www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2023; 12(3): 641-643

www.thepharmajournal.com
Received: 01-12-2022
Accepted: 05-01-2023

Suganya G
Associate Professor and Head, Department of Veterinary Physiology and Biochemistry, Veterinary College and Research Institute, Tamil Nadu Veterinary and Animal Sciences University, Chennai, Tamil Nadu, India

Leela V
Professor and Head, Department of Veterinary Physiology, Madras Veterinary College, Tamil Nadu Veterinary and Animal Sciences University, Chennai, Tamil Nadu, India

Corresponding Author:
Suganya G
Associate Professor and Head, Department of Veterinary Physiology and Biochemistry, Veterinary College and Research Institute, Tamil Nadu Veterinary and Animal Sciences University, Chennai, Tamil Nadu, India

Concentrations of thyroid hormone and prolactin during breeding season in emus

Suganya G and Leela V

Abstract
Emus (*Dromaius novaehollandiae*) are the second largest bird in the world after the ostrich. They are monogamous and seasonal breeders. They are bred for their meat, leather and oil. Its reproductive cycle and the endocrine physiology that regulates its reproductive pattern are necessary for understanding and controlling the breeding activity of the domesticated emus. There are no known literatures that have reported the hormonal pattern of the emus during the breeding season. Hence, an attempt was made to study the concentrations of thyroid hormone and prolactin of the emus during the pre-breeding, breeding and post breeding seasons. Blood samples were collected from thirty apparently healthy emus (15 male and 15 female) of 5 to 6 years of age during the pre-breeding, breeding and post breeding seasons. Plasma was separated by centrifugation and stored in aliquots at - 20 °C till further analysis. Hormones such as tri-iodothyronine and prolactin were analysed using the commercially available kits. The data was subjected to statistical analysis by one way Anova. The results indicated a significantly higher ($P < 0.01$) tri-iodothyronine and prolactin levels during the post-breeding season. This study will be useful in understanding the physiology of reproductive functions in the emus.

Keywords: Emu, hormones, tri-iodothyronine, prolactin, breeding seasons

1. Introduction

Emu (*Dromaius novaehollandiae*) is a flightless, exotic bird belonging to the order ratite and is the second largest bird. Emus are reared for their meat, leather and oil which are reported to have high economic value. The anatomical and physiological features of emu birds are suitable for rearing under temperate and tropical climatic conditions. It is a prolific breeder and has an annual reproductive cycle. Sperm production and laying of eggs starts in the autumn and last till spring (Malecki *et al.*, 1998) [8]. The breeding season of emus varies with latitude and is consistent with photoperiodism (Blache *et al.*, 2001a) [2] as disappearance of sexual behaviour coincides with photo refractoriness. Emus exhibit a peculiar reproductive cycle that the male incubates the egg and also influence the hatchability. Emus are primarily monogamous and seasonal breeders. They are short day breeders and the annual reproductive cycle and the study of endocrinology behind their reproductive patterns is essential for understanding and controlling the breeding activity of the domesticated emus. As hormones are known to influence production and reproduction in emus, a pioneer study was conducted to evaluate the hormones such as tri-iodothyronine and prolactin, during the pre-breeding, breeding and post-breeding seasons. The breeding season in the emus is between October to March in India.

2. Materials and Methods

The study was conducted in emu birds maintained at a commercial farm in Tamil Nadu, India. The birds were reared under intensive system with standard management practices. Blood samples were collected from apparently healthy thirty emu birds (15 male and 15 female) of 5 to 6 years of age in heparinised vacutainers during pre-breeding (one month prior to breeding season), breeding and post-breeding seasons (one month post breeding season). About 1 ml of blood was collected from right jugular vein in heparinised vacutainers and plasma was separated by centrifugation and stored in aliquots at - 20 °C till further analysis. The concentrations of tri-iodothyronine and prolactin were analyzed using the ELISA kit obtained from Agappe Diagnostics Limited.

2.1 Statistical analysis

The data were statistically analyzed by one - way analysis of variance (ANOVA) and post hoc analysis were carried out using Duncan’s test for multiple comparisons using SPSS software version 20 for windows.

3. Results and Discussion

The concentrations of Tri iodothyronine and Prolactin during breeding season in Emus are presented in Table 1.

The overall mean T_3 and prolactin concentration observed in the emu birds during different seasons were 42.69±1.70 ng/dl and 62.99±2.89 ng/ml, respectively. Both T_3 (57.64±3.07 ng/dl) and prolactin (97.59±2.33 ng/ml) concentration were significantly higher ($P < 0.01$) during the post-breeding season than during the pre-breeding and breeding seasons.

3.1 Thyroid hormone concentration

The plasma T_3 concentration in the present study was found to be decreased during the pre-breeding and breeding seasons and increased at the termination of the breeding season. Emus are seasonal breeders and the annual breeding cycle is inversely related to an annual cycle of changes in fat deposition and appetite (Williams *et al*., 1998) [17]. Increased sexual behaviours are noticed during the beginning of breeding season are associated with the progressive development of seasonal anorexia with lowest food intake when the birds are laying or incubating (O'Malley, 1996) [11]. These changes that occur during the breeding season are correlated with 20 – 30 per cent changes in the live weight, characterized by changes in deposition and utilization of fat (Mincham *et al*., 1998) [9]. These changes are primarily regulated by the hormones that control metabolism especially thyroid hormones and gonadal steroids (Stevens, 1996) [16]. Thyroid hormones, particularly T_3, is derived from its precursor thyroxine plays a key role in maintaining the metabolic rate (Klandorf *et al*., 1981) [7]. Thyroid hormones mediate the interaction between the seasonal cycles of breeding and metabolism (Sharp *et al.,* 2005) [15]. The concentration of plasma thyroid hormones decreases in the presence of active gonads and this may be as a result of a depressed effect of gonadal steroids on circulating thyroid hormone binding proteins (Sharp and Klandorf, 1981) [12].

The increase in the T_3 during post breeding season may be attributed to the fact that the thyroid hormones induce molt and cessation of egg laying in birds. Thyroid hormone concentrations increase during the period when there is a decline in egg laying and play a permissive role in the development of photo refractoriness denoting the lack of gonadal responsiveness to long days (Anne McNabb, 2005) [1]. Thyroid hormones reduce the gonadal hormones by decreasing the hypothalamic gonadotropin releasing hormones in the breeding emus, indicating that thyroid hormones mimic the effects of long day length. In seasonally breeding birds that molt naturally, cessation of reproductive activity and molt occur concurrently with increase in thyroid hormone (Goldsmith and Nicholls 1984a,b) [5, 6]. During molt demand for energy is very high both for new feather production and to balance the additional heat loss with poor insulation during the molt. Therefore, increase in the thyroid hormone concentration at this time are partially involved with the level of energy demand and thermogenesis.

3.2 Prolactin concentration

In the present study, there was a two fold increase in the prolactin concentration during the post-breeding season when compared to the breeding season. The results were in accordance with that of Malecki *et al.* (1997) [8] in the male emu birds and reported that the increased concentrations of plasma prolactin are associated with increasing day length and the termination of seasonal breeding. Increased plasma prolactin concentration leads to suppression of reproductive functions in the incubating emus and terminate their breeding season. In many birds, breeding behaviour has an effect on prolactin which is superimposed on the seasonal cycle (Sharp *et al*., 1997) [14]. The presence of nests and eggs further stimulates prolactin secretion, possibly as a direct tactile response. In breeding male emus, as male emus incubate the eggs, prolactin levels were higher than in non-incubating birds at the same time. Prolactin induces gonadal regression by suppressing luteinizing hormone (LH) secretion from the pituitary and antagonizes the steroidogenic action of LH in the gonads (Camper and Burke, 1977) [3].

The late seasonal peak in prolactin is not necessarily associated with the expression of incubation or parenting behaviour but always coincides with the development of reproductive refractoriness (Sharp *et al*., 1986; Wingfield and Farner, 1993; Dawson and Sharp, 1998; Malecki *et al*., 1998 and Nicholls *et al*., 1998) [13, 18, 4, 8, 10]. In the emu, each breeding cycle starts in autumn with the dissipation of photo refractoriness, first stimulates the central mechanisms that control luteinizing hormone secretion and then stimulates those that regulate prolactin secretion (Blache *et al*., 2001a) [2]. The increase in prolactin is associated with depressed levels of plasma testosterone, affecting spermatogenesis leading to precocious termination of fertility. Photoperiodic control of prolactin secretion is similar to that in mammals in that its secretion is stimulated by long photoperiods and inhibited by short photoperiods (Dawson *et al*., 2001) [4]. Malecki *et al*. (1997) [8] observed that the prolactin secretion increased over winter, peaked after the breeding season and then decreased to base-line values in spring which is typical of birds that terminate breeding by the development of photo refractoriness. Malecki *et al*. (1998) [8] reported that the plasma prolactin concentrations increased near the winter solstice well after breeding season began and there is a direct response to photo stimulation. Therefore, reproduction in emu is controlled in such a way that the reproductive system is 'switched on' following the summer solstice, which provides essential information indicating the arrival of suitable breeding conditions (Wingfield *et al*., 1992) [19]. Conversely, the reproductive system appears to be 'switched off' to prevent emus from breeding in spring as the birds have a long incubation period and need to raise their chicks before food resources become limited with the onset of dry season.

Table 1: Concentrations of Tri iodothyronine and Prolactin during breeding season in Emu

Seasons	Tri iodothyronine (ng/dl)	Prolactin (ng/ml)
Pre-breeding (n = 30)	32.51±1.60 [a]	48.26±2.49 [a]
Breeding (n = 30)	37.93±1.62 [a]	43.13±1.72 [a]
Post-breeding (n = 30)	57.64±3.07 [b**]	97.59±2.33 [b**]
Pooled Mean±SE (n = 90)	42.69±1.70	62.99±2.89

**- Highly significant (p<0.01)

Mean values having same superscript within a column do not differ significantly

4. Conclusion

The present study revealed that the thyroid hormone and prolactin are inversely related to breeding season and T_3 is also is associated with the metabolic changes that occur during the breeding season in emus. Thyroid hormones and prolactin influence the seasonal breeders and play a major role in the photo refractoriness of seasonally breeding birds.

5. References

1. Anne McNabb FM. The HPT axis in birds and its role in bird development and reproduction. In: draft detailed review paper on Thyroid hormone disruption assays; c2005; c158-161.
2. Blache D, Talbort RT, Blackberry MA, Williams KM, Martin GB, Sharp PJ. Photoperiodic control of the concentration of luteinizing hormone, prolactin and testosterone in the male emu (*Dromaius novaehollandiae*), a bird that breeds on short days. J Neuroendocrinol. 2001;13(11):998-1006.
3. Camper PM, Burke WH. The effect of prolactin on reproductive function in female Japanese quail (*Coturnix coturnix japonica*). Poultry Sci. 1977;56:1130-1134.
4. Dawson A, King VM, Bentley GE, Ball GF. Photoperiodic control of seasonality in birds. J Biol. Rhythms. 2001;16:365-380.
5. Goldsmith AR, Nicholls TJ. Thyroxine induces photorefractoriness and stimulates prolactin secretion in European starlings (*Sturnus vulgaris*). J Endocrinol. 1984a;1010:R1-R3.
6. Goldsmith AR, Nicholls TJ. Thyroidectomy prevents the development of photorefractoriness and the associated rise in plasma prolactin in starlings. Gen. Comp. Endocrinol. 1984b;54:256-263.
7. Klandorf H, Sharp PJ, Mcleod MG. The relationship between heat production and plasma thyroid hormone levels in the domestic hen. Gen. Comp. Endocr. 1981;45:513-520.
8. Malecki IA, Martin GB, P O'Malley J, Meyer GT, Talbot RT, Sharp PJ. Endocrine and testicular changes in a short day seasonally breeding bird, the emu (*Dromaius novaehollandiae*), in southwestern Australia. Anim. Rep. Sci. 1998;3:143-155.
9. Mincham R, Malecki IA, Williams KM, Blache D, Williams IH, Martin GB. Assessment of fat content and body composition in the emu (*Dromaius novaehollandiae*). Proc. Aust. Soc. Anim. Prod. 1998;22:197-200.
10. Nicholls TJ, Goldsmith AR, Dawson A. Photorefractoriness in birds and comparison with mammals. Physiol. Rev. 1998;68:133-176.
11. O'Malley P. An estimate of the nutritional requirements of emu. In: Improving our understanding of ratites in farming environment, Deeming, D. C. (ed) Ratite conference, Oxfordshire, UK; c1996. p. 92-108.
12. Sharp PJ, Klandorf H. The interaction between the day length and the gonads in the regulation of levels of plasma thyroxine and Triiodothyronine in the Japanese quail. Gen. Comp. Endocr. 1981;45:504-512.
13. Sharp PJ, Klandorf H, McNeilly AS. Plasma prolactin, thyroxine, triiodothyronine, testosterone and luteinizing hormone during a photo induced reproductive cycle in mallard drakes. J Exp. Zool. 1986;38:409-413.
14. Sharp PJ, Malecki IA, Williams KM, Martin GB. Neuroendocrine control of broodiness and incubation behavior in ratites. In: Kawashima, S and S. Kikuyama (eds). Advances in Comparative Endocrinology. Monduzzi Editore, Bologna; c1997. p. 417-422.
15. Sharp PJ, VanCleff JK, Martin GB, Blache D. Photoperiodic control of seasonal breeding and appetite in emu. 3rd International Ratite Symposium and XII World ostrich Congress; c2005. p. 53-59.
16. Stevens L. Avian biochemistry and molecular biology. Cambridge University Press, Cambridge; c1996.
17. Williams KM, Blache D, Malecki IA, Sharp PJ, Tregg TE, Rigby RDG, *et al*. Growth, sexual development and carcass composition in intact and surgically or hormonally gonadectomised male and female emus. Proc. 2nd International ratite congress, Oudtshorn, South Africa, 21-25th September; c1998. p. 75-80.
18. Wingfield JC, Farner DC. Endocrinology of reproduction in wild birds. In: Farner, D. S., J. R. King and K. C. Parks, eds. Avian Endocrinology. London: Academic Press Inc. 1993;9:163-327.
19. Wingfield JC, Hahn TP, Levin R, Honey P. Environmental predictability and control of gonadal cycles in birds. J Exp. Zool. 1992;261:214-231.