
Carcass Traits and Sensory Characteristics of Meat of Broiler Fed Varying Levels of *Tithonia diversifolia* Flower Meal (TDFM) as Substitute of Conventional Feeds in Mizoram

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Abstract: The study was for assessment of carcass traits and sensory evaluation of meat of broilers fed varying levels of *Tithonia diversifolia* flower meal (TDFM) as substitute of conventional feeds in Mizoram. One hundred and eighty day-old broiler chicks were randomly assigned to six treatments and fed TDFM incorporating @ 0%, 2%, 4%, 6%, 8% and 10% of the total ration as substitute of conventional energy and protein feed ingredients. The feeding trial was conducted for 42 days duration rearing the chicks under deep litter system of management following standard managerial protocols. At the end of 6 week, 6 birds from each treatment were scarified for studying carcass traits and sensory evaluation of meat. There was no significant difference ($P < 0.05$) in average live weights of the birds at 42nd day of age up to 6% TDFM inclusion level. The average hot carcass weights were found to be proportional to the live weights. Dressing percentage was calculated to be significantly reduced at 8% and 10% TDFM inclusion level, but no significant differences ($P < 0.05$) was found up to 6% inclusion level. The prime cuts (expressed as % hot carcass weight) i.e. breast, back, drumstick, thigh and neck were comparable amongst the groups without any significant difference. Weights of the edible offals were found to be variable. On sensory evaluation, there was no significant difference ($P > 0.05$) among groups for colour, flavour, tenderness and overall acceptability of meat. It was concluded that TDFM can be incorporated up to 6% of the total ration as substitute of conventional energy and protein feed ingredients without any significant effects on live weight, carcass traits and sensory qualities of meat of broiler at 42nd day of age in Mizoram.

Keywords: *Tithonia diversifolia* Flower Meal, Broiler, Carcass Traits, Sensory Evaluation, Mizoram

1. Introduction

‘Quality carcass traits’ is as desirable as ‘Rapid growth rate’ in broilers for ensuring profits to the farmers. However, expenditure involved in feeding attribute significantly to the net profit because feeding cost accounts for nearly 60-80% of the total expenditure of the enterprise [1, 2, and 3]. Thus, in recent times, reducing feeding cost is becoming the fundamental goal for sustainability in profits of broiler farming. As the prices of conventional feed ingredients are increasing day by day, it is becoming imperative to look for locally available and cheap sources of feed ingredients, particularly those that do not have competition in

consumption between human and livestock [4].

In Mizoram, broiler farming is a popular economic activity amid farming communities for huge demand of broiler meat in the state. Nearly 100% of the population of Mizoram is non-vegetarian and chicken is one of the most preferred meats throughout the state. However, the main hindrance is the cost involved in feeding for higher prices of feed ingredients and compounded feeds of broiler in the state reducing profit margin significantly. Agriculture is, by and large, rainfed and *jhum* or shifting cultivation is widely practiced throughout the state. However, for low fertility of soil attributed to erosion of water and acidity of soil, agricultural productivity is very low. This leads to shortage of

nutritional feeds in the state as a result of which more than 90% of the feed ingredients come from outside state [5].

The wild sunflower (*Tithonia diversifolia* Hemsl. A. Gray) is a large shrub which has the potentiality to be utilised as a feed-stuff of broiler in Mizoram. It is because this plant is abundantly available throughout Mizoram during March-April to December-January every year, and its leaves and full-bloom flowers are good sources of nutrients [6]. Although reports are available about the feeding of *Tithonia diversifolia* leaf meal to broilers [7, 8, 9, 10], report is scanty about the utilization of full-bloom flower of *Tithonia diversifolia* in 'meal form' for feeding to broilers. In the present study, an attempt was made to study the effects of feeding full-bloom flower of *Tithonia diversifolia* in 'meal form' to broilers as substitute of conventional energy and protein ingredients on carcass traits and sensory characteristics of meat in Mizoram.

2. Materials and Methods

2.1. Location of the Study

The study was carried out in the poultry unit of the Instructional Livestock Farm Complex (ILFC), College of Veterinary Sciences & Animal Husbandry, Central Agricultural University, Selesih, Aizawl, Mizoram, India during 2013-2014.

2.2. Experimental Design

One hundred and eighty day old commercial broiler chicks were purchased from distributor of Aizawl city, Mizoram. The chicks were randomly divided into 6 homogenous groups designating as T-I, T-II, T-III, T-IV, T-V and T-VI with 30 chicks in each group. The design of experiment was Completely Randomized Design (CRD). The 30 chicks of each group were further divided into 3 replicates of 10 chicks in each replicate. All the chicks were wing-banded for easy identification.

2.3. Preparation of *Tithonia Diversifolia* Flower Meal (TDFM)

The wild sunflower (*Tithonia diversifolia*) plants with full-bloom flowers were collected from different locations in and around the College of Veterinary Sciences and A.H., Central Agricultural University, Aizawl, Mizoram. The flowers were separated from the stems, pooled together and were sun-dried before milled using a hammer grinding machine to produce flower meal.

2.4. Experimental Ration and Feeding of Experimental Broilers

Twelve balanced experimental rations (i.e. six broiler starter and six broiler finisher) were prepared following BIS [11] recommendations. The TDFM was incorporated @ 0%, 2%, 4%, 6%, 8% and 10% of the total ration replacing conventional feed ingredients namely, yellow maize, rice polish, soyabean

meal and groundnut cake. T-I served as the control and the chicks of this group were fed starter and finisher rations with 0% TDFM. The T-II, T-III, T-IV, T-V and T-VI groups were fed rations containing TDFM @ 2%, 4%, 6%, 8% and 10% of total ration, respectively. Broiler starter ration was fed from 0 to 35th day of age and from 36th day onwards, broiler finisher ration was fed to all the experimental groups. Feed and fresh drinking water were provided *ad libitum* to all the groups throughout the experiment. The chicks were reared in battery brooder during the first two weeks of their life after which they were housed in a well-ventilated deep litter house partitioning into eighteen pens providing floor space @ 1.5 ft. X 1.5 ft. /bird. The birds were vaccinated against ND (Lasota) on 7th day and against IBD on 14th day of age. The Bio-security measures were strictly followed during the experimental period.

2.5. Study on Carcass Traits

The feeding trial was conducted for 6 weeks duration. At the end of 42nd day of age, six birds (i.e. two birds from each replicate) were randomly taken for carcass characteristics study. The birds were fasted overnight and slaughtered following standard procedure in the Department of Livestock Product Technology, College of Veterinary Sciences and A.H., Central Agricultural University, Selesih, Aizawl, Mizoram. The birds were scalded in warm water. The feathers were plucked manually and after removing the head and shank, visceral organs were removed and the hot carcass weight was recorded. The prime cuts i.e. breast, back, neck, thigh, drumstick and wing were separated and weighed individually. Edible visceral organs i.e. liver, gizzard and heart were separated from the intestines and weighted individually.

2.6. Sensory Evaluation

For sensory evaluation, samples of meat from breast part were taken for all the groups. A total of twenty-four (24) untrained scorers were assigned to evaluate the meat samples for colour, flavour, juiciness, tenderness, palatability and overall acceptability on a 10 point descriptive scale. The meat samples without salt were grilled for 15 minutes at 70⁰ C in an electric oven, sliced into uniform sizes after cooling, and were presented to the scorers after wrapping with aluminium foil. Each scorer was provided with water and pieces of bread to serve as neutralizers between samples.

2.7. Analytical Procedures

The feed samples were analysed for proximate composition as per AOAC [12].

2.8. Statistical Method

For interpretation of results, data were analysed statistically following methods of Snedecor and Cochran [13].

3. Results and Discussion

Mizoram is one of the eight North Eastern states situated

in the fast east corner of India at 92° 15' & 93° 29' E longitude and 21° 58' & 24° 35' N latitude with total geographical areas of 21,087 square kilometres. Mizoram is rich in flora, tropical trees and plants. The climate is mild, generally cool in summer (temperature 20⁰ – 30⁰ C) and not very cold in winter (temperature 11⁰ -21⁰ C). The state receives very high rainfall during summer particularly during May to October every year and average annual rainfall is 250 cm/annum.

Mizoram rural economy is agriculture and livestock based as 70-80% of rural people are engaged, directly or indirectly, with the agriculture and livestock sector. Agriculture and allied sector contributes about 21.76% of GDP at current prices [14] in the state.

3.1. Percentage Ingredient and Nutritional Composition of Experimental Rations

The percent ingredient composition and nutritive value of the experimental rations is presented in table 1. The rations were formulated following feeding standard of BIS, 2002 for broilers in all the groups.

3.2. Carcass Characteristics

The average body weight at 42nd day of age was found to be 1383.33±18.56, 1395.00±11.55, 1411.67±12.02, 1387.00±5.77, 1316.67±20.28 and 1196.33±12.02gm respectively for 0%, 2%, 4%, 6%, 8% and 10% TDFM inclusion group, respectively (table 2). Although live weights of the birds were observed to decrease with increased inclusion level of TDFM, but there was no significant

difference (P<0.05) up to 6% level. Similarly, hot carcass weights were also found to be variable at different inclusion levels and were proportional to the live weights. In T-V and T-VI, hot carcass weights were significantly reduced. The dressing percentage was comparable up to 6% TDFM inclusion level, but was significantly reduced in T-V and T-VI. This might be for reduced hot carcass weight as compared to other groups for significantly decreased live weight. Helsper *et al.*, [15] reported significantly decreased live and dressed weight in broilers fed *Tithonia diversifolia* leaf meal and concluded that this might be for presence of anti-nutritional factors like tannins and saponins which were known to decrease digestibility of protein and other nutrients. These anti-nutritional factors are also known to bind with dietary protein, digestive enzymes and proteins of saliva and mucosal membranes thereby reducing digestibility of nutrients and hence growth rate of broilers.

The prime cuts (expressed as percentage hot carcass weight), namely, breast, back, drumstick, thigh and neck were comparable amongst the groups as hot carcass weight was found to be proportional to live weight. Similar findings were also reported by Ekeocha and Afolabi [7] in broilers fed Mexican sunflower leaf meal up to 10% level. This indicated no negative effects of feeding TDFM on carcass traits of broilers which are of consumer significant. Weights of the edible offals were found to be variable. However, weights of liver and spleen were found to increase with increased inclusion levels of TDFM which might be for toxic effects of anti-nutritional components of TDFM.

Table 1. Broiler starter and finisher ration with TDFM.

Broiler starter						
Ingredient	T-I	T-II	T-III	T-IV	T-V	T-VI
Maize (kg)	52	50	50	49	48	47
Rice polish (kg)	10	12	11	10	10	10
Soyabean meal (kg)	20	19	18	18	17	15
Ground nut cake (SE) (kg)	10	9	9	9	9	10
Fish meal (kg)	6	6	6	6	6	6
TDFM (kg)	0	2	4	6	8	10
Feed additives/Mineral mixture* (kg)	1.8	1.8	1.8	1.8	1.8	1.8
Iodised Salt (kg)	0.2	0.2	0.2	0.2	0.2	0.2
Total (kg)	100	100	100	100	100	100
CP (%)	23.98	23.36	23.1	23.24	23.02	22.87
ME (Kcal/kg)	2879	2874.6	2869.7	2857.8	2849.9	2839.5
CF (%)	4.22	4.66	4.92	5.2	5.55	5.97
Broiler finisher						
Maize (kg)	57	56	56	55	55	54
Rice polish (kg)	13	13	12	11	10	10
Soyabean meal (kg)	15	14	14	14	13	12
Ground nut cake (SE) (kg)	8	8	7	7	7	7
Fish meal (kg)	5	5	5	5	5	5
TDFM (kg)	0	2	4	6	8	10
Feed additives/Mineral Mixture* (kg)	1.8	1.8	1.8	1.8	1.8	1.8
Iodised salt (kg)	0.2	0.2	0.2	0.2	0.2	0.2
Total (kg)	100	100	100	100	100	100
CP (%)	20.79	20.56	20.24	20.38	20.13	19.91
ME (Kcal/kg)	2939	2931.1	2928.7	2916.8	2911.9	2904
CF (%)	4.24	4.59	4.78	5.06	5.32	5.67

* Feed additives/Mineral mixture: Tricalcium phosphate–1%, Lysine–0.05%, Methionine–0.15%, Trace mineral mixture–0.4%, Vitamin mixture–0.2%. CP: Crude protein, ME: Metabolisable energy, CF: Crude fibre

Table 2. Dressing percentage and primal cuts (percentage hot carcass weight) of the broiler fed TDFM in their ration.

Parameter	Treatment group						SEM
	T-I	T-II	T-III	T-IV	T-V	T-VI	
Ava. live weight at 42 nd day of age (g)	1383.33 ^a ±18.56	1395.00 ^a ±11.55	1411.67 ^a ±12.02	1387.00 ^a ±5.77	1316.67 ^b ±20.28	1196.33 ^c ±12.02	18.64
Hot carcass weight (g)	951.80 ^a ±28.87	969.73 ^{ab} ±8.82	995.80 ^b ±7.64	964.73 ^{ab} ±3.33	872.07 ^c ±3.34	791.47 ^d ±3.33	17.69
Dressing percentage	68.78 ^a ±1.27	69.52 ^a ±0.13	70.64 ^a ±0.07	69.56 ^a ±0.14	66.27 ^b ±1.24	66.17 ^b ±0.40	0.48
Primal cuts (as % hot carcass weight)							
Breast	23.57±0.47	23.46±0.33	23.75±0.23	23.38±0.29	23.53±0.79	23.47±0.85	0.19
Back	18.10 ^a ±0.11	18.22 ^a ±0.36	17.21 ^{ab} ±0.85	16.69 ^b ±0.26	16.43 ^b ±0.20	15.91 ^b ±0.27	0.25
Drumstick	11.72±0.19	10.89±0.27	11.17±0.52	10.55±0.37	10.54±0.67	10.38±0.41	0.19
Thigh	10.71±0.49	10.66±0.56	11.16±0.72	10.49±0.86	10.12±0.65	10.46±0.72	0.24
Wing	10.13 ^a ±0.22	9.63 ^{abc} ±0.16	9.84 ^{ab} ±0.17	9.11 ^{cd} ±0.21	9.18 ^{bcd} ±0.33	8.77 ^d ±0.16	0.14
Neck	5.22±0.21	5.06±0.39	4.95±0.11	4.64±0.12	4.67±0.09	4.61±0.19	0.09
Skin	10.11 ^a ±0.41	9.71 ^{ab} ±0.11	9.17 ^{bc} ±0.25	9.18 ^{bc} ±0.18	8.69 ^c ±0.16	8.83 ^c ±0.18	0.14

Means bearing different superscripts (a, b, c, d) in a row differ significantly (P<0.05).

Table 3. Weights of the edible offal of the broiler fed TDFM in their ration.

Parameter	Treatment group						SEM
	T-I	T-II	T-III	T-IV	T-V	T-VI	
Gizzard (g)	39.28 ^a ±0.66	37.35 ^{ab} ±0.68	38.52 ^a ±0.40	37.05 ^{ab} ±0.18	37.97 ^{ab} ±1.51	35.79 ^b ±0.32	0.38
Heart (g)	8.23 ^a ±0.15	7.67 ^a ±0.24	7.63 ^a ±0.26	7.80 ^a ±0.12	6.80 ^b ±0.21	6.87 ^b ±0.09	0.14
Liver (g)	37.67 ^a ±0.18	38.00 ^a ±0.50	36.83 ^a ±0.23	40.73 ^b ±0.84	40.87 ^b ±0.24	41.93 ^b ±0.24	0.49
Spleen (g)	2.10 ^a ±0.06	2.80 ^{bc} ±0.11	2.96 ^c ±0.26	2.33 ^{ab} ±0.09	3.93 ^d ±0.18	3.83 ^d ±0.15	0.18

Means bearing different superscripts (a, b, c, d) in a row differ significantly (P<0.05).

Table 4. Sensory evaluation of broiler meat fed TDFM incorporated rations.

Parameter	T-I	T-II	T-III	T-IV	T-V	T-VI	SEM
Colour	7.17±0.09	7.20±0.15	7.16±0.19	7.13±0.12	7.07±0.23	7.00±0.11	0.06
Flavour	6.33±0.18	6.47±0.15	6.30±0.15	6.17±0.23	6.06±0.17	6.13±0.12	0.07
Juiciness	6.47 ^{ab} ±0.19	6.57 ^a ±0.18	6.47 ^{ab} ±0.19	5.87 ^c ±0.07	5.97 ^{bc} ±0.09	5.83 ^c ±0.19	0.09
Tenderness	6.73±0.12	6.63±0.20	6.73±0.24	6.70±0.25	6.53±0.24	6.51±0.28	0.08
Taste/palatability	4.90±0.06	4.87±0.15	4.73±0.14	4.72±0.09	4.80±0.12	4.60±0.06	0.04
Overall Acceptability	6.30±0.25	6.13±0.34	6.07±0.29	5.90±0.26	6.03±0.24	5.97±0.18	0.09

Means bearing different superscripts (a,b,c) in a row differ significantly (P<0.05)

3.3. Sensory Evaluation

The sensory evaluation of meat is presented in table 4. The average scores for different parameters were found to be variable. There was no significant difference (P>0.05) among groups for colour and flavour indicated that feeding of TDFM has no influence of colour and flavour of broiler meat. The average juiciness score was found to be significantly higher up to 4% TDFM inclusion level. This might be for deposition of fats which increased juiciness of meat. However, the tenderness, palatability and overall acceptability scores were similar without any significant differences (P>0.05) indicating that TDFM had no negative effects on overall acceptability of broiler meat.

4. Conclusion

From the findings of the present study, it was concluded that TDFM can be incorporated up to 6% of the total ration as replacement of conventional energy and protein feed

ingredients without any significant effects on live weight at 42nd day of age, carcass traits and sensory qualities of meat of broiler in Mizoram.

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