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Effects of dietary protein and energy levels on meat quality, cholesterol, Haematology and serum biochemical parameters in Arni ducks of Tamil Nadu

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Abstract
A total of 224 day old straight run Arni ducklings were reared under intensive system at PGRIAS, Kattupakkam, Chennai to study the effects of dietary protein and energy levels on meat quality, cholesterol level in meat, pH, haematology and serum biochemical parameters. The experimental period were divided into starter (0-3 weeks) and finisher (4-12 weeks) phases. One control and 6 combinations of CP and ME were used as treatment diets. Dietary protein and energy levels had non-significant effects on proximate composition, pH (5.8 ± 0.01) and sensory evaluation of meat. Highest values of proximate composition like moisture, crude protein, total ash, ether extract seen in T4 (62.8 ± 1.9), T1 (19.4 ± 0.4), T1 (4.3 ± 0.9) and T2 (25.1 ± 1.2) respectively. But, had significant ($P< 0.01$) effect on cholesterol level of meat. Highest and lowest cholesterol content was observed in T3 (84.3 ± 0.4 mg) and control group (60.3 ± 1.2 mg) respectively. Haematology and serum biochemical parameter were not influenced by dietary protein and energy levels except serum uric acid, which had significant ($P< 0.01$) effect by dietary treatment groups. Serum uric acid in control group (1.95 ± 0.2) and group T1 (1.96 ± 0.1) were significantly ($P< 0.01$) higher than group T6 (1.04 ± 0.1).

Keywords: Meat quality, cholesterol, pH, sensory evaluation, native ducks

1. Introduction
In the global scenario, duck production has largely increased from 1993 to 2012, and the meat production from ducks has increased from 1.72 to 4.34 million tons [1]. Asia being the leading duck meat producer in the world, accounts for 83% of total duck meat [2]. In India duck population was 23.5 million of which Tamil Nadu has a total duck population of around 2.29 million [1], and ranks third next to West Bengal and Assam. The duck population in Tamil Nadu has increased to 120.38% from 2007 to 2012 [1]. Native (desi) ducks and improved duck varieties contribute about 0.96% and 0.28% of egg production in India respectively [2]. The contribution of duck meat also cannot be neglected in the total meat production. Duck meat is famous for their flavor, aroma, high composition of essential amino acids and high percentage of polyunsaturated fatty acids at globally [3]. Duck meat is next alternative to the chicken as protein source. Duck meat composition is differed from the chicken and it considered as red meat owing higher red muscle fibers in breast muscle [4, 5]. In recent years consumers had more interest towards the quality of meat rather than their cost at market. The duck farmers are aiming to decrease the production cost without affecting the meat quality in order to increase the profit as well as increase the acceptance of consumers. Proximate composition like dry matter, crude protein and ether extract were had no significant effect when fed with various levels of CP and ME in broilers at 28 days of age [6]. Researcher [7] revealed that the main factor affecting meat cholesterol levels in meat may be high-energy feed restriction. Dietary protein levels had no effects in serum biochemical parameters in broiler chicks [8]. Hence, the objective of present study has been to determine the effects of combination of dietary crude protein and energy levels on meat quality, cholesterol level, haematology and serum biochemical parameters in Arni ducks of Tamil Nadu.

2. Materials and Methods
2.1 Location of study
The experiment was conducted at Post Graduate Research Institute in Animal Sciences (PGRIAS), Kattupakkam, Tamil Nadu Veterinary and Animal Sciences University.

It is located at a latitude of 12°83'53.24" N and longitude of 80°04'03.15" E with an altitude of 52 meters above mean sea level. Ducks reared for 12 weeks from November 2017 to February 2018 and laboratory works carried out from March to May 2018.

2.2 Experimental design

A total of 224 day old, straight run Arni ducklings at Post Graduate Research Institute in Animal Sciences, Kattupakkam, Tamil Nadu Veterinary and Animal Sciences University were used for the present study. The ducklings were randomly divided into 7 treatments each having four replicates, in each replicate 8 ducklings was allotted by simple random sampling method. The ducklings were reared under intensive system. The experimental period was divided into two phases, namely starter (0-3 weeks), finisher (4-12 weeks) and both feeds were prepared in mash form. The experiment was designed to study the effect of seven different combinations of crude protein and metabolizable energy levels (including the control group based on BIS 1992[9] standards) in two-phase like starter and finisher on the growth performance, carcass characteristics and economics. The experimental design had control group which had 23% crude protein and 2800 kcal/kg ME of starter diet based on BIS standards. Whereas, T1, T2 and T3 had 23, 22 and 21% crude protein respectively with an iso-caloric energy level of 2700 kcal/kg ME. T4, T5 and T6 had 23, 22 and 21% crude protein respectively with an iso-caloric energy level of 2600 kcal/kg ME. Similarly, finisher diet of the control group had 20% crude protein and 2900 kcal/kg ME (BIS 1992 [9] standards). Whereas, T1, T2 and T3 had 20, 19 and 18% crude protein respectively with an iso-caloric energy level of 2800 kcal/kg ME. T4, T5 and T6 had 20, 19 and 18% crude protein respectively with an iso-caloric energy level of 2700 kcal/kg ME. All the experimental ducks were reared under standard management conditions in the intensive system and fed *ad libitum* with a known quantity of feed on a daily basis. Clean potable water was provided *ad libitum*. The design of the experiment is shown in Table 1.The composition of experimental starter feeds and finisher feeds are presented in Table 2 and 3 respectively.

Table 1: Experimental design

Experimental Group	Starter (0-3 weeks)		Finisher (4-12 weeks)		No. of ducks (4 replicates x 8 ducks)
	CP (%)	ME (kcal/kg)	CP (%)	ME (kcal/kg)	
C	**23**	**2800**	**20**	**2900**	**32**
T1	23	2700	20	2800	**32**
T2	22	2700	19	2800	**32**
T3	21	2700	18	2800	**32**
T4	23	2600	20	2700	**32**
T5	22	2600	19	2700	**32**
T6	21	2600	18	2700	**32**

C – Control group, T – Treatment group

At the end of 12th week, 8 ducks (4 from each sex, 2 per replicate) from each treatment were randomly selected for evaluation of meat quality. After 8 hours of deprivation of the feed, the slaughter was carried out by improved Kosher method [10].

2.3 Meat quality studies

Proximate analysis, cholesterol, pH and sensory evaluation were carried out to assess the meat quality of Arni ducks fed with treatment diets. The proximate composition such as moisture, crude protein, ether extract and total ash in the meat were analyzed by following the standard procedure of AOAC [11].

Cholesterol content of fresh meat samples were determined using cholesterol estimation kit. Lipid extract from meat was used instead of blood serum, as per the method described by researcher [12]. Lipid extract was prepared by taking one gram of meat sample and adding 10 ml of freshly prepared 2:1 chloroform: methanol solution and homogenizing in a laboratory blender. The homogenate was then filtered using Whatman No. 42 filter paper and 2.5ml of distilled water was added to the filtrate, mixed and centrifuged at 2500 rpm for 5 min. After centrifugation the aqueous layer (Methanol) was removed by suction and the volume of the bottom (Chloroform) layer having cholesterol was collected. From this, 25 µl of the sample was pipetted in a test tube and kept in hot water bath at 100º C for2-3 minutes till it got dried. To this 5 ml of cholesterol reagent was added, mixed and kept in boiling water bath for 90 seconds for colour development. The absorbance of standard and test against blank was taken at a wavelength of 530 nm. The total cholesterol (mg/dl) of duck meat was calculated as follows [12]:

Total cholesterol = OD of sample / OD of standard * standard

Table 2: Composition of the experimental starter diets for Arni ducklings

Ingredients	C	T1	T2	T3	T4	T5	T6
Maize	54.84	49.50	50.50	51.40	42.20	43.00	44.70
DORB	0.14	3.32	5.37	7.66	11.72	14.32	15.51
SFOC	0.14	4.50	4.85	4.40	4.80	4.50	4.70
Soya bean meal	40.70	38.40	35.00	32.20	37.10	33.90	30.80
Mineral mixture[1]	1.30	1.30	1.30	1.30	1.30	1.30	1.30
Calcite	1.10	1.10	1.10	1.15	1.10	1.10	1.10
DCP	1.00	1.10	1.10	1.10	1.00	1.10	1.10
AB2D3K[2]	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Vitamin supplement[3]	0.20	0.20	0.20	0.20	0.20	0.20	0.20
Toxin binder[4]	0.20	0.20	0.20	0.20	0.20	0.20	0.20

Salt		0.30	0.30	0.30	0.30	0.30	0.30	0.30
DL-Methionine[5]		0.07	0.07	0.07	0.08	0.07	0.07	0.08
Total		100.00	100.00	100.00	100.00	100.00	100.00	100.00
Required levels	CP (%)	23	23	22	21	23	22	21
	ME(kcal/kg)	2800	2700	2700	2700	2600	2600	2600
Calculated composition								
CP (%)		22.9	23.03	22.01	21.05	23.06	22.01	21.02
ME (kcal/kg)		2791.8	2702.5	2701.2	2701.4	2603.8	2600.0	2609.1
Calcium (%)		1.16	1.2	1.19	1.21	1.19	1.21	1.21
Avail. Phosphorus (%)		0.45	0.49	0.49	0.48	0.48	0.5	0.49
Lysine (%)		1.44	1.43	1.34	1.26	1.43	1.34	1.26
Methionine (%)		0.46	0.47	0.46	0.46	0.47	0.46	0.46

[1]Mineral Mixture contains (%) Dicalcium Phosphate 50.873, calcium carbonate 46.260, Ferrous sulphate 0.940, Manganese Sulphate 1.220, Zinc Oxide 0.500, Copper sulphate0.190, Pottassium Iodate 0.017. [2]pergram contains: vit A-82500 IU, vit B2-50 mg, vit D3-12000 IU, vit K-10 mg, [3]each 2.5 kg contains: vit A 12500000 IU, vit D3 2500000 IU, vit B2 5 g, vit B6 0.4 g, vit B12 15mg, vit E 800 IU, vit K 2 g, Niacinamide 10 g, Calcium d-pantothenate 4 g, Choline chloride 300g, Calcium 760 g, Copper 2 g, Iodine 2g, Iron 20 mg, Manganese 55g, Zinc 52 g, Cobalt 100 mg, [4]Blend of Aluminosilicates, [5]99% pure, C – Control, T – Treatment

Table 3: Composition of the experimental finisher diets for Arni ducks

Ingredients		**C**	**T1**	**T2**	**T3**	**T4**	**T5**	**T6**
Maize		61.44	57.80	58.60	60.00	50.50	52.10	53.00
Palm Oil		1.00	0.50	0.50	0.50	0.50	0.50	0.50
DORB		0.90	3.90	6.04	7.48	11.84	12.34	14.68
SFOC		0.90	3.14	3.20	3.70	4.00	5.60	5.00
Soya bean meal		31.90	30.50	27.40	24.00	29.00	25.20	22.50
Mineral mixture[1]		1.20	1.20	1.20	1.20	1.20	1.20	1.20
Calcite		0.90	1.15	1.15	1.15	1.15	1.15	1.15
DCP		1.10	1.15	1.15	1.15	1.15	1.15	1.15
AB2D3K[2]		0.01	0.01	0.01	0.01	0.01	0.01	0.01
Vitamin supplement[3]		0.20	0.20	0.20	0.20	0.20	0.20	0.20
Toxin binder[4]		0.20	0.20	0.20	0.20	0.20	0.20	0.20
Salt		0.25	0.25	0.25	0.25	0.25	0.25	0.25
L-Lysine[5]		0.00	0.00	0.10	0.16	0.00	0.10	0.16
Total		100.00	100.00	100.00	100.00	100.00	100.00	100.00
Required levels	CP (%)	20	20	19	18	20	19	18
	ME(kcal/kg)	2900	2800	2800	2800	2700	2700	2700
Calculated composition								
CP (%)		19.93	20.02	19.04	18.01	20.04	19.02	18.08
ME (kcal/kg)		2890.3	2805.4	2801.3	2803.7	2702.8	2703.2	2704.1
Calcium (%)		1.06	1.17	1.17	1.16	1.19	1.18	1.18
Avail. Phosphorus (%)		0.45	0.47	0.47	0.47	0.48	0.48	0.48
Lysine (%)		1.19	1.19	1.20	1.18	1.18	1.19	1.18
Methionine (%)		0.35	0.36	0.35	0.34	0.37	0.36	0.34

[1]Mineral Mixture contains (%) Dicalcium Phosphate 50.873, calcium carbonate 46.260, Ferrous sulphate 0.940, Manganese Sulphate 1.220, Zinc Oxide 0.500, Copper sulphate0.190, Pottassium Iodate 0.017. [2]pergram contains: vit A-82500 IU, vit B2-50 mg, vit D3-12000 IU, vit K-10 mg, [3]each 2.5 kg contains: vit A 12500000 IU, vit D3 2500000 IU, vit B2 5 g, vit B6 0.4 g, vit B12 15mg, vit E 800 IU, vit K 2 g, Niacinamide 10 g, Calcium d- pantothenate 4 g, Choline chloride 300g, Calcium 760 g, Copper 2 g, Iodine 2g, Iron 20 mg, Manganese 55g, Zinc 52 g, Cobalt 100 mg, [4]Blend of Aluminosilicates, [5]99% pure, C – Control, T – Treatment

The pH of the frozen meat samples (8 hours) was measured using a digital pH meter (µ pH system 361). Frozen (8 hours) duck meat sample were thawed and cooked by using domestic pressure cooker until the internal temperature of 121ºC which was sufficient to cook the meat. The cooked samples were cut into 1 cm slices and the samples were served in odourless plastic plates to a panel of 7 members. They were provided with a score card of nine point hedonic scales to assess the colour, appearance, flavor, texture, juiciness, tenderness and overall acceptability of the meat.

The blood samples were collected in the EDTA vial and stored at -4°C for 12 hours and thawed before analysis. Hemoglobin (Hb) was analysed by using Sahli's hemoglobinometer and packed cell volume (PCV) was analysed by using microhematocrit [13]. The blood samples were collected in the procoagulant vials and allowed to clot and centrifuged for 10 minutes at 2000 rpm to separate the serum. The separated serum was kept in -20°C until analysed. The serum samples were analysed for lipid profile such as Triglycerides, Cholesterol, HDL and LDL [14]. Protein fractions such as Total protein, Albumin, Globulin and kidney function tests such as Creatinine and uric acid were analysed in an A15 Biosystem auto analyser by using commercially available enzymatic diagnostic kits [14].

3. Statistical analysis

One way ANOVA was carried out using SPSS software version 23.0 for raw data, and seen the significance levels between the treatment groups on proximate composition, Cholesterol level of meat, pH, hematological and serum biochemical parameters. Post Hoc was carried out by using Duncan multiple range test.

4. Results and Discussion

Effect of treatment diets on proximate composition, cholesterol content in meat, pH of Arni duck (meat with skin) are presented in Table 4. Proximate composition (%) like moisture, crude protein, total ash and ether extract of Arni duck meat had non-significant ($P > 0.05$) difference among treatment groups. Proximate composition like moisture, crude protein, total ash, ether extract seen in T4 (62.8 ± 1.9), T1 (19.4 ± 0.4), T1 (4.3 ± 0.9) and T2 (25.1 ± 1.2) respectively. The results of present study are in accordance with the findings of researchers [15, 16] who reported that the proximate composition of meat were not influenced by various CP and ME combination diets. The results of present study are in disagreement with the findings of researcher [17] who recorded that dietary energy to protein ratio was increased and there was a linear decline in carcass protein and an increase in carcass fat. These variations might be the amino acid composition or the dietary energy to protein ratio is not much varied in present study. The proximate results in the present study were in the range of USDA, 2016 [18] database results.

Cholesterol levels in duck meat had significant ($P < 0.01$) difference among treatment groups. Highest cholesterol content was observed in T3 (84.3 ± 0.4mg) and lowest observed in control group (60.3 ± 1.2 mg). In the present study, dietary combination of CP and ME influenced the cholesterol levels of Arni duck meat. No specific literature could be traced for the effects of CP or ME on cholesterol levels of duck meat. As per USDA, 2016 [18] cholesterol level in duck meat is 80 mg. The results indicated that the varying levels of CP and ME lowered cholesterol levels in the duck meat. Researchers [19, 20] reported that cholesterol metabolism and cholesterol cellular concentration increase with age in poultry. Researcher [7] revealed that the main factor affecting meat cholesterol levels in meat may be high-energy feed restriction.

In the present study pH of Arni duck meat was not influenced ($P > 0.05$) by treatment diets which are having various combinations of CP and ME. This result can be supported with research [21] findings, which revealed that ME, lysine and ME x lysine had no significant effect on pH of breast muscle at 45 minutes. As known that dietary CP and ME had no effects on ultimate pH in meat. Arni duck meat had pH value of 5.8 to all the treatment groups.

Effect of treatment diets on sensory evaluation of meat are presented in Table 5. There is no significant ($P > 0.05$) difference in duck meat among treatment groups on sensory evaluation parameters like appearance, flavor, texture, tenderness, juiciness and overall acceptability. But based on mean values from the Friedman test, ranks were given to the meat of treatment groups, Control group (4.50) stands at 1st rank and T1 (4.37), T3 (4.24), T2 (3.98), T4 (3.70), T5 (3.61) and T6 (3.61) were stands at 2nd, 3rd, 4th, 5th and 6th rank respectively. No specific study regarding the effects of CP or ME and interaction on sensory evaluation of duck could be traced. But, sensory evaluation scores of Arni duck meat were merely similar to the findings of research study [22] carried out earlier. Researcher [23] noticed that tenderness was 5.44 ± 1.24 and juiciness was 4.45 ± 1.02 of the Pekin duck breast meat. These results varied from present study. Arni duck meat had lesser score for tenderness and higher score for juiciness. These variations due to increased water and /or fat content in the meat which influence the juiciness, our duck meat possess higher water and fat content.

Table 4: Effect of treatment diets on proximate composition, cholesterol and pH of Arni duck meat with skin (Mean ± SE)

Parameters (%)	C	T1	T2	T3	T4	T5	T6	Sig.
Moisture	61.0 ± 3.2	59.5 ± 3.0	51.7 ± 2.5	56.8 b± 3.9	62.8 ± 1.9	62.4 ± 3.3	60.6 ± 1.2	NS
Crude Protein	19.3 ± 1.1	19.4 ± 0.4	18.3 ± 1.2	16.2 ± 1.3	16.7 ± 0.3	17.4 ± 1.0	17.8 ± 0.8	NS
Total Ash	3.5 ± 0.8	4.3 ± 0.9	3.5 ± 0.8	3.4 ± 0.8	2.4 ± 0.4	2.7 ± 0.6	2.2 ± 0.3	NS
Ether Extract	15.5 ± 3.3	16.4 ± 3.5	25.1 ± 1.2	22.9 m± 4.2	17.2 ± 1.7	14.6 ±1.9	16.5 ± 1.4	NS
Cholesterol (mg/100g)$^{++}$	60.3^{a} ± 1.2	71.0^{bc} ± 4.6	67.7^{ab} ± 2.2	84.3^{d} ± 0.4	77.4^{cd} ± 4.0	80.5^{d} ± 2.2	79.2^{d} ± 1.7	**
pH	5.8 ± 0.01	5.8 ± 0.01	5.8 ± 0.01	5.8 ± 0.01	5.8 ± 0.01	5.8 ± 0.01	5.8 ± 0.01	NS

NS- Non significant, **$P < 0.01$

Mean values having different superscripts differ significantly, N =6 per treatment

C – Control, T – Treatment, ++ significant ($P < 0.01$) for CP and ME levels

Table 5: Effect of treatment diets on Sensory evaluation of Arni duck meat (Mean ± SE)

Treatment groups	Appearance	Flavour	Texture	Tenderness	Juiciness	Overall acceptability
Control	5.71 ± 0.2	5.14 ± 0.3	5.57 ± 0.2	4.57 ± 0.2	5.71 ± 0.2	5.71 ± 0.2
T1	5.71 ± 0.2	5.29 ± 0.2	5.43 ± 0.2	4.57 ± 0.2	5.71 ± 0.2	5.57 ± 0.2
T2	5.86 ± 0.2	4.86 ± 0.3	4.71 ± 0.2	4.57 ± 0.2	5.71 ± 0.2	5.57 ± 0.2
T3	5.43 ± 0.2	5.14 ± 0.3	5.43 ± 0.2	4.57 ± 0.1	5.71 ± 0.2	5.71 ± 0.2
T4	5.29 ± 0.2	4.86 ± 0.3	5.00 ± 0.2	4.86 ± 0.2	5.57 ± 0.2	5.29 ± 0.2
T5	5.43 ± 0.2	5.00 ± 0.3	5.14 ± 0.3	4.43 ± 0.2	5.57 ± 0.2	5.29 ± 0.2
T6	5.57 ± 0.2	5.14 ± 0.3	5.00 ± 0.2	4.43 ± 0.1	5.29 ± 0.2	5.43 ± 0.2
Sig.	NS	NS	NS	NS	NS	NS

NS- Non significant N = 7 per treatment, C – Control, T – Treatment

Effect of treatment diets on hematology and serum biochemical parameters are presented in Table 6 Hematological and serum biochemical parameters were not influenced by CP, ME and CP x ME. The results are similar to that of findings of researcher [24] who observed that blood plasma parameters of Mamourah cockerels was not influenced by dietary protein and energy levels at 14 weeks of age. No specific literature on effects of ME and CP x ME on hematological on ducks were available. Researcher [25] reported Hb levels of Khaki Campbell x Thai native female ducks fed with different protein levels ranged from 12.8 to 13.8 g/100 ml at 12 weeks of age. However, the results in the present study were varied from this value which may be due to different genotype and environment. The results are in accordance with the findings of researcher [26] who observed that the Hb was 10.39 g/dl and PCV was 50%, Arni ducks fed

with different treatment diets containing CP, ME had Hb in the range of 9.83 – 10.50 g/dl and PCV in the range of 45.83 – 48.33%. Researchers [27, 28] reported that the protein levels of 18, 20 and 22% had no significant difference on serum biochemistry of ducks, similar to the findings in the present study. However, serum uric acid in control group (1.95 ± 0.2) and group T1 (1.96 ± 0.1) were significantly ($P< 0.01$) higher than group T6 (1.04 ± 0.1). These results may be due to excessive protein entering urea cycle. The results are in accordance with the findings of researcher [8] who observed that decrease protein level from 21 to 18% decreases uric acid concentration in broiler chicks.

Table 6: Effect of treatment diets on hematology and serum biochemical parameters of Arni duck meat (Mean ± SE)

Treatment groups	C	T1	T2	T3	T4	T5	T6	Sig.
Hb	10.00 ± 0.4	10.00 ± 0.4	10.17 ± 0.3	10.17 ± 0.5	10.50 ± 0.4	10.50 ± 0.4	9.83 ± 0.3	NS
PCV	47.50 ± 1.4	46.83 ± 1.5	48.33 ± 1.1	47.83 ± 1.0	45.83 ± 1.1	47.33 ± 1.3	47.50 ± 1.1	NS
TP	4.58 ± 0.1	3.97 ± 0.1	4.17 ± 0.4	4.87 ± 0.3	4.40 ± 0.3	4.47 ± 0.3	3.98 ± 0.2	NS
Albumen	2.05 ± 0.1	1.95 ± 0.1	1.90 ± 0.1	2.08 ± 0.1	2.02 ± 0.1	2.07 ± 0.1	2.07 ± 0.1	NS
Globulin	2.53 ± 0.05	2.02 ± 0.1	2.27 ± 0.4	2.78 ± 0.3	2.38 ± 0.3	2.40 ± 0.3	1.92 ± 0.2	NS
Triglycerides	206.5 ± 24.0	162.8 ± 25.4	217.0 ±12.3	171.5 ± 27.5	189.8 ±18.3	171.0 ± 25.4	154.5 ± 28.1	NS
Cholesterol	100.0 ± 11.2	84.0 ± 4.5	111.5 ± 11.5	87.3 ± 9.4	96.2 ± 9.3	86.3 ± 12.1	81.8 ± 10.5	NS
HDL	46.2 ± 3.7	49.4 ± 6.2	47.2± 1.6	40.5 ± 4.9	49.1 ± 2.3	39.2 ± 3.1	46.3 ± 3.9	NS
LDL	42.7 ± 3.8	47.5 ± 5.4	43.7 ± 4.8	43.8 ± 6.3	47.3 ± 3.5	38.1 ± 4.0	41.2 ± 4.5	NS
Creatinine	1.12 ± 0.1	1.31 ± 0.1	1.18 ± 0.1	1.28 ± 0.1	1.05 ± 0.1	1.28 ± 0.1	1.37 ± 0.2	NS
Uric acid	1.95^{c} ± 0.2	1.96^{c} ± 0.1	1.67^{ab} ± 0.04	1.14^{a} ± 0.1	1.75^{ab} ± 0.1	1.50^{b} ± 0.1	1.04^{a} ± 0.1	**

*NS- Non significant, **P< 0.05*

Mean values having different superscripts differ significantly

C – Control, T – Treatment, N = 6 per treatment

5. Conclusion

In conclusion, various levels of dietary CP and ME did not influence the meat quality *viz.* proximate composition and sensory evaluation. However, highest cholesterol levels seen in group T3 which and also not interacted in blood parameters except serum uric acid concentration. Serum uric acid indicated that the excessive protein levels in the feed excreted as nitrogen and ammonia by entering the urea cycle. So, the dietary protein levels in the duck feed can be reduced which not affect the proximate composition and meat quality. Furthermore studies required to ensure the minimum level of protein and energy requirement of Arni ducks, without affecting their meat quality. Meat products can be prepared from the Arni duck meat and evaluate for meat quality with public which may give additional information.

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7. References

1. Nineteenth livestock census-2012 All India Report. Department of Animal Husbandry, Dairying and Fisheries.
2. Basic Animal Husbandry & Fisheries Statistics. 2017. AHS Series-18. Government of India Ministry of Agriculture & Farmers Welfare Department of Animal Husbandry, Dairying and Fisheries.
3. Olayiwola A. Review of Research in Duck Nutrient Utilization. International Journal of Poultry Science. 2006; 5:201-218.
4. Smith DP, Fletcher DL, Buhr RJ, Beyer RS. Pekin duckling and broiler chicken pectoralis muscle structure and composition. Poultry Science. 1993; 72:202-208.
5. Ali MS, Kang G, Yang H, Jeong J, Hwang Y, Park G *et al*. A comparison of meat characteristics between duck and chicken breast. Asian Australasian Journal of Animal Sciences. 2007; 20:1002.
6. Iqbal Z, Mughal A, Kamran Z, Ali A, Ahsan U. Effect of constant ME: CP at different levels of CP and ME on growth performance and meat characteristics of broilers from 1-28 days. Archiva Zootechnica. 2014; 17(2):43-53.
7. Ponte PIP, Mendes I, Quaresma M, Aguiar MNM, Lemos JPC, Ferreira LMA *et al*. Cholesterol levels and sensory characteristics of meat from broilers consuming moderate to high levels of alfalfa. Poultry Science. 2004; 83(5):810-814.
8. Darsi E, Shivazad M, Zaghari M, Namroud NF, Mohammadi R. Effect of reduced dietary crude protein levels on growth performance, plasma uric acid and electrolyte concentration of male broiler chicks. Journal of Agricultural Science and Technology. 2012; 14:789-797.
9. BIS, Bureau of Indian standards-for broiler duck, 1992.
10. Steinsaltz, Adin. The Essestial Talmud. 1976, 224-225.
11. AOAC. Official methods of analysis, Association of official analytical chemist 19th edition, Washington D.C., USA, 2012.
12. Wybenga DR, Pileggi VJ, Dirstine PH, Di Giorgio J. Direct manual determination of serum total cholesterol with a single stable reagent. Clinical chemistry. 1970; 16(12):980-984.
13. Coles EH. Veterinary clinical pathology. WB Saunders. 1980.
14. Agapee diagnostic kits. Used Manufacturers protocol for all biochemical paramters.
15. Iqbal Z, Mughal A, Kamran Z, Ali A, Ahsan U. Effect of constant ME: CP at different levels of CP and ME on growth performance and meat characteristics of broilers from 1-28 days. Archiva Zootechnica. 2014; 17(2):43-53.
16. Sarwar G, Akhter S, Khan SH, Anjum MA, Nadeem MA. Effect of different dietary protein and energy levels on the growth performance, meat and body fat composition in broiler chicks. Pakistan Journal of Agricultural Sciences. 2015; 52(4):1125-1129.
17. Siregar AP, Cumming RB, Farrell DJ. The nutrition of meat-type ducks. 2. The effects of variation in the energy and protein contents of diets on biological performance and carcass characteristics. Australian Journal of Agricultural Research. 1982; 33(5):865-75.

18. USDA, United States Department of Agriculture Agricultural Research Service, 2016. National Nutrient Database for Standard Reference Legacy Release. https://ndb. nal. usda. gov/ ndb/ search /list viewed on 01. 04. 2018.
19. Lorenz FW, Entenman C, Chaikoff IL. The influence of age, sex, and ovarian activity on the blood lipids of the domestic fowl. Journal of Biological Chemistry. 1938; 122:619-33.
20. Wagner WD, Clarkson TB. Mechanisms of the genetic control of plasma cholesterol in selected lines of Show Racer pigeons. Proceedings of the Society for Experimental Biology and Medicine. 1974; 145(3):1050-1057.
21. Tang MY, Ma QG, Chen XD, Ji C. Effects of dietary metabolizable energy and lysine on carcass characteristics and meat quality in Arbor Acres broilers. Asian Australasian Journal of Animal Sciences. 2007; 20(12):1865.
22. Omojola AB. Carcass and organoleptic characteristics of duck meat as influenced by breed and sex. International Journal of Poultry Science. 2007; 6(5):329-34.
23. Chartrin P, Meteau K, Juin H, Bernadet MD, Guy G, Larzul C *et al*. Effects of intramuscular fat levels on sensory characteristics of duck breast meat. Poultry Science. 2006; 85(5):914-22.
24. Rabie MH, Sherif KE, El-Khalek AA, El-Gamal AA. Effect of Dietary Energy and Protein on Growth Performance and Carcass Traits of Mamourah Cockerels. Asian Journal of Animal and Veterinary Advances. 2017; 12:142-151.
25. Thongwittaya N, Pleusamran P, Choktaworn N, Tasaki I. Energy and protein requirements of Khaki Campbell x Thai Native growing ducks. Asian-Australasian Journal of Animal Sciences. 1992; 5(2):357-63.
26. Kavitha K, Manohar GR, Vairamuthu S, Ramamurthy N. Haematological Study in White Pekin and Indigenous Ducks of Tamil Nadu. International Journal of Science, Environment and Technology. 2016; 5(4):2621-2624.
27. Joshi SK, Sahoo SK, Babu LK, Giri SC, Mondal D. Effects of feeding different levels of proteins on the performance in Khaki Campbell ducks during starter stage. Indian Journal of Animal Research. 2015; 49(1):70-6.
28. Behera NK, Babu LK, Sahoo SK, Giri SC, Pati PK, Panigrahi B, *et al*. Effect of Feeding Different Levels of Protein on Mortality, Carcass Characteristics, Biochemical Parameter, Time Motion Study and Economics of Desi Ducks under Intensive System of Rearing. Asian Journal of Animal Sciences. 2016; 10(1):106-12.