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Effect of dietary protein on reproductive growth of Khaki Campbell ducks

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ABSTRACT

A study was carried out to find out the minimum level of crude protein in grower diet of female ducks between 8–16 weeks of age for optimum growth of reproductive organs and earliest onset of egg laying. Khaki Campbell ducklings (420) were brooded and maintained with starter ration till 8 wks of age after which 180 female ducks were randomly selected and reared in 3 groups with 3 replicates in each. Three types of iso-caloric grower ration (14, 16 and 18% crude protein) were offered separately between 8–16 wks of age. At 12th and 16th wk of age, biometry of female reproductive tract was taken. Total protein, total cholesterol, calcium and inorganic phosphorus level in blood serum at 12 and 16 wks age and age at first egg were recorded. The observations revealed the maximum growth of female reproductive organs took place between 12–16th wk age. Significant differences were found in length of whole reproductive tract, infundibulum and weight of ovary between 3 feeding groups at 12th wk of age and width of ovary at 16th wk. Age at first egg was the lowest for 16% CP followed by 18 and 14% fed group. Concentration of total protein at 12 and 16 wks and calcium at 16th wk age differed significantly between groups. Thus, It may be concluded that 16% CP in diet is beneficial for Khaki Campbell ducks during growing stage for better reproductive organ growth as well as for early sexual maturity.

Key words: Crude protein, Khaki Campbell duck, Reproductive organ

Khaki Campbell ducks are appreciated for their potentiality of laying eggs. Faster growth of reproductive tract and early attainment of sexual maturity in this breed of duck is essential for exploitation of its potentiality for maximum economic gain. Protein has an important role in growth and egg production. Protein requirement is influenced by age, growth rate, reproduction, climate, energy levels, disease, family and strain, body size and egg production (NRC 1994, Anggorodi 1995). A balanced protein diet is must for poultry as ration with high protein and low energy can reduce growth and inefficient in feed usage (Leeson and Summer 2001). Laying performance of Pitalah ducks is more dependent on available dietary protein rather than place of rearing as reported by Sabrina *et al.* (2003). Thus an experiment was planned to study the reproductive tract growth through biometry of genital organs and estimation of certain blood bio-chemical parameters in Khaki Campbell ducks fed with different levels of dietary protein.

MATERIALS AND METHODS

Management of ducks: The experiment was conducted in the Regional Centre, Central Avian Research Institute, Bhubaneshwar during the year 2013. Day-old ducklings (420; single hatch) of Khaki Campbell variety were collected from the centre's experimental hatchery and were brooded under electric lamp (100 watt) with proper provision of heat and light. Rice husk was used as litter material and were changed frequently to keep the floor dry and hygienic. Sufficient clean drinking water in plastic chick drinkers was made available to the ducklings for the initial 10 days. Thereafter water in plastic troughs was provided to the ducklings for drinking and dipping their head in water which is a normal physiologic phenomenon in ducks. Starter ration (22% CP and 2,750 K Cal ME) was offered (*ad lib.*) to the ducklings between 0–8 wks of age. By the completion of eighth week, female ducks were separated and were randomly divided into 3 groups having 3 replicates in each group with 20 females in each replicate. During grower stage (9–16 weeks) experimental diets containing 14, 16 and 18% CP were offered (*ad lib.*) to the ducks twice daily as per their requirement. Care was taken to balance the metabolizable energy content and level of essential amino acids in each diet. The composition of the experimental diet is presented in Table 1. The feed offered was as wet mash by adding equal amount of water to it. The feeder, waterer and water channels were cleaned daily. Before the onset of the experiment all the birds were dewormed properly.

Provision of water channel and lighting: The growing ducks after 1 month of age were provided with the facility of water channels (1.5 ft depth) located at one side of the pan to which the birds have free access during day time.

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The water in the channels were evacuated and refilled daily for hygienic management. Besides, sufficient clean drinking water in plastic troughs was offered separately. The birds reared in the pans were facilitated with proper ventilation and day light provision. However, 4 h extra lighting was made arranged through electric bulb during evening time which exposed the ducks 16 h to lighting source during the experiment period beyond brooding age.

Table 1. Composition of the different experimental rations fed to Khaki Campbell ducks during grower stage (9–16 weeks of age)

	14% CP	16% CP	18% CP
Wheat (kg)	48	50	54
Soybean meal (kg)	8	14	18
DORB (kg)	24	20	15
Fish meal (kg)	0	0	3
Rice polish (kg)	17	13	7
M.mix (ISI) (kg)	2	2	2
Oyster shell grit (kg)	0.5	0.5	0.5
DCP (kg)	0.5	0.5	0.5
Total (kg)	100.00	100.00	100.00
DL-methionine (g)	100	70	0.00
L- lysine (g)	350	200	0.00
Vit. A, D, E, K (g)	15	15	15
Vitamin B complex (g)	15	15	15
Vitamin E with selenium (g)			
Toxin binder (g)	100	100	100
Ch. chloride (g)	100	100	100
Trace mineral (g)	100	100	100
Crude protein	14.28	16.16	18.42
M energy	2581	2598	2612
Calcium	1.431	1.449	1.587
Available P	0.541	0.526	0.556
Lysine	0.964	0.967	0.969
Methionine	0.3144	0.317	0.3108
Cost (Rs/q)	2163	2291.98	2443.03

Biometry of reproductive tracts, blood bio-chemistry and other reproductive parameters: For the purpose of studying biometry of reproductive tract, 6 males and 6 females from each replicates were sacrificed in 2 phases i.e. at 12th and 16th wk of age. Before sacrifice the birds were kept starved overnight. Only clean drinking water was offered (*ad lib.)*. Pre-slaughter body weight of individual birds was recorded. The ducks were bled and the feathers were plucked adopting semi scalding method. Whole reproductive tracts were recovered from the carcasses carefully. Live body wt (g), dressed body wt (g), length (cm) of whole reproductive tract, length and width (cm) of vagina/shell gland, isthmus, magnum, infundibulum along with length (cm), width (cm) and weight (g) of left ovary were measured using sensitive balance, venire callipers and digitised screw gauge.

Blood samples (5 ml) from female birds (6 samples from each replicate) were collected randomly from wing vein at 12th and 16th wk of age. Serum samples separated by centrifugation were subjected for estimation of total protein, total cholesterol, calcium and inorganic phosphorus concentration in blood. Age (days) at first egg in each replicate group was recorded. The data thus obtained were analysed as per Snedecor and Cochran (1989).

RESULTS AND DISCUSSION

Live and dressed body weight: The live and dressed body weight of ducks at 12th and 16th wk of age maintained with 14, 16 and 18% dietary CP are presented (Table 2).

Table 2. Reproductive organ growth of female ducks (Khaki Campbell) under different levels of dietary protein

Parameters		Age of ducks					
		12th wk			16th wk		
Crude protein in diet		14%	16%	18%	14%	16%	18%
Live B.wt. (g)		1313.67 ±48.48	1366.67 ±41.03	1264.00 ±36.17	1370.00 ±47.03	1300.67 ±35.80	1352.67 ±105.43
Dressed B.wt. (g)		871.33 ±44.56	918.00 ±26.10	844.00 ±22.03	953.33 ±50.94	860.00 ±5.77	913.33 ±63.67
Whole reproductive tract	Length (cm)	12.58^{a}±0.48	18.35^{b}±4.20	14.08 ^{a}±0.31	37.70±13.90	36.25±13.95	36.63±10.46
	Wt (g)	2.31 ^{a}±0.74	5.85^{b}±3.05	2.51 ^{a}±0.01	24.02±11.45	24.44±11.11	28.54±14.75
Vagina/shell gland	Length (cm)	2.39±0.43	3.88±1.14	2.22±0.12	4.55±0.83	4.81±0.30	4.84±0.94
	Width (cm)	0.86±0.11	1.02±0.22	0.52±0.06	1.18±0.04	1.26±0.04	1.44±0.15
Isthmus	Length (cm)	1.14±0.13	1.47±0.37	0.89±0.12	5.38±1.72	4.43±1.04	5.67±1.51
	Width (cm)	0.67±0.17	0.85±0.26	0.34±0.04	1.19±0.18	1.19±0.28	1.14±0.11
Magnum	Length (cm)	5.68 ^{b}±0.12	9.49 ^{a}±2.54	7.06 ^{b}±0.73	22.09±8.21	23.09±10.10	21.30±4.68
	Width (cm)	0.39±0.03	0.49±2.54	0.27±0.06	0.86±0.31	0.87±0.35	0.79±0.26
Infundibulum	Length (cm)	1.34±0.17	1.68±0.50	1.57±0.44	4.32±2.08	3.53±1.69	3.34±0.91
	Width (cm)	0.57±0.22	0.84±0.24	0.71±0.27	0.86±0.13	0.84±0.17	1.00±0.38
Ovary (left)	Length (cm)	1.86±0.08	2.46±0.07	2.15±0.28	3.35±0.85	3.22±0.73	3.71±0.75
	Width (cm)	0.84±0.13	0.91±0.10	0.64±0.08	1.04 ^{a}±0.12	1.39 ^{b}±0.34	1.08 ^{a}±0.15
	Weight (g)	0.43 ^{a}±0.03	0.87 ^{b}±0.30	0.58 ^{a}±0.03	2.83±1.88	2.21±1.18	2.87±1.98
Age at first egg (days)					121.66	111.33	117.33

Different superscripts in a row within one age group differ (P<0.05) significantly.

Table 3. Blood serum biochemistry of ducks (Khaki Campbell) under different levels of dietary protein

Parameters	Age of ducks					
	12th wk			16th wk		
Crude protein in diet	14%	16%	18%	14%	16%	18%
Total protein (g/dl)	2.90[a]±0.36	4.76[b]±1.09	5.20[b]±0.99	2.71 [a]±0.42	4.96 [b]±1.44	3.27 [a]±0.42
Total cholesterol (mg/dl)	207.82±18.20	230.55±6.35	229.89±31.11	235.69±58.68	227.98±22.74	229.94±15.18
Calcium (mg/dl)	15.92±7.12	13.86±4.64	19.64±18.34	11.47[a]±0.43	19.83[b]±3.54	19.90[b]±3.61
Inorganic phosphorus (mg/dl)	4.61±0.88	3.37±0.48	3.67±0.41	6.32±0.67	8.32±0.63	8.68±3.52

Different superscripts in a row within one age group differ (P<0.05) significantly.

Observation revealed that gain in body weight almost ceased after 12th wk of age. Levels of dietary protein imparted no significant effect on overall body growth neither at 12th nor at 16th wk of age. Jalil *et al*. (1997) reported 866.80 g body weight of Khaki Campbell ducks at 12th wk of age maintained under village condition with supplementary feeding provision which was much less than that of present finding. However, his report on 16th wk body wt (1206.00g) of ducks in the same flock was almost at par with our observation. The better growth of ducks by 12th wk of age continued till 16th wk in all the 3 feeding groups recorded in the present study might be due to the availability of desired quality feed in required quantity during the peak growing period which may not be possible in village condition. The dressed body weight of ducks observed in this experiment followed the same trend to that of live body weight of birds which is a normal phenomenon.

Growth of female reproductive tract: Weight and dimensions of whole reproductive tract / organs of female Khaki Campbell ducks reared with 3 different levels of dietary protein recorded at 12th and 16th wks of age are presented in Table 2. Observation revealed the growth of different parts of reproductive tract found increased in many folds at 16th wk of age over its size at 12th wk which implies that maximum growth of reproductive organs took place between 12th–16th wk of age in Khaki Campbell ducks. Growth of whole reproductive organs (length and weight) at 12th wk age was the highest for the group fed with 16% CP which differed significantly (P<0.05) from other 2 dietary groups. Biometry of various parts of reproductive tract revealed the length of magnum in 16% CP dietary group significantly (P<0.05) higher than other 2 dietary groups at 12th wk age. Nonsignificant higher values for other parts of reproductive tract at 12th week age were found for 16% CP feeding group. Biometrical measurements of whole and various parts of reproductive tracts recorded at 16th wk age showed neither such growth trend nor any significant difference for any particular feeding group. At present the relevant literature with regard to biometry of reproductive tract in avian species is not available to support our findings.

Growth of left ovary: Ovarian growth (Table 2) during 12–16th wk was prominent. At 12th wk of age the weight of left ovary was the highest for the group fed with 16% CP, which differed significantly (P<0.05) from other 2 feeding groups. Length and width of left ovary at 12th wk of age remained unaffected to CP% in diet. At 16th wk of age the value for width of ovary recovered from 16% CP fed group is the highest and is significantly different (P<0.05) from other 2 feeding groups, which might be due to the presence of growing follicles on its surface. There was no variation observed for length and weight of ovary among the 3 feeding groups at this age of birds although weight of ovary is the least for groups offered with 16% CP. Akinola *et al.* (2012) studied the ovary-oviduct weight of Japanese quail with different dietary nutrient level and opined that energy content in the diet for Japanese quail could be a major factor for determining gonad development and subsequent onset of sexual maturity. Further, Hashiguishi *et al.* (1998) and Soars *et al.* (2003) demonstrated that low crude protein diet depressed growth and delayed sexual maturity in female quails. However, the present study on Khaki Campbell ducks revealed 16% crude protein is the optimum for ovarian growth.

Blood biochemistry: Biochemical estimations of total protein, total cholesterol, total calcium and inorganic phosphorus at 12th and 16th week of age is presented (Table 3). Level of total protein in serum was the highest for the ducks reared with 16% CP in diet at both 12th and 16th week of age which differed significantly (P<0.05) to other feeding groups. Further, concentration of calcium in blood serum at 12th and 16th wk of age was the highest for birds fed with 18% CP followed by 16 and 14% . Calcium level estimated for 18 and 16% CP fed group at 16th wk age differed significantly (P<0.05) with that of 14% CP fed group whereas no statistical difference was found between 16 and 18% CP fed groups. Further, levels of total cholesterol and inorganic phosphorus for both age groups of ducks revealed no significant difference between the 3 dietary feeding groups.

Age of sexual maturity: The age of ducks at first egg recorded in the present investigation was the earliest (111.33 days) for group fed with 16% CP followed by 117.33 days (18% CP) and 121.66 days (14% CP) respectively. Agudu (1971) reported that decreased protein % in diet (24, 22, 20, 18 and 16%) is responsible for delay in sexual maturity (13 days between earliest and latest onset of egg laying) in chicks. However, attainment of sexual maturity in Japanese quail was found unaffected to 41, 42 and 44% crude protein in diet (Odunsi *et al.* 2007). This might be due to a much higher level of crude protein necessary for quail diet. The

current observation revealed the optimum level of CP (16%) for earliest sexual maturity which is significantly (P<0.05) less than both high (18%) and low (14%) protein fed groups. Further, higher concentration of total protein and calcium in blood serum of ducks, fed with 16% CP at 16 wks of age is indicative of attaining early sexual maturity as evidenced by earliest initiation of egg laying among all the groups. The present observation finds partial support of Cherry and Morris (2008) who suggested 15.70% CP to ducks from 0–42 days followed by increase in CP level for efficient growth and production management. Thus, it may be concluded that 16% dietary protein need to be offered to the female Khaki Campbell ducks as grower ration for better reproductive organ growth with early initiation of laying.

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