	1.41	1.37
Available phosphorus	0.65	0.45	0.38	0.47	0.39
ME* (Kcal/kg)	2813	2800	2802	2805	2809
<i>Finisher diet</i>					
Crude protein	20.23	20.17	20.2	21.29	22.32
Crude fibre	4.25	4.51	4.63	5.165	5.71
Ether extract	2.53	5.31	7.37	9.9	12.48
Total ash	8.24	9.17	7.8	8.0	7.58
Acid insoluble ash	3.12	2.67	2.93	2.1	2.65
Nitrogen free extract	64.75	60.84	60	55.64	51.90
Calcium	1.42	1.53	1.32	1.41	1.37
Available phosphorus	0.45	0.38	0.37	0.36	0.42
ME* (Kcal/kg)	2902	2903	2902	2900	2903

*Calculated values.

6 weeks. At the end of 6 weeks, the feed conversion ratio (FCR), of chicks of individual groups was calculated. Six chicks were randomly picked up from each treatment for collection of blood for harvesting serum at the end of sixth week. Serum was used for estimation of biochemical parameters, viz. total protein, albumin, globulin, urea nitrogen, uric acid, triglycerides, cholesterol and HDL cholesterol and enzyme activity, viz. aspartate-aminotransferase (ASAT) activity, alanine-aminotransferase (ALAT) activity and alkaline phosphatase (ALP) activity. The biochemical and enzyme activity of serum were determined by using the reagent kits. Six birds from each treatment were sacrificed at the end of sixth week and tissues like liver, kidney, heart, intestine, pancreas, spleen and bursa of fabricius were further processed (Gridley 1960) for histopathological examination. Economics of broiler production was calculated taking in to account the expenditure incurred on feed. The local rate of feed ingredients was taken in to account for calculation of feed cost. Other expenditure such as labour, litter material, medicines, vaccines and electricity were considered same for all the groups. The sale price of broilers was calculated at ₹ 36/kg live weight, the then prevailing market price. Data was analysed statistically (Snedecor and Cochran 1967).

RESULT AND DISCUSSION

The average sixth week body weight of the experimental broilers is presented in Table. 3. The sixth week average body weight in T₁, T₂, T₃, T₄ and T₅ were 1854, 1845, 1836, 1829 and 1818g, respectively. There was no significant ($P > 0.05$) difference in the weekly body weights of the groups up to 6 week of age. Rao and Alli (2002) did not observe any adverse effect of simaruba oil on body weight gain of the albino rats in a 13-week feeding trial. However, in the present experiment, the body weight has progressively declined with the increase in the level of SF in the diet although there was no significant difference in body weight between groups. Crude fat obtained either by pressure, or by extraction with a solvent has a slightly bitter taste (Severen 1953). The expeller pressed SF used in the present experiment was also slightly bitter in taste. This indicates a possible inclusion of toxin into the oil as a consequence of these extraction methods. Though, quassinoids, the major toxic constituent present in the seed are not fat soluble (Rao 2003), the presence of remnants of the toxin in the fat cannot be eliminated. More over, besides quassinoids, traces of other toxins like glycosides are also reported (Caceres *et al.* 1990) to be found in the seed. Therefore, in view of the progressive growth depression of birds on feeding simaruba oil, the possibility that the remnants of the quassinoids or other toxins could have gone in the fat and caused this growth depression cannot be over looked. The feed conversion ratio of T₁, T₂, T₃, T₄ and T₅ were 1.92, 1.90, 1.90, 1.88 and 1.87, respectively. Average feed consumption as well as body weight gain of

Table 3. Average weekly body weight (g) of experimental broilers

Treatments	Weekly body weight (g)						
	Day-old	First	Second	Third	Fourth	Fifth	Sixth
T ₁	51.74±0.555	185.32±7.138	339.30±11.450	638.95±16.068	901.23±20.567	1468.68±20.003	1854.21±31.868
T ₂	51.81±0.584	180.64±4.503	346.74±19.55	634.01±15.351	955.83±28.043	1467.90±20.629	1845.37±26.819
T ₃	53.17±1.108	165.36±6.720	337.16±21.91	611.59±17.645	944.45±26.492	1489.15±28.555	1835.74±33.065
T ₄	52.46±0.665	170.95±4.623	325.78±9.28	599.89±17.885	919.10±30.152	1472.90±25.216	1829.24±26.484
T ₅	52.91±0.719	169.85±4.085	325.14±9.62	603.79±17.379	913.90±29.496	1454.38±21.314	1817.92±29.040

Table 4. Serum-biochemical values and serum-enzyme activities of the experimental broilers at the end of sixth week

Parameters	D1	D2	D3	D4	D5
Serum triglycerides (mg %)	157.57±4.79	160.95±5.38	163.39±5.33	165.01±7.87	167.94±5.48
Serum cholesterol (g %)	102.3±3.71	104.3±2.06	108.1±2.23	110.1±1.40	113.4±6.66
Serum HDL cholesterol (mg %)	71.10±1.52	71.71±3.71	72.62±2.63	72.53±2.03	73.17±1.58
Total serum protein (g/dl)	3.18±0.09	3.21±0.09	3.04±0.15	3.15±0.13	3.03±0.21
Serum albumin (g/dl)	1.27±0.04	1.28±0.04	1.21±0.06	1.26±0.05	1.21±0.09
Serum globulin (g/dl)	1.91±0.06	1.93±0.05	1.82±0.09	1.89±0.08	1.82±0.13
Serum urea nitrogen (mg/dl)	2.35±0.08	2.27±0.05	2.28±0.05	2.33±0.07	2.22±0.08
Serum uric acid (mg/dl)	5.03±0.10	5.03±0.08	4.98±0.08	4.97±0.11	5.00±0.11
ASAT activity (IU/L)	65.03±3.19	66.46±2.06	66.81±2.39	66.52±0.72	66.88±1.85
ALAT activity (IU/L)	12.90±1.13	12.14±0.58	13.07±1.30	13.44±0.96	13.17±0.70
ALP activity (IU/L)	133.33±3.47	134.67±2.23	133.67±1.43	134.00±2.07	132.67±1.43

Table 5. Cost-benefit analysis of broiler production using diets containing different levels of simaruba fat

Head of expenditure	Dietary treatments				
	D1	D2	D3	D4	D5
Cumulative feed consumption up to 6 week of age per bird (kg)	3.46	3.41	3.39	3.34	3.36
Cost of feed up to 6 week of age per bird (₹)	28.10	27.49	26.94	26.16	26.02
Cost of day old chicks (₹)	14	14	14	14	14
Other expenses per bird (₹)	5	5	5	5	5
Cost of production per bird (₹)	47.10	46.49	45.94	45.16	45.02
Average bodyweight at the end of 6th week (kg)	1.854	1.845	1.835	1.827	1.817
Cost of production per kg live weight (₹)	25.41	25.20	25.04	24.69	24.78
Sale proceeds per kg live weight (₹)	36	36	36	36	36
Net profit/kg live weight	10.59	10.80	10.96	11.31	11.22
Reduction in cost of production over control (₹/kg)	—	0.21	0.37	0.71	0.63

all the groups was almost similar. The feed conversion efficiency of the birds seems to be unaffected by the level of dietary SF irrespective of the level of inclusion. No mortality of the experimental broilers was recorded in any of the experimental groups fed different levels of SF up to sixth week of age.

The mean serum triglycerides, cholesterol, HDL cholesterol, total protein, albumin, globulin, serum urea nitrogen, and serum uric acid values of different groups did not differ significantly from the control, which is indicative of normal lipid metabolism in the treatment groups. There was no significant ($P > 0.05$) difference in the mean serum ASAT, ALAT and ALP activities between different groups.

The relatively unaltered activities of these enzymes in serum of the groups with different levels of dietary SF could be an indication that the liver was not severely affected. No gross lesions of pathological significance was observed in the visceral organs like, liver, kidney, intestine, spleen bursa of fabricius, lungs and heart of chicks of control as well as those of SF fed groups. However, the birds of T₄ and T₅ exhibited more deposition of peritoneal fat and moderately congested livers. There was no histopathological change of significance in the visceral organs like kidney, intestine, spleen, bursa of fabricius, lungs and heart of the broilers of different groups. However, in T₅, moderate to marked vascular congestion of the portal veins and sinusoidal distention with increased

activity of Kupffer cells was observed. This might be due to the presence of remnants of toxins present in the expeller pressed SF.

The cost-benefit analysis of broiler production under feeding different levels of SF is presented in Table 5. The cost of broiler production was reduced with the increase in the level of SF in the diet resulting in the increase in the margin of profit.

The finding of the present experiment indicated that the expeller pressed simaruba fat could be incorporated in the broiler ration up to 7.5% without any deleterious effect on growth and feed conversion.

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