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Performance of cross-bred (White Pekin × Khaki Campbell) ducks under intensive system of rearing

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ABSTRACT

In the present investigation, the performance of a crossbred (White pekin × Khaki Campbell) duck of meat and egg variety produced through artificial insemination were studied under intensive system of management. A total of 157 day old ducklings were reared in the experimental duck farm with standard management practice of brooding, and growing with balanced feed and health management. However, at 16th wk of age, 30 female ducks were confined to individual cage to record their egg laying performances. The growth performance revealed the significant difference between male and female from 8th to 24th week of age. Most of the body measurement parameters found higher than that of Khaki Campbell and less than that of White Pekin ducks of similar age. The blood biochemistry estimates revealed no variation between male and female ducks except for albumin and calcium wherein the value is highly significant for females. The carcass quality estimates of 20th week male ducks were at par with their age. The average age of sexual maturity was recorded as 131.83±1.65 days and age at 50% egg production in the flock was 139 days. The duck day egg production per cent up to 45th week of age was 80.31±3.44 and it was also recorded that in 108 occasions, one duck laid more than one egg. The egg estimates study of the experimental duck eggs (100 nos) at 40 wks age revealed 62.31± 0.44 g egg weight and 92.378 ± 0.453 as Hague unit scale. The study revealed that the production and reproduction parameters of the cross-bred (WP × KC) ducks may meet the expectation of farmers to be benefitted through both meat and egg production.

Keywords: Body weight, Carcass quality, Cross-bred duck, Egg production

Ducks are the second most important avian species providing eggs and meat for human consumption. The duck production in India is mostly confined to rural farmers. They raise different varieties of ducks for both meat and egg purpose. However their demand for a dual variety of duck suitable for semi-intensive rearing is perceived through trainings and interactions. Among different varieties of ducks, the two important exotic varieties, i.e. White pekin and Khaki Campbell are for meat and egg purpose, respectively. The white pekin (WP) is a true broiler duck having white plumage and grow very fast attaining 3.29 to 3.61 kg body wt. by 8th wk of age (NRC 1994) but of poor egg laying (130-135 eggs/year) ability (Padhi *et al.* 2010a). Khaki Campbell on the other hand may not be profitable for meat purpose but very good layer duck which can lay 242-271 eggs in a laying year under intensive management practice with standard feeding and health management (Nho and Tieu 1997). However, farmers have a preferential choice for ducks having multi-colored plumage with optimum growth and laying potentiality. Most of the native ducks are smaller in size and lay eggs significantly less in number than Khaki Campbell (Das *et al.* 2008, Giri *et al.* 2014). Therefore, an experiment was planned to evaluate the performances of a cross-bred (WP × KC) duck in farm condition with an aim to further propagate in the extensive system to meet the farmers need of a dual purpose duck variety.

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MATERIALS AND METHODS

Experimental birds: The present experiment was conducted in Regional Centre, Central Avian Research Institute, Bhubaneswar, India for a period of one and half year. A total of 15 white pekin breeding drakes (45 weeks age) were maintained in cages with normal feeding management practice. After 15 days of acclimatization in cages, they were used for semen collection by Message method (Giri *et al.* 2016). Semen thus collected was diluted (Semen: NSS :: 1:1) and was inseminated to 100 nos of Khaki Campbell female ducks (~50 wks age). Five times artificial inseminations were done within a period of 10 days. Eggs were collected from 4th day of first insemination till 3rd day of last insemination. A total of 362 hatching eggs were collected and incubated in the experimental hatchery out of which 232 healthy ducklings hatched. From the healthy day old ducklings, a total of 157 were randomly selected, numbered (wing band) and were subjected for the present study.

Fig. 1. WP × KC ducks in shed.

Fig. 2. Pair of WP × KC ducks.

Rearing and management of birds: The day old ducklings in the farm were brooded under light for two weeks with *ad lib.* feed (wet duck mash: CP 21% and ME 2900 kcl/kg) and sufficient clean drinking water. Rice husk was used as litter material for all the time. Antibiotic coverage through drinking water (for initial 3 days) and multivitamin preparation in feed (for one week) during brooding period of 10 days was undertaken for healthy growth and minimal mortality. The birds were provided more floor space as they grew. Accordingly, duck grower mash (CP 16% and ME 2500 kcl/kg) from 8th week onwards and the duck layer ration (CP 18% and ME 2750 kcl/kg) from 14th week onward were offered. The ducks were allowed to remain in the run-space during day time where provision of water channel was made. No feed but drinking water was offered to the birds in night shelter. Calcium preparation and general medication was provided to the adult ducks during egg laying period. Vaccination against duck plague was done at 12th weeks of age. Male and female ducks were physically identified by 16th week of age and were separated. With an aim to record the individual egg production data, 30 female ducks were kept in individual cages (made up of galvanised iron, coated with plastic covering). Feed and water were offered to ducks inside the cage. Subsequently egg laying was initiated and the eggs were collected from the cages that helped in recording individual duck egg production data. Male ducks (12 nos) at 20th week of age were sacrificed to study the carcass characteristics as per the method envisaged by Padhi *et al.* (2010a).

Data recording: Body weight (g) of the experimental birds were recorded at 0 day, 2nd, 4th, 6th, 8th, 10th, 12th, 16th, 20th, 24th and 40th week of age. Body measurements (both male and female) of ducks at 20th week of age were recorded. Blood serum biochemistry (20th week age), egg production parameters (up to 45th week of age), carcass quality of male birds (16th week age) and egg analysis (20th to 45th week of age) were undertaken following standard procedures. Data thus generated were analysed by applying standard statistical procedure (Snedechor and Cochran 1989).

RESULTS AND DISCUSSION

Growth parameter: The bi-weekly body weight recorded till 20th week followed by 24th, 28th and 40th week

Table 1. Growth performances of Cross-breed (WP×KC) ducks up to 40th week age

Age (wk)	Female			Male			Combined sex		
	Mean	±S.E.	n	Mean	±S.E.	n	Mean	±S.E.	n
0	35.94^{b}	0.45	66	37.80^{a}	0.42	91	37.02^{ab}	0.32	157
2nd	202.33^{NS}	6.53	66	208.82	5.72	91	206.10	4.31	157
4th	747.06^{NS}	16.06	66	777.52	14.61	91	764.71	10.90	157
6th	1150.52^{NS}	22.61	66	1203.89	22.15	91	1179.22	16.03	157
8th	1354.30^{NS}	26.38	66	1541.14	23.74	91	1462.60	19.16	157
10th	1430.55^{b}	27.17	66	1735.58^{a}	23.71	91	1607.35^{ab}	21.58	157
12th	1559.70^{b}	32.73	66	1843.43^{a}	24.73	91	1724.15^{ab}	22.83	157
14th	1594.42^{b}	30.60	66	1854.71^{a}	28.17	91	1745.29^{ab}	23.21	157
16th	1577.39^{b}	32.25	66	1840.10^{a}	27.62	91	1729.66^{ab}	23.42	157
18th	1612.39^{b}	30.30	66	1827.01^{a}	18.92	91	1736.79^{ab}	18.84	157
20th	1682.27^{b}	36.05	66	1829.70^{a}	24.60	81	1764.83^{ab}	22.13	147
24th	1741.03^{b}	49.41	66	1834.96^{a}	29.93	62	1786.52^{ab}	26.23	98
28th	1734.55^{NS}	33.88	66	1818.09	29.49	23	1756.13	26.61	89
40th	1722.55^{NS}	32.19	66	1818.64	55.78	22	1746.57	28.23	88

Different superscripts in a row indicates significant difference ($p<0.05$) between the group.

of age is presented in Table 1. Sex differentiation of the birds was done by 14th week of age. Observation of growth performance revealed that males weigh more than female ducks in all stages of growth up to 40 weeks age. However, significant difference ($p<0.05$) between male and female was found from 10th to 24th week of age. The present observation of body weight at 8th week age is much less than the 7th week growth of Pekin ducks (Kokoszy´nski *et al.* 2019) and higher than that of Khaki Campbell ducks (Mohanty *et al.* 2016) of same age. Further, Rabbani *et al.* (2019) reported that white pekin ducks attain 1485.41 to 1549.96 g body weight at 8th week of age under four different nutritional regimens which is in close proximity with the present observation. Therefore, the body weight recorded in the present study appears to be normal due to the genetic make-up of the bird which is a cross between a meat type and an egg type duck.

Body measurements: The body measurements of the cross-breed (WP×KC) ducks at 20 weeks age is presented in Table 2. Body measurements, i.e. Body length, breast circumference, bill length, shank length and shank width observed in the present study was higher than those of Khaki Campbell and White Pekin ducks at 10 wks age (Yakubu *et al.* 2015) which might be attributed to the higher age and cross-breeding effect of birds subjected for the present study. The keel length and shank length recorded in the present observation is higher than those reported by Padhi and Sahoo (2012) for White pekin, Khaki campbell and their cross (WP × KC) at 8th week of age which again reflects the higher age of ducks subjected for present study.

Blood bio chemistry: The blood biochemistry estimated in the experimental birds is presented in Table 3. Haemoglobin per cent in blood and few biochemical estimates of blood serum samples collected from male and female ducks (WP×KC) at 20 wks of age were done. The haemoglobin concentration between male and female experimental birds has no significant difference. The value of haemoglobin (combined sex) obtained (13.225±0.144 g/dl) in the present study is in close proximity with the report of Ameer *et al.* (2019) who estimated the same (13.293±1.646) in White pekin ducks at 8 weeks age under intensive management practice. Further, Mulley (1979) reported haemoglobin concentration of 12.88±1.25 and 13.03±1.52 g/dl in male and female black duck (*Anas superciliosa*), respectively in Australia, captured by net during spring season. The values of serum total protein (5.717±0.443 g/dl), total cholesterol (188.388±10.623 g/dl) and glucose (88.745±5.616 g/dl) level estimated in combined sex of ducks (WP×KC) during the present study were higher than the observation of Ameer *et al.* (2019) who estimated the same in 8 weeks old White pekin ducks. This might be attributed to higher age of birds taken for the present study. Such difference in values agree with Sumiati and Wiryawan (1961) who illustrated that serum biochemical constituents in duck are influenced by breed, age, and management practice (L-Rawashdeh 2000). Calcium concentration in serum of ducks (combined sex: 12.615±1.018 mg/dl) observed in the present study is within the same range

Table 2. Measurement of different body parts of Cross-breed (WP×KC) ducks at 20th wk age

Parameter	Female (30)		Male (30)		Combined sex (60)	
	Mean	±S.E.	Mean	±S.E.	Mean	±S.E.
Body Wt (g)	1561.76^{b}	32.19	1994.71^{a}	27.70	1778.63^{ab}	34.26
Body Length (cm)	63.11^{b}	0.68	66.28^{a}	0.93	64.78^{ab}	0.60
Body Height (cm)	21.26^{b}	0.26	22.75^{a}	0.33	22.06^{ab}	0.23
Breast Circumference (cm)	36.89^{b}	0.69	39.64^{a}	0.55	38.29^{a}	0.46
Bill Length (cm)	6.25^{b}	0.08	6.72^{a}	0.05	6.50^{ab}	0.06
Bill Width (cm)	2.68^{b}	0.04	2.87^{a}	0.03	2.78^{ab}	0.03
Head Width (cm)	3.14^{NS}	0.04	3.21	0.03	3.18	0.03
Head Length (cm)	6.28^{NS}	0.08	6.54	0.09	6.42	0.06
Keel Length (cm)	11.25^{b}	0.14	12.42^{a}	0.16	11.85^{ab}	0.13
Shank Length (cm)	6.78^{b}	0.09	7.24^{a}	0.11	7.02^{ab}	0.08
Shank Width (cm)	1.37^{b}	0.03	1.55^{a}	0.02	1.46^{ab}	0.02

Different superscripts in a row indicates significant difference ($p<0.05$) between the group.

Table 3. Blood biochemistry of Cross-breed (WP×KC) ducks at 20 wks age

Parameter	Female (12)		Male (12)		Combined sex (24)	
	Mean	±S.E.	Mean	±S.E.	Mean	±S.E.
Haemoglobin (g/dl)	13.142	0.208	13.308	0.204	13.225	0.144
Total Protein (g/dl)	6.319	0.779	5.115	0.384	5.717	0.443
Albumin (g/dl)	3.154^{a}	0.164	2.613^{b}	0.076	2.883^{ab}	0.105
Cholesterol (mg/dl)	190.292	20.160	186.483	8.050	188.388	10.623
Calcium (mg/dl)	15.513^{a}	1.596	9.716^{b}	0.509	12.615^{ab}	1.018
Glucose (mg/dl)	98.705	5.670	78.785	9.039	88.745	5.616

Different superscripts in a row indicates significant difference ($p<0.05$) between the group.

(7.90 to 18.00 mg/dl) reported by Ameer *et al.* (2019) who estimated the same in 8 weeks old White pekin ducks. Further, present observation of calcium concentration in blood revealed significant difference ($p<0.05$) between the sex of birds which contradicts the findings of Jerabek *et al.* (2018) who reported non-significant difference in blood calcium concentration of 40 days old Cherry Valley male and female ducks. This might be attributed to the much higher age (20 weeks) of experimental birds those started egg laying by the time blood sample collection and analysis was conducted.

Carcass quality: Duck farmers usually segregate the male birds between 14-16th week of age and sell them for meat purpose. Therefore, the present experiment was targeted to study the carcass quality of male ducks at this age. Thus, healthy male birds (12 nos) at the age of 16 weeks were selected for study of carcass characteristics and the data is presented in Table 4. The eviscerated weight per cent (49.89) observed in the present study was much less in comparison to the observation of Padhi *et al.* (2010a) who reported 68.51 and 17.78% respectively for eviscerated weight and skin with fat weight for 8 week old WP×KC ducks of combined sex. Further, carcass yield (%) and skin with fat (%) in three lines of 7 week old male white pekin ducks were 61.20 and 27.30 respectively (Kokoszynski *et al.* 2019) are much higher than that of present observation which might be attributed to the higher age of birds taken in present study where skin along with subcutaneous fat was removed completely during dressing of the bird. Similarly breast, back, thigh/leg and wing weight per cent observed in the current study were much lower than those reported by Padhi *et al.* (2010a) as the observed values are the per cent of live body weight in contrast to the per cent of eviscerated weight reported by the later. However, per cent yield of neck, head and giblet in the current observation were almost same as reported by Padhi *et al.* (2010a).

Table 4. Study of carcass quality at 16th wk age of Cross-breed (WP×KC) male ducks (12nos)

Parameter	Wt (g)		Percentage of body wt.	
	Mean	±S.E.	Mean per cent	±S.E.
Live b.wt	1865.50	65.77		
Wt after bleeding	1794.50	72.45	96.07	0.77
Eviscerrated wt	933.75	48.94	49.89	1.19
Thigh	76.50	5.33	4.08	0.19
Wing	84.50	4.37	4.55	0.24
Breast	272.25	11.87	14.61	0.44
Back	186.50	9.98	9.99	0.41
Drum stick	78.50	4.12	4.20	0.11
Neck	104.25	5.32	5.57	0.13
Abdominal fat	9.00	0.82	0.47	0.04
Head	98.75	3.70	5.30	0.14
Liver	39.75	1.79	2.13	0.06
Heart	13.50	0.82	0.72	0.03
Gizard	41.00	0.76	2.21	0.08
Giblet	94.88	2.91	5.10	0.08
Spleen	0.87	0.07	0.05	0.00

Table 5. Reproduction parameters of Cross-breed (WP×KC) female ducks up to 45th week age

Parameter		Value	±S.E.
No. of ducks kept in cage for study		30	
Average age at first egg (days)		131.83 (118-147)	1.65
Age at 50 % egg in the flock (days)		139	
Total egg production		4722	
Duck day egg production %		80.31	3.44
No of times duck laid more than one egg		108	
Avg egg wt (g)	20th wk	52.01	0.95
	25th wk	58.77	0.83
	30th wk	63.06	0.9
	35th wk	66.3	0.82
	40th wk	64.58	0.75
	45th wk	62.1	0.93

Sexual maturity and egg production: The reproduction parameters, viz. age at first egg and 50% egg production in the flock, production per cent, incidence of more than one egg laid by a duck in a day and average egg weight (g) from 20-45th week of age are presented in Table 5. The average age at first egg estimated for thirty ducks (131.83±1.65 days) in present study is less than that reported by Padhi *et al* (2010b) for White pekin ducks (148.00±4.61days) and higher than that reported by Padhi *et al.* (2010c) for Khaki campbell ducks (117 ±1.73). Giri *et al.* (2014) reported age at sexual maturity of 152.95±3.96 days for Khaki Campbell ducks reared under extensive management practice. However Giri *et al.* (2015) observed the same between 111 to 121 days for Khaki campbell ducks reared under intensive management with three dietary regimens of 14, 16 and 18% crude protein. Thus, the present study appears to be normal due to the genetic makeup of the birds subjected for experiment. The age at 50 per cent egg production (139 days) observed in the present study is less than that reported by Padhi *et al.* (2010b) for white pekin ducks (181±2.87 days) and 151±5.87 days for Khaki campbell ducks (Padhi *et al.* 2010c). The lower value in the present study than both the varieties of ducks reported above might be attributed to the better individual feeding of the ducks reared in the cages in contrast to the flock rearing under deep litter system reported above. In the present study, duck day egg production (80.31±3.44%) observed up to 45th week of age is much higher than that of Khaki campbell ducks (54.94±0.58) who reported up to 40 week age (Padhi *et al.* 2010b) and White pekin ducks (58.30±4.62) reported up to 40 wks age (Padhi *et al.* 2010c). The much higher value observed in the present study might be due to the cross-breeding of one egg and one meat variety ducks so also the managemental benefit of cage rearing of experimental birds. However, the effect of egg production data recorded up to 45th week of age in the present study in contrast to 40 weeks as reported by above

Table 6. Egg estimates study of Cross-breed (WP×KC) ducks at 40 wk age

Egg estimate	Mean	±S.E.
Egg weight (g)	62.31	0.44
Shape index (SI)	73.027	0.397
Albumin index (AI)	0.153	0.002
Yolk index (YI)	0.442	0.003
Albumin (%)	58.018	0.238
Yolk (%)	31.559	0.233
Shell (%)	10.422	0.071
Shell thickness (mm)	0.578	.006
Membrane thickness (mm)	0.019	0.001
Hague unit score	92.378	0.453

workers can never be ignored.

During the experiment period, it was observed that in 108 occasions, the ducks laid more than one egg in a day. The present observation finds no support to this fact. However, Ducks by Lawrence (www.ducksinfo.com) explained that getting more than one egg from a duck hen is not un-natural; the reason being the duck hormones are balancing out with time and it may not last long.

The average egg weight recorded in the present study showed increasing trend from 20th to 35th week age followed by gradual decrease in 40th and 45th week. The egg weight at 40th week observed in the present investigation is almost similar to Khaki campbell ducks (Padhi *et al.* 2010c) and less than that in White pekin ducks (Padhi *et al.* 2010b) of same age. Further, Swain *et al.* (2020) reported higher egg weight in Khaki campbell ducks (45th week age) by partial feeding of azolla. However, Das *et al.* (2003) reported less weight of egg in Khaki campbell ducks (above 65 weeks) reared under integrated duck-cum-fish cultivation. Thus, the present observation of egg weight up to 45th week of age appears to be rational for the cross-breed (WP×KC) ducks subjected for study.

Egg analysis: The egg estimates study of the experimental duck eggs (100 nos) at 40 wks age is presented Table 6. The egg weight, albumin index, yolk index, shell thickness and Hague unit scale recorded in the present study is higher and shape index is lower than those reported by Kavita *et al.* (2017) estimated for White pekin ducks. Swain *et al.* (2020) reported lower values of shape index, albumin index, yolk index, hague unit, shell thickness with and without membrane and yolk percent in Khaki campbell duck (45th week age) eggs than those observed in present study. However, values for albumin and shell per cent reported by Swain *et al.* (2020) are higher than those of present observation. The difference in above values might be attributed to the breed variation, management practices and age of the birds. However, the values of all the egg analysis parameters studied in the present experiment is in close proximity with the observation of Padhi *et al.* (2021) who estimated egg analysis in Kuzi ducks (40th week) of Odisha.

The present study regarding production and reproduction performances of a cross-bred (WP×KC) duck under intensive system of management revealed that the ducks are most suitable for the farmer to meet his expectations of better productivity of meat and egg production from cross-breed. However, the field performances of this cross-breed duck need to be evaluated under free range management practice for more accuracy and authenticity of the ability of the cross-bred duck so that proper recommendation can be made.

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