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Proximate and fatty acids composition of meat from native chicken fed varying levels of dietary protein

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Abstract
A study was conducted to evaluate the effect of dietary crude protein (CP) levels on breast meat proximate and fatty acids composition of Aseel chicken reared under intensive system of management. Seven experimental diets were formulated with different levels of CP (18.5, 19.0, 19.5, 20.0 20.5, 21.0 and 21.5%) with isocaloric energy level of 2800 ME kcal / kg. At the end of 16 weeks, higher crude protein% of breast meat was observed in 21% CP fed group. The highest crude fat content of meat was noticed in 20.5% CP fed group. The highest PUFA content (21.44%) was observed in the highest dietary protein fed group (CP 21.5%). A higher level of PUFA n-3 was observed in 18.5% CP fed group. The lowest n6: n3 ratio was found in 20% CP fed group.

Keywords: Native chicken, Aseel, crude protein, breast meat, proximate, fatty acids

1. Introduction
Native chicken farming is one of the most important growing sectors, modernized from a traditional backyard rearing to large scale intensive farming. The consumption of native chicken meat is intensifying due to its nutritive value, desirable taste and flavour. The value and quality of meat is assessed by its composition such as proteins, fatty acids levels and minerals content (Pearson and Gillet, 1996) [10]. Native chicken meat is preferred because of its low fat and higher ash content with unique aroma and flavour.
In recent years, native chickens are being reared under the intensive system in order to meet out the demand for their meat and eggs. Efforts are being carried out to enhance the productivity of the birds without compromising the unique breed characteristics of native chickens. Many factors are involved to influence the meat composition such as age, rearing methods, dietary nutrients and breed types (Boskovic *et al*., 2010) [2]. The selection of nutrient levels for chickens has a significant impact on poultry meat quality and safety. The supply of adequate nutrients in native chicken diets from day old up to marketing age exerts a substantial impact on proximate and fatty acids composition of meat. An appropriate nutrient level may be chosen while formulating diet for male and female Aseel native chicken to enhance the nutritive value and quality of meat (Kumaravel *et al*., 2021) [8].
The accumulation of fat occurs in birds after attaining maximum growth rate, which is followed by a reduction in growth rate and protein deposition, whereas fat deposition increased. The excess supply and available nutrients are utilized for lipogenesis and fat accretion. Precise dietary nutrient levels are utmost important factor to reduce feed cost per unit of weight gain (NRC, 1994) [9]. With this background, the present study was conducted to determine the effect of different dietary protein levels on proximate and fatty acids composition of breast meat of native chicken.

2. Materials and Methods
2.1 Experimental birds
A total of 210 sexed day old Aseel chicks were used to evaluate the effect of different levels of protein in an isocaloric diet on proximate and fatty acids composition of breast meat of Aseel chicken. The birds were randomly divided into seven treatments and three replicates of 10 chicks each. Experimental birds were reared for 16 weeks under deep litter system of management following standard management protocol. Feed and fresh water was provided *Ad libitum* throughout the experiment period.

This study was carried out at the Department of Animal Nutrition, Veterinary College and Research Institute, Tamil Nadu Veterinary and Animal Sciences University, Namakkal, India (78°9′41.11″E, 11°9′41″N).

2.2 Experimental diets

Seven experimental diets were formulated having seven levels of protein (CP) i.e., 18.5, 19.0, 19.5, 20.0, 20.5, 21.0 and 21.5% with an iso-caloric metabolizable energy (ME) level of 2800 kcal / kg (Table 1). The control group (T_1) fed with 20.0% of CP and 2800 kcal ME /kg and lower CP levels of 18.5, 19.0 and 19.5 were fed with T_2, T_3 and T_4 groups respectively. The higher CP levels of 20.5, 21.0 and 21.5% diets were fed with T_5, T_6 and T_7 groups, respectively.

2.3 Meat composition analysis

After completion of 16 weeks of the experiment, two birds from each replicate were randomly selected, slaughtered, and breast meat samples were harvested for proximate and fatty acids analysis. Meat moisture content was estimated after slow drying of the samples at 80 °C for 40 hours using hot air oven. The dry matter content was calculated from the moisture level. The CP content was estimated by Kjeldahl method; Soxhlet apparatus was used for ether extract estimation and ash content was estimated by ashing the samples in a muffle furnace at 600 °C (AOAC, 1995) [1].

The breast meat samples from six experimental birds of each treatment group were analysed for fatty acids composition using gas chromatography. A fixed quantity (0.2 µl) methylated sample was injected into the gas chromatograph equipped with a fused silica capillary column (30 m x 0.25 mm x 0.2 µm thickness). The oven temperature maintained at 180 °C for 5 min was increased to 220 °C and held for 5 min. The temperature of both inlet and detector was 250 °C. Flame ionization with air, hydrogen and nitrogen flow was 300, 30 and 4 ml per min, respectively. The methyl esters of fatty acids were separated in the column and quantified based on the retention time for fatty acids (Wang *et al*., 2000) [16].

2.4 Statistical analysis

All the data were analysed statistically using SPSS-26 software for one way ANOVA and level of significance were measured by the Duncan (1955) [4] test following the method of Snedecor and Cochran (1994) [13]. The present study was carried out with approval of the Institutional Animal Ethics Committee.

Table 1: Ingredients (%) and composition of experimental diets containing varying crude protein with an isocaloric (ME 2800 kcal /kg) nutrients

Ingredients (%)	Experimental diets						
	T_1	T_2	T_3	T_4	T_5	T_6	T_7
Maize	58.10	59.60	59.12	58.57	57.55	57.06	56.64
Deoiled rice bran	8.84	12.04	10.92	9.97	7.95	6.91	5.70
Soybean meal	29.22	24.27	25.93	27.55	30.72	32.27	33.87
Dicalcium phosphate	1.84	1.91	1.90	1.89	1.86	1.85	1.84
Calcite	1.20	1.21	1.21	1.21	1.20	1.20	1.19
Methionine	0.13	0.15	0.14	0.13	0.12	0.12	0.11
Lysine	0.09	0.24	0.18	0.13	0.00	0.00	0.00
Sodium chloride	0.34	0.30	0.33	0.31	0.35	0.35	0.40
Sodium bicarbonate	0.00	0.05	0.03	0.00	0.00	0.00	0.01
Trace mineral mixture[1]	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Vitamin AB_2D_3K[2]	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Vitamin B complex[3]	0.03	0.03	0.03	0.03	0.03	0.03	0.03
Coccidiostat[4]	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Toxin binders[5]	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Total	100	100	100	100	100	100	100
Nutrient composition (%)							
Dry matter	88.24	87.77	87.90	88.19	89.96	88.45	88.18
Crude protein	20.10	18.52	18.98	19.61	20.60	21.09	21.64
Crude fibre	05.28	05.07	04.95	04.56	04.90	05.44	04.63
Ether extract	02.93	02.99	02.89	02.99	02.80	02.95	2.89
Total ash	07.61	07.36	07.12	06.44	06.88	07.65	06.33
Acid insoluble ash	01.81	01.83	01.58	01.27	01.41	01.94	01.93
Nitrogen free extract	52.32	53.83	53.96	54.59	54.78	51.32	52.69
Calcium	01.01	01.09	01.08	01.05	01.10	01.03	01.09
Total Phosphorus	00.92	00.95	00.88	00.84	00.83	00.93	00.87
Lysine*	00.97	00.98	00.99	00.97	00.98	00.96	00.99
Methionine*	00.40	00.40	00.40	00.40	00.40	00.40	00.40
Metabolizable energy* (kcal/kg)	2802	2809	2805	2800	2806	2804	2802

[1]Supplied per kg of diet: Manganese - 54 mg, Zinc - 52 mg, Iron - 20 mg, Iodine - 2 mg, Copper - 2 mg and Cobalt - 1 mg.
[2]Supplied per kg of diet: Vitamin A - 16500 IU, Vitamin B_2 - 10 mg, Vitamin D_3 - 3200 IU and Vitamin K -2 mg.
[3]Supplied per kg of diet: Thiamine - 4 mg, Pyridoxine - 8 mg, Cyanocobalamine - 40.0 µg, Vitamin E - 40 mg, Niacin - 60 mg, Calcium D pantothenate-40 mg, Folic acid - 4 mg.
[4]Supplied per kg of diet: Salinomycin sodium - 12%
[5]Supplied per kg of diet: Mixture of silicates, cross linked insoluble polyvinyl pyrrolidone homopolymer, mannan oligosaccharide and activated charcoal. * Calculated values.

3. Results and Discussion

The results of proximate composition in breast meat of native chicken fed with different dietary protein levels are presented in Table 2. In present study, significant difference in moisture level was observed in breast meat of native chickens. The moisture level ranged from 70.62 to 72.79%. The lowest moisture per cent (70.62%) was observed in the highest protein fed group (T_7). In other words, dry matter content was higher (29.38%) in highest CP (21.5%) fed group, other treatment groups did not differ significantly (Fig. 1). Haunshi *et al*. (2013) [6] reported dry matter percentage of breast muscles were significantly higher in Aseel chicken meat.

Table 2: Proximate composition (%) of breast meat of native chicken at 16 weeks of age (Mean±S.E.)

Treatment groups	Moisture (%)	Crude protein (%)	Crude fat (%)	Total ash (%)
T_1	72.25^{b}±0.17	25.05±0.18	0.54±0.01	1.23^{bc}±0.02
T_2	72.79^{b}±0.28	24.50±0.33	0.75±0.07	1.13^{ab}±0.03
T_3	72.71^{b}±0.14	25.12±0.13	0.69±0.10	1.23^{bc}±0.02
T_4	72.83^{b}±0.46	24.66±0.38	0.65±0.09	1.08^{a}±0.03
T_5	71.98^{b}±0.33	24.56±0.39	0.78±0.06	1.27^{c}±0.07
T_6	72.06^{b}±0.37	25.53±0.20	0.70±0.11	1.13^{ab}±0.02
T_7	70.62^{a}±0.35	24.92±0.01	0.69±0.06	1.16^{abc}±0.03
P value	0.003	0.151	0.462	0.020

Each value is mean of six observations.
Means with at least one common superscript in a column do not differ significantly (p>0.05).

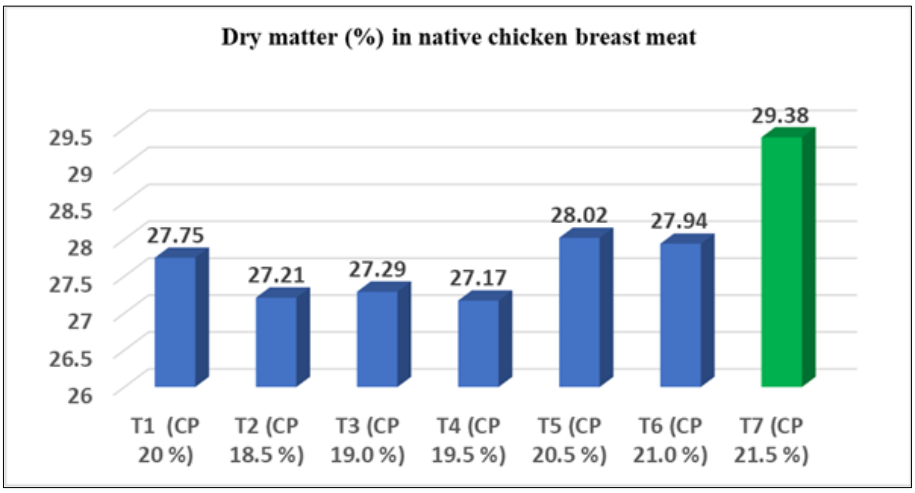

Fig 1: Effect of varying dietary protein levels on dry matter (%) content in breast meat of native chicken at 16 weeks of age.

The dietary protein levels did not influence the crude protein level of breast meat of native chickens when slaughtered at 16 weeks of age significantly (p>0.05). The numerically highest crude protein (25.53%) was noticed at 21% CP fed group. Likewise, crude fat content of breast meat was not affected due to varied dietary protein levels. The meat crude fat levels ranged between 0.65 and 0.78%. The highest crude fat content of breast meat was noticed in T_5 group (CP 20.5%). The higher ash content was found in T_5, T_7 and T_1 groups. No trend could be observed between dietary protein levels and ash content of breast meat.

Haunshi *et al*. (2013) [6] reported similar level of crude protein content of 23.69% in Aseel chickens at 20 weeks of age. Similar level of fat and ash content in Aseel chicken meat were reported by Rajkumar *et al*. (2017) [11]. The higher level of ash content in Aseel cross chickens indicates high mineral content in the meat (Souza *et al*., 2011) [14].

3.1 Fatty acids composition

The estimated mean fatty acids profile in breast meat of native chicken are presented in Table 3. The dietary protein levels did not significantly influence the breast meat fatty acids profile of native chicken. The highest PUFA content (21.44%) was observed in the highest protein (CP 21.5%) fed group (T_7). The PUFA: SFA ratio ranged between 0.43 and 0.54. A higher level of PUFA n-3 was observed in T_2 (18.5%) group. Lowest n6: n3 ratio was found in T_1 (20% CP) group. No precise trend could be noticed due to varying dietary protein levels on the fatty acid profile in the breast meat of native chickens.

Table 3: Fatty acids composition (%) of breast meat of native chicken at 16 weeks of age (Mean±S.E.)

Treatment groups	PUFA (%)	SFA (%)	PUFA: SFA ratio	PUFA n-6 (%)	PUFA n-3 (%)	n6: n3 ratio
T_1	18.29±2.87	39.55±0.36	0.43±0.09	14.53±2.21	3.89±0.57	3.73±0.06
T_2	20.75±0.96	39.34±0.02	0.53±0.02	18.01±1.64	4.58±0.33	4.01±0.61
T_3	19.36±2.51	39.09±0.45	0.50±0.07	16.37±2.64	3.72±0.73	4.60±0.71
T_4	18.63±2.79	40.53±0.89	0.43±0.05	14.48±1.46	2.56±0.29	5.88±1.10
T_5	18.82±1.21	39.38±0.06	0.48±0.03	17.53±0.88	4.42±0.89	4.24±0.70
T_6	18.74±1.92	39.34±0.39	0.48±0.05	15.24±0.83	2.61±0.16	5.86±0.25
T_7	21.44±1.97	39.59±0.62	0.54±0.06	16.82±2.52	3.94±0.22	4.37±0.92
P value	0.921	0.514	0.743	0.088	0.710	0.249

Each value is mean of six observations.
Means with at least one common superscript in a column do not differ significantly (p>0.05).
PUFA: Arachidonic acid (C20:4 n-6), Linoleic acid (C18:2 n-6), Linolenic acid (C18:3 n-3), EPA (C20:5 n-3) and DHA (C22:6 n-3)
SFA: Myristic acid (C14:0), Palmitic acid (C16:0), Steric acid (C18:0) and Behenic acid (C24:0)

The present study SFA and PUFA values are comparable with results of Ramesh *et al*. (2018) [12] who reported in breast meat of Aseel chicken at 12 weeks of age. Poultry meat contains 20 to 40% dry matter, 15 to 25% protein and 1.5 to 5.3% fat. The fat contents are most varying nutrient due to the influence of diet, age of animal and environmental conditions (Castellini *et al*., 2002) [3]. The higher intake of feed and less physical movements resulted in an increased fat accumulation in muscles. The chicken diets determine the composition of meat, particularly the essential polyunsaturated fatty acids (PUFA) like n-3 fatty acids (Farrell, 1998) [5]. Likewise, Jaspal *et al*. (2020) [7] recorded higher PUFA concentration in Aseel chicken meat when compared to broiler and Cobb Sasso chickens.

4. Conclusion

The varying dietary protein levels had significant effect on moisture and ash content in breast meat of Aseel chicken. The increased protein levels in the diet increased the dry matter content in the breast meat of native chickens. The crude fat content in breast meat of native chicken is not influenced by the dietary protein levels. The effect of varying dietary energy levels on meat fatty acids composition could be studied further in native chickens.

5. Acknowledgement

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