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Comparative morphological studies on the skin of broiler and Kuttanad ducks

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Abstract
The present study was undertaken to compare the morphology of the skin of broiler and Kuttanad ducks. Skin samples were collected from a total of 24 birds comprising six males and females, respectively in each group. All the birds under study showed quite similar structural characteristics of thin skin. Among broiler and Kuttanad ducks, mean body weight and gross mean weight of the skin showed no significant difference. The thickness varied considerably in different regions of the body. Maximum thickness was noticed in ventral abdominal region and minimum at the ventral wing region in both groups. Number of feather follicles per square centimetre area was less in regions with large feathers and more in regions with small feathers. Since ducks are semi-aquatic birds, a greater thickness of the skin in the ventral regions of the body is considered as an adaptation to resist heat dissipation.

Keywords: Skin, broiler duck, Kuttanad duck, morphology, follicles

Introduction
Duck rearing is an emerging agricultural sector that occupies a key position next to poultry in India. Livestock census, 2012 reveals that the duck population in India is 23.53 million, which is about 10 per cent of the total poultry population. Avian species possess a thin and delicate skin in contrast to other vertebrates (Nickel *et al*., 1977) [1]. Avian integument is characterized by the presence of feathers and its ability to generate huge amounts of keratin (Stettenheim, 2000) [2]. Structure of skin shows extreme variations among species. Examination of the integument is generally considered as a basic key to rule out disease conditions associated with skin. Birds with less body weight have more feathers per unit of body weight which implies that, for maintaining the same body temperature, smaller birds require more insulation than bigger birds (Hutt and Ball, 1938) [3]. Literature pertaining to the characteristics of skin in broiler and layer ducks is scanty. Since the duck industry generates huge volume of skin and feathers as bio-waste every day, contributing to environmental pollution, the present study will pave way for its proper utilization and future research.

Materials and Methods
The study was conducted on the skin of broiler Vigova Super-M ducks of six to eight weeks of age and spent Kuttanad ducks above 40 weeks of age. Skin samples were collected from a total of 24 birds from the Meat Technology unit, College of Veterinary and Animal Sciences, Mannuthy. Samples were collected from eight representative areas of the body *viz*., dorsal neck, alar, dorsal abdomen, ventral abdomen, pelvic, dorsal wing, ventral wing and lateral thigh regions. The following morphometric parameters like body weight, weight of skin, number of feather follicles per square centimetre area and thickness of fresh skin were measured from eight representative areas of the body of both males and females of broiler and Kuttanad ducks. One way ANOVA was performed to test the difference between the parameters among four groups and independent t test was performed to test the difference between broiler and Kuttanad ducks (Snedecor and Cochran, 1989) [4].

Results and Discussion
All the birds under study showed similar structural characteristics of thin skin (Nickel *et al*., 1977) [1]. In both broiler and Kuttanad ducks, the skin was white to pinkish (Fig. 1) and was covered by white feathers in broiler ducks and grey to white feathers in Kuttanad ducks (Stettenheim, 2000) [2]. Among broiler and Kuttanad ducks, mean body weight showed no significant difference (Tab. 1). Similarly, gross mean weight of the skin showed no significant difference between the two groups (Tab. 1).

Percentage contribution of skin to the total body weight differed significantly between four groups and it was maximum for Kuttanad duck male followed by broiler duck male and minimum for Kuttanad duck female (Tab. 2). Percentage contribution of skin to the total body weight in ducks ranged from 12.01±0.79 to 21.00±1.21 per cent. There was a significant positive correlation between the body weight and weight of the skin (r=0.413*) at 5 per cent level. Skin of greater rhea showed increase in thickness of both the epidermis and dermis over age (Picasso *et al.*, 2016) [5].

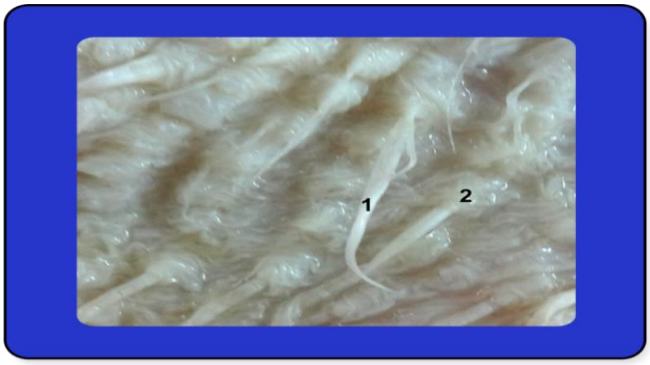

Fig 1: Gross skin of broiler duck. 1. Ensheathed feather, 2. Neck of the follicle, Filoplume (arrow)

The thickness varied considerably in different regions of the body in all the groups (Tab. 3). Maximum thickness was noticed in the ventral abdominal region in all the groups except in the female broiler duck where the skin of lateral thigh region showed maximum thickness. In general, skin was thicker on the ventral surface of the body compared to that of the dorsal surface (Ahmed *et al*., 1968) [6]. The integument at the sternal, abdominal and web regions of the duck was relatively denser than other regions of the body (Ahmed *et al.*, 1968) [6]. Minimum thickness was noticed at the ventral wing region in all the four groups where only few number of feathers are present. Lucas and Stettenheim (1972) [7] noted that the skin of chicken was thinner in the less feathered areas than in adjacent feathered areas. There was significant difference in the skin thickness of the broiler and Kuttanad ducks in the dorsal neck and ventral wing regions (Tab. 4).
Subcutis of the duck skin contained fat deposits that provided hydrostatic cushions over which the feathers moved as levers (Homberger and de Silva, 2000) [8].

Table 1: Comparison of body weight and weight of skin in broiler and Kuttanad ducks

Parameters	Broiler duck	Kuttanad duck	t-value
Body Weight (kg)	1.96±0.07	1.78±0.09	1.57^{ns}
Weight of skin (g)	382.50±18.05	326.67±43.94	1.18^{ns}
% weight of skin	19.58±0.76	17.94±2.17	0.72^{ns}

Table 2: Body weight and weight of the skin in broiler and Kuttanad ducks

Parameters	Broiler duck male	Broiler duck female	Kuttanad duck male	Kuttanad duck female	F-value
Body weight (kg)	2.05±0.12	1.87±0.06	1.87±0.15	1.69±0.11	1.69^{ns}
Weight of skin (g)	426.67±23.62^{a}	338.33±09.80^{b}	453.33±44.62^{a}	200.00±09.31^{c}	19.09**
% weight of skin	21.00±01.21^{ab}	18.17±00.53^{b}	23.86±02.45^{a}	12.01±00.79^{c}	12.23**

(Means bearing different letters as superscripts differs significantly within a row)
(** significant at 1% level, ns - non-significant)

Table 3: Thickness of skin (mm) in different body regions in broiler and Kuttanad ducks

Body regions	Broiler duck male	Broiler duck female	Kuttanad duck male	Kuttanad duck female	F-value
Dorsal Neck	1.00±0.00^{c}	1.00±0.00^{c}	1.24±0.11^{b}	1.58±0.08^{a}	16.91**
Alar	1.50±0.26	1.17±0.17	1.33±0.11	1.25±0.11	0.69^{ns}
Dorsal abdomen	1.36±0.06	1.34±0.12	1.28±0.01	1.08±0.14	1.46^{ns}
Ventral abdomen	2.00±0.00^{a}	1.50±0.18^{b}	1.50±0.22^{a}	2.00±0.00^{a}	4.00*
Pelvic	1.42±0.19	1.58±0.19	1.25±0.11	1.58±0.08	1.14^{ns}
Dorsal wing	1.23±0.06^{a}	1.08±0.03^{ab}	1.00±0.00^{b}	1.25±0.11^{a}	3.51*
Ventral wing	0.80±0.05^{b}	1.00±0.00^{a}	1.00±0.00^{a}	1.17±0.11^{a}	6.53**
Lateral thigh	1.61±0.06	1.59±0.11	1.37±0.14	1.67±0.17	1.12^{ns}

(Means bearing different letters as superscripts differs significantly within a row)
(* significant at 5% level, ** significant at 1% level, ns - non-significant)

The number as well as type of feathers varied from region to region (Lucas and Stettenheim, 1972) [7]. The whole body was covered by small contour feathers and downs. The number of follicles showed slight variation in different regions of the body in all the groups (Tab. 5). Number of follicles per square centimeter area was less in regions with large feathers and more in regions with small feathers. There was significant difference in the number of follicles between broiler and Kuttanad ducks in all the regions except in pelvic and ventral wing regions (Tab. 4).

Table 4: Comparison of skin thickness and number of feather follicles in broiler and Kuttanad ducks

Parameters	Thickness of skin			No of follicles per cm^2		
	Broiler duck	Kuttanad duck	t-value	Broiler duck	Kuttanad duck	t-value
Dorsal Neck	1.00±0.00	1.41±0.08	5.02**	12.00±0.00	10.83±0.30	3.92**
Alar	1.33±0.16	1.29±0.07	0.24^{ns}	7.83±0.11	12.5±0.15	24.82**
Dorsal abdomen	1.35±0.06	1.18±0.08	1.60^{ns}	6.00±0.00	5.00±0.00	-
Ventral abdomen	1.75±0.115	1.75±0.131	0.00^{ns}	5.42±0.15	5.42±0.23	7.00**
Pelvic	1.50±0.129	1.42±0.083	0.54^{ns}	4.33±0.22	5.33±0.28	0.00^{ns}
Dorsal wing	1.16±0.038	1.13±0.065	0.44^{ns}	10.5±0.26	6.75±0.13	12.85**
Ventral wing	0.90±0.039	1.08±0.056	2.68*	8.50±0.15	8.42±0.15	0.39^{ns}
Lateral thigh	1.60±0.06	1.52±0.112	0.66^{ns}	4.00±0.00	5.75±0.25	2.76*

Table 5: Feather distribution per cm^2 area of different body regions in broiler and Kuttanad ducks

Body regions	Broiler duck male	Broiler duck female	Kuttanad duck male	Kuttanad duck female	F-value
Dorsal Neck	12.00±0.00[a]	12.00±0.00[a]	10.67±0.42[c]	11.00±0.45[b]	5.00*
Alar	8.00±0.00[b]	7.67±0.21[b]	12.33±0.21[a]	12.67±0.21[a]	218.89**
Dorsal abdomen	6.00±0.00[a]	5.33±0.21[b]	4.17±0.31[c]	5.00±0.00[b]	16.73**
Ventral abdomen	4.00±0.00[c]	4.00±0.00[c]	5.33±0.42[b]	6.17±0.17[a]	22.12**
Pelvic	5.50±0.22	5.33±0.21	5.33±0.33	5.50±0.34	0.11[ns]
Dorsal wing	10.00±0.00[b]	11.00±0.45[a]	6.67±0.21[c]	6.83±0.17[c]	71.39**
Ventral wing	8.330.21	8.67±0.21	8.50±0.22	8.33±0.21	0.56 [ns]
Lateral thigh	4.33±0.33	4.33±0.33	5.00±0.45	5.67±0.33	3.06[ns]

(Means bearing different letters as superscripts differs significantly within a row)
(* significant at 5% level, ** significant at 1% level, ns - non-significant)

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