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MORPHOMETRICAL PARAMETERS OF HIPPOCAMPUS IN BROILER AND LAYER BIRDS

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Abstract: The brain samples for recording the macromorphological and morphometrical parameters were collected from the broiler and layer birds at different age intervals. Morphometrical studies were made in proportion to the weight of the cerebral hemisphere. the variation in the mean hippocampal weight was also calculated and analyzed statistically for significant variation. The mean weight of the hippocampus was the highest in the 8 weeks old group and the lowest in 2 weeks old group in both sexes of broiler birds. The mean weight of the hippocampus in male birds was more than the female from 3 weeks of age to 15 weeks of age whereas from 18 weeks to 72 weeks of age the same was more in females than the male layer birds. The morphometrical results were adduced to possible suppositions with the help of available literature. It is strongly assumed that eggers, which takes more feed than the males is bound to have more mean hippocampal weight than the male birds, as observed in the present study.
Keywords: Morphometry, Hippocampus, Chicken, Layer, Broiler.

Introduction

Brain is the most amazing and most mysterious creation in the universe and even the super computer badly fades out in front of the brain. There is wide variation in brain morphology among different birds. The brain was hour-glass shape and large in the white crested polish chicken and cerebellum, hippocampus, septum, and olfactory bulb were well developed (Frahm and Rehkamper, 1998). The brain volume and brain weight is considered as important parameter for measuring the degree of brain development, cognitive behavior and intellectual capacity (Kawabe *et al*., 2009; Peng *et al*., 2010). Both anatomical and physiological observation recorded proves that the hippocampus is organized in a lamellar fashion and the orientation of the lamella differs among species (Warwick and Willams, 1989). Hippocampus is better developed in birds living water and on the ground though small in some birds such as Parakeet and Sparrow (Sherry and Vaccarino, 1989). Among the birds, a mammoth industry running into crores has been woven around the ‘web’ of chicken.

The literatures on brain research in avian species is restricted only to the cerebral cortex, cerebellum and spinal cord only. Research in hippocampus of birds reared in Indian climate

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has been spasmodic. Prompted by this, a research study was under taken to explore the morphological and morphometrical parameters on the hippocampus of chicken reared in our state in various age groups of broiler and layer birds. This work will help to find more information on hippocampus in both broiler and layer chicken.

Materials and Methods

For the present study, the brain samples of the broiler and layer birds were collected from the commercial broiler and layer farms in and around the Veterinary College and Research Institute, Namakkal and Poultry Research Station, Chennai. The brain samples obtained were from broiler birds (2 weeks to 8 weeks at an interval of 2 weeks) and layer birds (3 – 24 weeks at 3 weeks interval, 24 – 72 weeks at 4 weeks interval). In broiler and layers, samples were collected from both sexes at the rate of 6 samples per sex for every age group).

The heads of birds were separated at the level of 2^{nd} cervical vertebrae and the cranial cavity was cut open carefully. The meninges of the brain were dissected out from the bones of attachment. The olfactory lobes and optic nerves at the level of optic chiasma on the ventral surface of the brain were carefully dissected out to remove the whole brain from the cranial cavity. The cerebellum was removed and the cerebral hemispheres were located by dissection and the morphology was studied. The hippocampus was collected and weighted and the tabulated data was analyzed statistically (Snedecor and Cochran, 1967).

Results and Discussion

The hippocampus in the chicken was located in the most dorsal and medial portion of the cerebral hemisphere, similar to the findings of Schober (1964) in the hippocampus of Cyclostomes, excepting the absence of structures like lobules subhippocampus of Cyclostomes, excepting the absence of structures like lobules subhippocampi and saccus dorsalis in the hippocampus of chicken. The hippocampus of the chicken, a non food storer, was smaller than the hippocampus of the Homsing Pigeons, Owl and European Magpie and these are food storers. In these birds, the hippocampus was said to occupy the entire dorsomedial wall of the cerebral hemisphere (Rehkamper et al., 1988).

1. Morphometry - Broilers

The mean weight of the hippocampus was the highest in the 8 weeks old group and the lowest in 2 weeks old group in both sexes. The mean weight increased with increase in age and the male birds had more mean weight of the hippocampus than the female birds (Table 1). The proportion percentage of the mean weight of the hippocampus to the weight of the brain differed significantly between the sexes in all the age groups and the male birds had higher proportion percentage. This was in consonant with the observation that in broilers, male attains faster growth rate than the female birds (North, 1985).

The difference in the percentage proportion was maximum in the 2 weeks old group (0.0003 %) and it was minimum in 4 weeks old group (0.001 %) between male and female birds. The enzyme Aromatase, which converts testosterone into estrogen is less in male and consequent less conversion of testosterone into estrogen, enable the male bird to attain more weight generally (Vockel et al., 1990). The present study was in conformation with the above finding with respect to more mean weight of the hippocampus in male birds than females.

2. Morphometry - Layers

The mean weight of the hippocampus in male birds was more than the female from 3 weeks of age to 15 weeks of age whereas from 18 weeks to 72 weeks of age the same was more in female birds than the male birds. This was in conformation with the finding of Sherry et al. (1992) that the female cowbird has larger hippocampus than the male. the mean weight of the hippocampus of the male in 3 weeks old birds did not differ significantly from that of the female birds, but difference was significant in 6 weeks old birds with more mean weight in the male birds and the trend continued upto 15 weeks of age.

The difference in the mean weight of the hippocampus from 24 to 72 weeks did differ significantly between male and female birds. This trend might be strongly adduced to the egg laying stress starting around 21 weeks of age in female birds. This hypothesis derives support from the observation made by Sherry et al. (1992) and Swenson and Reece (1996) that the avian hippocampus is involved in the release of stress steroids and it has an important role in spatial learning and memory as these functions are performed better by eggers.

The maximum difference in the mean weight of the hippocampus between sexes was at 56 weeks of age and the female birds had more weight (Table 1). The highest mean weight of the hippocampus was 25.35 mg attained at an earlier age by 60 weeks old birds in female. The lowest mean weight was recorded in 3 weeks old birds (18.15 mg in male and 17.95 mg in female) in both sexes.

The proportion percentage of the mean weight of the hippocampus to the weight of the brain was more in the male than in the female from 3 weeks old birds to 15 weeks old birds. But the trend reversed in the ensuing groups as the proportion percentage was more in the female from 18 weeks old birds to 72 weeks old birds. The highest proportion percentage was shown by 3 weeks old birds in both sexes (1.833 % in male and 1.824 % in female) and the lowest was in the 24 week old birds (1.291 % in male and 1.310 % in female).

The maximum difference in the proportion percentage of the weight of the hippocampus to the weight of the brain between the sexes was also at 56 weeks of age (Table.1). This age group falls within the average peak production period which is between 40-60 weeks and the egg production percentage slowly reduces after that (North, 1985). This suggests that the higher proportion percentage of the mean weight of the hippocampus to the brain weight had a positive correlation with higher egg production.

This fact leads to a supposition that the hippocampus has a role to play in feeding and egg laying indirectly. This is supported by Remus and Fireman (1991), Healy and Krebs (1996) and Swenson and Reece (1996) who have observed that hippocampus has an indirect role in feeding and feed conversion, as the hippocampus shares many pathway connections with septum, hypothalamus and telencephalic processing areas (Good, 1987). Besides, hippocampus mediates those movements, which are part of patterns in location of feed and feeding (Healy and Krebs, 1996). Hence, it is strongly assumed that eggers, which takes more feed than the males is bound to have more mean hippocampal weight than the male birds, as observed in the present study.

Table 1: Mean hippocampal weight and its proportion percentage to the brain weight between sexes in broilers and layers (No. of animals used in each group = 6)

BROILERS								
Age in Weeks	**Brain Weight (gm)**		**Mean Hippocampal Weight (M.H.W) (Mg)**		**Significant variation in M.H.W. between sexes**		**% of mean Hippocampal Weight to Brain Weight**	
	Male	**Female**	**Male**	**Female**	**0.05 level**	**0.01 level**	**Male**	**Female**
02	1.22	1.103	15.25	14.85	Yes	Nil	1.248	1.346
04	1.219	1.198	17.45	17.15	Yes	Nil	1.432	1.431
06	1.345	1.323	19.15	19.0	Yes	Nil	1.423	1.436
08	1.451	1.432	20.55	20.25	Yes	Nil	1.416	1.414
LAYERS								
03	0.990	0.984	18.15	17.95	Nil	Nil	1.833	1.824
06	1.079	1.077	18.65	18.35	Yes	Nil	1.728	1.703
09	1.191	1.181	19.05	18.75	Yes	Nil	1.600	1.587
12	1.273	1.272	19.55	19.35	Yes	Nil	1.535	1.521
15	1.380	1.374	20.05	19.85	Yes	Nil	1.452	1.444
18	1.463	1.469	20.45	20.55	Nil	Nil	1.397	1.398

21	1.558	1.559	20.75	20.85	Nil	Nil	1.331	1.337
24	1.642	1.640	21.2	21.5	Yes	Yes	1.291	1.310
28	1.649	1.651	21.55	22.15	Yes	Yes	1.306	1.341
32	1.650	1.660	21.95	22.85	Yes	Yes	1.330	1.376
36	1.655	1.668	22.35	23.45	Yes	Yes	1.350	1.405
40	1.667	1.679	22.55	23.55	Yes	Yes	1.352	1.402
44	1.672	1.686	23.05	24.35	Yes	Yes	1.378	1.444
48	1.678	1.697	23.25	24.75	Yes	Yes	1.385	1.458
52	1.677	1.696	23.45	25.15	Yes	Yes	1.398	1.482
56	1.676	1.687	23.85	25.35	Yes	Yes	1.423	1.502
60	1.675	1.683	23.95	25.35	Yes	Yes	1.429	1.506
64	1.674	1.676	24.05	25.25	Yes	Yes	1.436	1.506
68	1.673	1.673	24.05	25.0	Yes	Yes	1.437	1.494
72	1.672	1.672	23.85	25.0	Yes	Yes	1.426	1.495

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