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Body measurements and testosteron level of male Timor deer (*Rusa timorensis*) at various hierarchies

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ABSTRAK

Tujuan dari penelitian ini adalah mengamati lingkar leher, lingkar dada, lingkar skrotum dan kadar testosterone pejantan-α, pejantan-β dan pejantan subordinat rusa Timor di penangkaran akibat adanya pembentukan dominasi hirarki. Penelitian ini menggunakan 12 rusa Timor jantan (Umur 51 ± 6 bulan; bobot badan 68,29 ± 8,41 kg dan berada pada fase ranggah yang sama). Rusa Timor jantan dipisahkan dalam 3 kandang dengan masing-masing 4 ekor per kandang. Kit ELISA digunakan untuk mengukur kadar testosteron, sedangkan pita ukur digunakan untuk mengukur lingkar leher, lingkar dada dan lingkar skrotum. Sampel darah dan pengukuran lingkar leher, lingkar dada dan lingkar skrotum dari 12 ekor rusa Timor jantan dikumpulkan sebelum dan 43 hari sesudah pembentukan dominasi hirarki. Analisis parametrik Wilcoxon signed ranks dan Kruskal-Wallis digunakan dalam penelitian ini, sedangkan uji lanjut dilakukan dengan menggunakan Mann-Whitney U test apabila analisis statistik menunjukkan signifikansi. Hasil analisis statistik terhadap lingkar leher, lingkar dada, lingkar skrotum dan kadar testosteron rusa Timor jantan menunjukkan perbedaan yang tidak nyata sebelum pembentukan dominan hirarki. Lingkar dada dan lingkar skrotum rusa Timor jantan menunjukkan hasil yang tidak berbeda nyata sesudah pembentukan dominan hirarki. Perbedaan nyata ditunjukkan oleh parameter lingkar leher ($P<0,05$; $\chi^2 = 8,74$) dan kadar testosteron ($P<0,05$; $\chi^2 = 7,87$) sesudah pembentukan dominan hirarki rusa Timor jantan. Kesimpulan dari penelitian ini adalah dominasi hirarki mempengaruhi testosteron level dan lingkar leher.

Kata Kunci : *Rusa Timor, jantan, ukuran tubuh, kadar testosteron, hirarki*

ABSTRACT

The aim of this research was to observe body (neck, chest and scrotum) circumferences and testosterone level of α-male, β-male and subordinate male Timor deer reared under captivity after establisment of the dominance hierarchy. Twelve males (51 ± 6 months old; 68.29 ± 8.41 kg body weight and in same antler stages) were used in this research. The bucks was grouped into three stall each containing four bucks. ELISA kit and tape measurements were used for plasma Testosterone assay and body measurement, respectively. Data was collected before and 43 days after establishment of the dominance hierarchy. Wilcoxon signed ranks test and Kruskal-Wallis H test of non-parametric analysis was used. Significant difference was tested with Mann-Whitney U test. The results showed no significantly different for body circumferences (neck, chest, scrotum) and testosterone level of male

Timor deer before establishment of dominance hierarchy. Chest and scrotum circumferences of male Timor deer after establihment of dominance hierarchy showed no significantly different. Significantly difference shown on parameter neck circumference ($P<0.05$; $\chi^2 = 8.74$) and testosteron level ($P<0.05$; $\chi^2 = 7.87$) after establishment of dominance hierarchy. In conclusion, dominance hierarchy affected the testosterone level and body measurement.

Keywords : *Timor deer, male, body measurement, testosterone level, hierarchy*

INTRODUCTION

Deers are wild potential animal to support meat supply for the Indonesian. Timor deer is one of endemic species of deer (Samsudewa and Capitan, 2011). Timor deer has good quality of meat, antler and skin. They are raised in captive breeding in New Zealand, Australia, Indonesia, Mauritius, New Caledonia, China, Korea and Russia (Semiadi and Nugraha, 2004). However, productivity Timor deer in one captive breeding in Kudus, Central Java up to 2013 was only 0.5 fawn/year (Samsudewa *et al*., 2016). The 0.5 means that of 100 females Timor deer every year will produce 50 heads of fawn.

The productivity of deer farming in captivity can be improved if some key aspects of management were controlled including feeding and aggressive male behavior (Samsudewa *et al*., 2016). Male aggressiveness was one of the common behaviors during mating to form hierarchy. Establishment of dominance hierarchy naturally will form α-male (superior male of Timor deer), β-male (the second rank of male Timor deer), subordinate-1 (S1) male (the third rank of male Timor deer) and subordinate-2 (S2) male (the fourth rank of male Timor deer). Fighting was one of behavior happened during establishment of dominance hierarchy and affected to the behavioral stress. Moberg (1991) stated that behavioral stress has adverse effects on reproduction system of both males and females.

Testosterone level is one of the parameters to monitor stress and reproduction performance. Animals that experience stress suffering often fail to reproduce successfully. Testosterone level was related with muscle size, especially continuously used muscle. Testosterone also related with testical circumference as an organ who produce this hormone (Rudiono, 2007).

Research about effect of dominance hierarchy to the body measurement and testosterone level of Timor deer in captive breeding was limited. This research will help the farmer to decide which one the best male Timor deer for mating.

In order to develop better management practices to maximize reproductive capacity of deer farms, it is necessary to study the relation of testosterone level and body circumferences of α-male, β-male and subordinate male Timor deer raised under captivity after establishment of dominance hierarchy.

MATERIALS AND METHODS

Materials

Research was conducted in H. Yusuf Wartono's Timor deer captivity, Kudus, Central Java, Indonesia. Twelve males were used in this research (51 ± 6 months old; 68.29 ± 8.41 kg body weight and in same antler stages). Blood samples, tape measurement (range 0-150 cm, sensitivity 0.1 cm), sedation materials and tools, DRG Kit ELISA, ELISA reader machine EL 808IU (24 V; 100 watt), washer machine Biotex ELX 50 (24 V; 40 watt), micropippete Socorex Acura (1-10 µL; 10-100 µL; 200-200 µL; 100-1000 µL) and multipipette eppendorf stream were used in this research.

Methods

Blood samples from 12 Timor deer were collected before and 43 days after establishment of dominance hierarchy. Blood samples were collected by jugular venipuncture. Blood analysis was conducted to obtain testosterone level. Body circumference (neck, chest and scrotum) was measured before and after establishment (Figure 1 and Figure 2). Four male Timor deer in every stall will form dominance hierarchy by fighting around one week. Finally, Timor deer in every stall will form α-male, β-male and subordinate male. The male Timor deer will nourished up to 43 days.

Data Analysis

Wilcoxon signed ranks test and Kruskal-Wallis H test of non-parametric analysis was done for body circumferences (neck, chest and scrotum) circumferences and testosterone level. Significant

Figure 1. Measurement of Neck Circumferences of Male Timor Deer

Figure 2. Measurement Scrotum of Male Timor Deer

difference was tested with Mann-Whitney U test (Santoso, 2014).

RESULTS AND DISCUSSIONS

Neck Circumferences

Average values of neck circumference of α, β and subordinate male Timor deer before and after establishment of dominance hierarchy are shown in Table 1.

Statistical analysis of the data using Wilcoxon signed ranks test for neck circumference showed no significant difference in median values before and after establishment of dominance hierarchy groups for all hierarchy levels. Kruskal-Wallis H test also showed no significant differences among hierarchies before (χ^2 = 4.13) establishment of dominance hierarchy on neck circumference. On the other hand, significant differences ($P<0.05$) was estimated among different groups after (χ^2 = 8.74) establishment of dominance hierarchy. The Mann-Whitney U test revealed that the α-males had the largest neck circumference followed by β and S1 males, and the smallest was from those of S2-males. No significant difference was found between β and S1-males.

Neck circumference was observed to be proportionately lower in deers with lower dominance hierarchy. Only α-males showed increasing value in neck circumference. Savanth *et al.* (2011) reported that the neck musculature of Sambar deer was larger during the rut season, especially those at the highest rank of dominance hierarchy. The increasing size of neck musculature resulted from rubbing antlers, an activity of scent marking. This activity is mostly done by the dominant rank. Monfort *et al*. (1993) reported that during rut season, mean neck girth of Eld's deer (*Cervus eldi thamin)* stags increases along with increasing testosterone level and behavioral aggression. Basal means of neck girths were ranged from 56.8 to 60.8 cm and this increased from 70.6 to 74.7 cm during rut season.

Chest Circumference

Average values of chest circumference of α, β and subordinate male Timor deer before and after establishment of dominance hierarchy are shown in Table 2.

The Wilcoxon signed ranks test for chest circumference showed no significant difference in median values before and after establishment of dominance for all hierarchy levels. Kruskal-Wallis H test showed no significant difference among the groups before (χ^2 = 4.44) and after (χ^2 = 6.46) establishment of dominance hierarchy.

Monfort *et al*. (1993) in his research on Eld's deer stags (*Cervus eldi thamin*) reported that increasing chest girths is correlated to body weight. Mean of body weight observed in July was 87.8 ± 5.2 kg and this increased steadily until the peak in January with the values 105.0 ± 5.5 kg. This was in slight contrast with the body weight, basal means of chest girth were 106.9 to 115.8 cm and they peaked in January with the values 119.3 to 124.8 cm.

Scrotum Circumference

Average values scrotum circumference of α, β and subordinate male Timor deer before and after establishment of dominance hierarchy are presented in Table 3.

Table 1. Average Values of Male Timor Deer Neck Circumference at Various Hierarchies Before and After Establishment (43 Days) of Dominance Hierarchy

Factor	Hierarchy			
	α-Male	β-Male	S1-Male	S2-Male
	..... cm			
Before	57.03	55.60	51.57	44.80
After	62.90	50.83	50.37	40.10
Z	1.60	1.60	1.60	1.07

α-Male: Superior male Timor deer; β-Male: Second rank of male Timor deer; S1-Male: Third rank of male Timor deer; S2-Male: Fourth rank of male Timor deer; Z; Z value of Wilcoxon Signed Rank

Table 2. Average Values of Male Timor Deer Chest Circumference at Various Hierarchies Before and After Establishment (43 Days) of Dominance Hierarchy

Factor	Hierarchy			
	α-Male	β-Male	S1-Male	S2-Male
	..... cm			
Before	94.70	90.70	88.00	88.63
After	95.27	88.93	88.67	86.63
Z	1.07	1.60	0.00	1.07

α-Male: Superior male Timor deer; β-Male: Second rank of male Timor deer; S1-Male: Third rank of male Timor deer; S2-Male: Fourth rank of male Timor deer; Z: Z value of Wilcoxon Signed Rank

Wilcoxon signed ranks test for scrotum circumference showed no significant difference in median values between before and after establishment of dominance for all hierarchy levels. Kruskal-Wallis H test showed no significant difference among the groups before (χ^2 = 0.87) and after (χ^2 = 6.35) establishment of dominance hierarchy for scrotum circumference.

Decreasing scrotum circumference after establishment of dominance hierarchy was shown to be proportionately larger in lower rank males (β, S1 and S2-males). Monfort *et al.* (1993) also reported that in pre-rutting, scrotum circumference of Eld's deer stags was 14.9 ± 0.7 cm and this increased steadily (0.3 cm per week) to 20.7 ± 1.1 cm during rutting.

Testosterone Level

Testosterone is the main reproductive hormone in male. Testosterone is necessary to maintain normal spermatogenesis in mature animals (Blottner *et al.,* 1996). Average values testosterone level of α, β and subordinate male Timor deer before and after establishment of dominance hierarchy are shown in Table 4.

Wilcoxon signed ranks test for testosterone level showed no significant difference in median values before and after establishment of dominance hierarchy for all male groups. Kruskal-Wallis H test showed no significant difference among the groups before (χ^2 = 5.17) establishment of dominance groups in terms of testosterone level. However, there were significant differences (P<0.05) among hierarchies after (χ^2 = 7.87) establishment of dominance hierarchy. The α-males registered the highest testosterone level which was significantly higher (P<0.05) than those of β, S1 and S2-males. The last three groups showed no significant differences in testosterone levels among

Table 3. Average Values of Male Timor Deer Scrotum Circumference at Various Hierarchies Before and After Establishment (43 Days) of Dominance Hierarchy

Scrotum Circumference	Hierarchy			
	α-Male	β-Male	S1-Male	S2-Male
	..... cm			
Before	19.13	18.23	19.07	18.00
After	20.03	17.03	17.00	15.00
Z	1.60	0.82	1.60	1.60

α-Male: Superior male Timor deer; β-Male: Second rank of male Timor deer; S1-Male: Third rank of male Timor deer; S2-Male: Fourth rank of male Timor deer; Z: Z value of Wilcoxon Signed Rank

Table 4. Average Values of Male Timor Deer Testosterone Level at Various Hierarchies Before and After Establishment (43 Days) of Dominance Hierarchy

Testosteron Level	Hierarchy			
	α-Male	β-Male	S1-Male	S2-Male
	..... ng/ml			
Before	15.67	16.00	7.67	2.67
After	20.00	4.33	9.67	3.33
Z	0.54	1.34	0.45	0.45

α-Male: Superior male Timor deer; β-Male: Second rank of male Timor deer; S1-Male: Third rank of male Timor deer; S2-Male: Fourth rank of male Timor deer; Z: Z value of Wilcoxon Signed Rank

themselves.

Social defeat affects level of testosterone. Blanchard *et al.* (2002) reported that in primates, social defeat seems to play a role in perpetuating the difference in testosterone levels between dominant and subordinate animals. In situations where there is continued fighting in social groups, the difference in testosterone between social ranks is maintained. The present study also showed that β-males have the most significant decrease in terms of testosterone level. This is due to stress from repeated agonistic behavior. The β-males, as second rank males, will always compete with α-males. Blanchard *et al*. (2002) stated that repeated agonistic behavior plays a role in maintaining the low testosterone levels in defeated animals.

Testosterone level also plays role on the development of muscle. Testosterone level also affected the hematologic profile. Dominant males (α-males) had the highest level of testosterone, the highest increasing neck circumferences and the best vitality condition. Timor Deer in lower ranks were observed to have proportionately lower neck circumference. Large neck circumference in α-male is related with high testosterone level. Testosterone level affects neck circumference because testosterone causes muscle dilation. Rudiono (2007) reported that administration of testosterone at various levels in Kacang doe causes dilation of fibril muscle longissimus dorsi and rectus femoris. He further stated that dilation of fibril muscle can be explained by two different reasons. First, androgen receptor in muscle binds to testosterone hormone, causing the nucleus in muscle to produce protein. Second, high testosterone levels stimulate the release of other hormones such as growth hormone from the hypothalamus. Dilation of fibril muscle also need to be exercised to maintain muscle strength. Monfort *et al.* (1993) reported that in Eld's deer stags, aggressive behavior increased rapidly along

with increasing testosterone level. One of the manifested aggressive behaviors was rubbing antler. Beside for scent marking, rubbing antler was also used for training the neck and shoulder muscle (Savanth *et al*., 2011).

CONCLUSION

Neck circumference was the phenotypic characteristics affected by dominance hierarchy. The α-male had the highest testosterone level compared to the other males, and it appeared to be the key for the highest degree of reproductive behavior. Testosterone level increased along with neck circumference.

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