



Gross and Morphometrical Studies on the Female Reproductive Tract of White Leghorn and Kadaknath Hens

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ABSTRACT

This study was conducted on 50 mature female birds comprising of 25 Kadaknath and 25 White Leghorn hens procured from the poultry farm of College of Veterinary and Animal Science, Bikaner. The left ovary of White Leghorn showed presence of hierarchy of mature follicles where as that of Kadaknath appeared as bunch of grapes. The length, width and follicular diameter were significantly higher in White Leghorn than Kadaknath hens. No significant difference was observed in the body weight of both the breeds. The mean length and weight of oviduct was significantly higher in White Leghorn than Kadaknath hens. Magnum was the longest segment with an average length of 19.216±1.44 cm in White Leghorn and 9.145±0.63 cm in Kadaknath whereas vagina was the shortest segment with an average length of 3.233±0.24 cm in White Leghorn and 1.352±0.09 cm in Kadaknath hens.

HIGHLIGHTS

- The mean length, width and weight of ovary were significantly higher in White Leghorn than Kadaknath hens.
- Magnum was the longest segment and vagina was the shortest segment of oviduct in both the breeds.

Keywords: Kadaknath, Morphometry, Ovary, Oviduct, White Leghorn

Avian reproductive system is a complex biological system that undergoes a series of hormonal, neural, biochemical and cellular changes during the formation of an egg. In almost all species of birds, only the left ovary and oviduct are functional. The right one typically regresses during development and is non-functional in the adult bird. The left ovary consists of a mass of yellowish, rounded objects called follicles, each containing an ovum or yolk. The avian oviduct is divided into 5 distinguishable regions namely infundibulum, magnum, isthmus, uterus and vagina (Mishra *et al.*, 2014). Infundibulum receives yolk from ovary, magnum helps in synthesis and secretion of albumen, isthmus forms fibrous membrane around egg white and secretes shell membrane, uterus forms egg shell and vagina connects uterus to cloaca. Therefore, the oviduct plays a pivotal role in the assembly of egg components after receiving ova from ovary.

The White Leghorn is a breed of chicken originating in Tuscany, in Central Italy. It is a light breed that matures early and starts laying at about 4 months of age. They are well suited for uninterrupted egg laying where as egg production of Kadaknath is less that ranges between 80 to 90 eggs per year with egg weight of 49 g. The clutch size of White Leghorn is more than Kadaknath. The flesh of Kadaknath has medicinal properties and it is high in iron, amino acids and low in cholesterol (184.74 mg/100 g) than White Leghorn (300 mg/100 g) (Saxena, 2019). Due to these characteristics, it is important to gain an

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insight into the reproductive tract of both the breeds. Also due to paucity of available literature on the mature female reproductive tract of Kadaknath and White Leghorn hens had prompted this research work.

MATERIALS AND METHODS

The study was conducted on 50 mature female birds comprising of 25 Kadaknath and 25 White Leghorn hens which were procured from Poultry Farm of College of Veterinary and Animal Science, Bikaner and were investigated in the Department of Veterinary Anatomy, College of Veterinary and Animal Science, Bikaner. After procurement of birds, their live weight (kg) was recorded and then birds were sacrificed by cervical fracture. Gross parameters of ovary (shape and colour, length, width, weight and average size of follicles) and oviduct (length, circumference and diameter of different segments of oviduct) were recorded. The length, width and size of follicles of ovary were measured by vernier calliper. The weight of ovary and oviduct was measured by weighing balance. Length and diameter of oviduct was also measured by vernier calliper. Circumference of each part of oviduct was measured by non-stretchable thread and then measured with the help of scale.

RESULTS AND DISCUSSION

The left ovary of Kadaknath and White Leghorn showed triangular base directed cranially and apex pointed caudally which was similar to findings reported by King (2012). The left ovary showed presence of large number of mature follicles giving the appearance of bunch of grapes (Fig. 1) as reported by Akinloye *et al.* (2014) in Japanese quail.

The left ovary of Kadaknath was attached to left kidney and that of White Leghorn was attached to both right and left kidney which was similar to findings of Deka *et al.* (2015) in Pati and Chara-Chemballi ducks and Burke (1977) in laying hens. The colour of ovary was dark grey in Kadaknath. However, in White Leghorn, it was pinkish to yellow due to accumulation of yolk showing the faster development of follicles in White Leghorn than Kadaknath. The present finding was supported by the reports of Pollock and Orosz (2002), that as per maturation, the follicles become pale yellow in colour due to accumulation of yolk.

The weight of ovary was significantly higher in White Leghorn (39.31 ± 1.55 gm) as compared to Kadaknath (21.47 ± 0.85 gm) (Table 1). These findings were in accordance with Rahman *et al.* (1999). On the contrary, Deka *et al.* (2015) reported that the weight of left ovary in Chara-Chemballi duck (88.22 ± 0.52 gm) was significantly higher than the Pati duck (13.90 ± 0.25 gm).



Fig. 1: Photograph of ovary (gross morphology) showing numerous follicles of different sizes in White Leghorn

The mean length and width of ovary was 5.739 ± 0.42 cm and 5.194 ± 0.29 cm in White Leghorn which was significantly higher than Kadaknath hens with an average of 4.176 ± 0.19 cm and 3.142 ± 0.17 cm (Table 1) where as in uttara fowl, the mean length and width of ovary was 3.17 ± 0.27 cm and 2.28 ± 0.08 cm respectively as reported by Khan *et al.* (2017). The diameter of ovarian follicle in White Leghorn was 15.181 ± 1.25 mm which was significantly more than Kadaknath hens (6.088 ± 0.65 mm) (Table 1). The present finding in White Leghorn was supported by the findings of Mirhish and Nsaif (2013) in adult turkey according to which the mature ovarian follicles ranged between 8-32 mm in diameter. However, in Kadaknath, ovarian diameter was less.

Percent ovarian weight to body weight was found as 2.763 ± 0.16 in White Leghorn and 1.592 ± 0.05 in Kadaknath hens (Table 1). The present observation was in

contradiction with the findings of Akinloye *et al.* (2014) in Japanese quail according to which the relative ovarian weight was 0.309% of the mean body weight.

Table 1: Gross morphometry of ovary of White Leghorn and Kadaknath hens

Sl. No.	Parameters	White Leghorn	Kadaknath
1	Body weight (kg)	1.444±0.05	1.349±0.03
2	Weight of ovary (gm)	39.31±1.55	21.47*±0.85
3	Length of ovary (cm)	5.739±0.42	4.176*±0.19
4	Width of ovary (cm)	5.194±0.29	3.142*±0.17
5	Diameter of follicle (mm)	15.181±1.25	6.088*±0.65
6	% Ovary weight to body weight	2.763±0.16	1.592*±0.05

Mean values with similar superscripts show significant difference ($P < 0.05$).

Oviduct

The left oviduct extended caudally from the left ovary to the urodeum of cloaca and occupied the largest part of abdominal cavity. This observation was in congruence with the observations of Hodges (1974) in fowl and Mishra *et al.* (2014) in Bangladeshi chicken. The coiling was seen along the whole length of left oviduct in both White Leghorn (Fig. 2) and Kadaknath hens (Fig. 3).

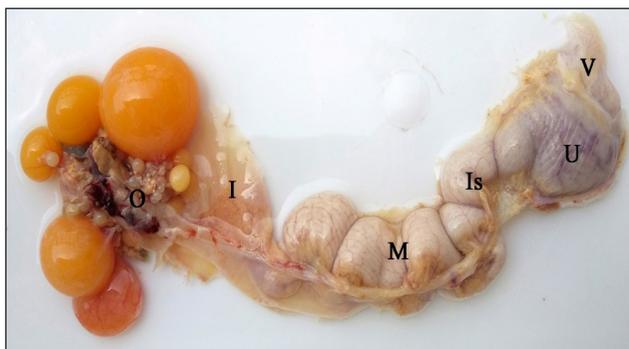


Fig. 2: Female reproductive tract of White Leghorn hen showing O-Ovary, I-Infundibulum, M-Magnum, Is-Isthmus, U-Uterus, V-Vagina

This observation was in consonance with the reports of Ingole (1985) in Narmada-XL (Dwarf) and Normal White Leghorn birds. The colour of left oviduct was whitish

in White Leghorn hens (Fig. 2) while it was greyish in Kadaknath hens (Fig. 3). This finding was in partial harmony with the findings of Ferdous *et al.* (2011) in ISA brown chicken whose colour was whitish at three weeks, greyish at twenty-three weeks and pale or yellowish at forty-six weeks of age.

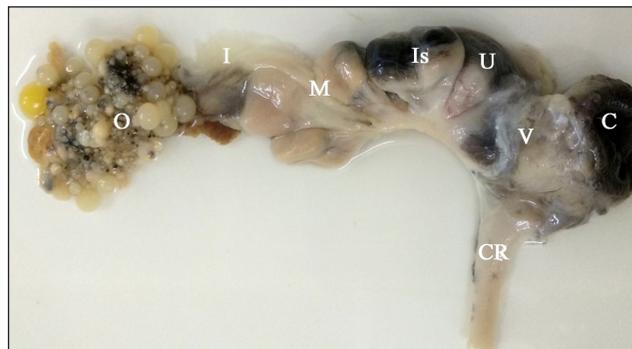


Fig. 3: Female reproductive tract of Kadaknath hen showing O-Ovary, I-Infundibulum, M-Magnum, Is-Isthmus, U-Uterus, V-Vagina, C-Cloaca, CR-Colorectum

The mean length and weight of left oviduct in Kadaknath was 21.95±1.2 cm and 14.69±1.5 gm which was significantly increased to 38.55±2.0 cm and 57.87±6.2 gm in White Leghorn hens (Table 2). The length of left oviduct in White Leghorn was closer to the findings of Alshammary *et al.* (2017) according to which the length of left oviduct in adult geese was 39-43 cm. The percent oviduct weight to body weight was 3.95±0.36 and 1.074±0.09 in White Leghorn and Kadaknath hens (Table 2) where as Akinloye *et al.* (2014) reported that the mean length of oviduct in Japanese quail was 13.00±1.383 cm with mean weight of 0.831±0.235 gm which was 0.674% of the mean body weight (123.33±4.94 gm).

Table 2: Gross morphometry of left oviduct of White Leghorn and Kadaknath hens

Sl. No.	Parameters	White Leghorn	Kadaknath
1	Weight of oviduct (gm)	57.87±6.2	14.69*±1.5
2	Length of oviduct (cm)	38.55±2.0	21.95*±1.2
3	% Oviduct weight to body weight	3.95±0.36	1.074*±0.09

Mean values with similar superscripts show significant difference ($P < 0.05$)

Infundibulum was located adjacent to the ovary, divided into two different portions-anterior funnel and posterior neck region. This was in conformity with the findings of Naragude *et al.* (1999a) in avian species and Alshammary *et al.* (2017) in geese. The mean length of infundibulum was 8.117±0.15 cm in White Leghorn and 7.011±0.16 cm in Kadaknath (Table 3) which was in close agreement with Naragude *et al.* (1999b) according to which the average length of infundibulum in Rhode Island Red birds was 7.37±0.08 cm. The average circumference and diameter of infundibulum was 6.18±0.16 cm and 4.595±0.33 cm in White Leghorn hens and 4.6±0.12 cm and 2.055±0.22 cm in Kadaknath (Table 3). However, Sturkie (1976) reported the diameter of funnel end of infundibulum was 8.00 to 9.00 cm. Patil (2012) also reported the circumference and diameter of infundibulum was 12.13±0.41 cm and 0.49±0.02 cm in young hens and 24.18±0.80 and 0.57±0.03 in spent hens which was in disagreement with the present findings.

Magnum was the longest and most coiled part of oviduct. This observation was in accordance with Mahmud *et al.* (2017). The average length of magnum was 19.216±1.44 cm in White Leghorn and 9.145±0.63 cm in Kadaknath hens (Table 3). Mishra *et al.* (2014) found that the average length of magnum was 18.40±6.75 cm in native chicken of Bangladesh which was in close proximity to that of White Leghorn. However, Shyam (2012) stated that the average length of magnum was 30.80 cm in Aseel and 32.64 in Rhode Island Red birds which were higher than the length of magnum in White Leghorn and Kadaknath hens. The average circumference and diameter of magnum was 4.370±0.36 cm and 2.082±1.7 cm in White Leghorn and 2.950±0.12 cm and 1.24±0.08 cm in Kadaknath hens (Table 3) which simulated to the findings of Patil (2012).

He reported that the range of circumference and diameter of magnum was between 3.80-4.40 cm and 1.07-1.61 cm in young hens and 4.50-5.70 cm and 1.43-2.01 cm in spent hens.

Isthmus was shorter and less in diameter than magnum. It was separated from magnum by narrow translucent zone which was in agreement with that of Khan *et al.* (2017) in uttara fowl. The average length of isthmus was 7.189±0.39 cm in White Leghorn and 4.588±0.24 cm in Kadaknath (Table 3). Similar finding was reported by Sturkie (1976) in laying hen. He found that the mean length of isthmus ranged from 3.00 to 12.00 cm. Sarma and Sarma (2001) noticed the length of isthmus was 7.68±0.03 cm in non-descript chicken. Khan *et al.* (2017) mentioned that the length of isthmus was 7.70±0.15 cm in uttara fowl. The average circumference and diameter were 2.64±0.18 cm and 1.117±0.04 cm in White Leghorn and that in Kadaknath was 2.090±0.04 cm and 0.774±0.06 cm (Table 3). These findings were in agreement with that of Sturkie (1976) and Patil (2012). Sturkie (1976) reported that the diameter of isthmus in laying hen ranged from 0.90-1.00 cm and 0.40 cm in inactive stage. Patil (2012) evaluated that the average circumference and diameter of isthmus was 2.50±0.06 cm and 0.60±0.01 cm in young hens and 2.69±0.08 cm and 0.58±0.02 cm in spent hens.

Uterus or shell gland was the widest portion of oviduct with short anterior tubular part and pouch like posterior part, located between isthmus cranially and vagina caudally. This finding resembled with the reports of Johnston *et al.* (1963), Solomon (1975) and Gilbert (1979). The average length of uterus was 5.597±0.12 cm in White Leghorn and 4.293±0.16 cm in Kadaknath (Table 3). Shyam (2012) reported that the average length of uterus ranged

Table 3: Statistical analysis of morphometrical observations of various parameters of left oviduct of White Leghorn and Kadaknath hens

Parameters	Length (cm)		Circumference (cm)		Diameter (cm)	
	White Leghorn	Kadaknath	White Leghorn	Kadaknath	White Leghorn	Kadaknath
Infundibulum	8.117±0.15	7.011*±0.16	6.18±0.16	4.6*±0.12	4.595±0.33	2.055*±0.22
Magnum	19.21±1.44	9.145*±0.63	4.370±0.36	2.950*±0.12	2.082±1.7	1.24*±0.08
Isthmus	7.189±0.39	4.588*±0.24	2.64±0.18	2.09*±0.13	1.117±0.04	0.774*±0.06
Uterus	5.597±0.12	4.293*±0.16	8.19±0.28	4.94*±0.31	3.61±0.16	2.07*±0.11
Vagina	3.233±0.24	1.352*±0.09	3.24±0.32	3.03±0.36	1.307±0.09	0.917*±0.02

Mean values with similar superscripts show significant difference (P< 0.05).

from 4.50 to 8.50 cm in Aseel similar to the findings of White Leghorn. The mean circumference and diameter was 8.19 ± 0.28 cm and 3.61 ± 0.16 cm in White Leghorn and 4.94 ± 0.31 cm and 2.07 ± 0.11 cm in Kadaknath (Table 3). This finding was in partial harmony with the reports of Patil (2012) who mentioned that the circumference of uterus ranged between 6.30-8.30 cm in young hens and 8.20-10.50 cm in spent hens and diameter of uterus ranged between 2.34-2.77 cm in young hens and 3.16-4.20 cm in spent hens.

Vagina was the shortest part of oviduct with a narrow S-shaped muscular tube opened into the cloaca which was in consonance with the reports of King and Mc Lelland (1975), Ferdous *et al.* (2011) and Alshammary *et al.* (2017). The average length of vagina in White Leghorn was 3.233 ± 0.24 cm and in Kadaknath was 1.352 ± 0.09 cm (Table 3). The present finding was in accordance with the finding of Alshammary *et al.* (2017) who reported the length of vagina as 2.9 ± 1.1 cm. However, contrary to this, Shyam (2012) reported that the average length of vagina in Aseel was 6.35 cm and in Rhode Island Red was 7.41 cm. The average circumference and diameter of vagina was 3.24 ± 0.32 cm and 1.307 ± 0.09 cm in White Leghorn and 3.03 ± 0.36 cm and 0.917 ± 0.02 cm in Kadaknath (Table 3). This finding resembled with the reports of Patil (2012) according to which circumference and diameter of vagina was 3.11 ± 0.16 cm and 0.75 ± 0.75 cm in young hens and 3.56 ± 0.15 cm and 0.94 ± 0.07 cm in spent hens.

CONCLUSION

Gross observations revealed that only the left ovary and oviduct was found functional in adult birds. The left ovary consists of numerous follicles of different sizes. The biometric data obtained from this study provides a baseline data for the female reproductive tract of adult White Leghorn and Kadaknath hens. Though slight variations with the values of morphometric data were observed, this study provides a baseline data for subsequent studies and comparative analysis with other avian species also.

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