Preview of Estrogen, Progesterone and an Electrolite Plasma and the Act of Kidney on Sodium, Kalium, and Chorin of Bligon Goat's Estrous Cycle

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Abstract. This research was aimed to obtain status of reproduction hormone and electrolyte plasma and kidney's act on electrolyte in normal estrous cycle of 4 healthy female Bligon goats. The electrolyte, hormone and electrolyte clearance study has done in the first day, 3rd–5th, 6th–16th, and 17th–18th day of oestrus cycle. Estrogen and progesterone were analyzed with ELISA, while Na, K, Cl were with spectrophotometer. The average difference for each parameter in any period of oestrus cycle was subject to analysis of variance continued by Turkey HSD. The average of estrogen in estrous cycle was 211.25–247.77 pg/dl potential to increase around the estrous and decrease in luteal period (3rd–5th day and 6th–16th estrous cycle), and progesterone was 0.21–0.70 ng/dl with significant increase in luteal period (3rd–5rd day and 6th–16th estrogen cycle). Na, K, Cl in plasma in estrous cycle were not significantly different. Conclusively, progesterone levels in the late luteal period of Bligon goat's estrous cycle was significantly higher than that in other periods of oestrus. Estrogen levels tended to increase prior to and during the periods of oestrus and decrease during the luteal period despite the lack of significant changes, also in status of plasma electrolytes and renal acts of electrolytes.

Key words: Electrolytes, goat, hormone, estrous

Abstrak. Penelitian bertujuan untuk mendapatkan status hormon reproduksi dan plasma elektrolit dan reaksi ginjal terhadap elektrolit pada siklus estrus kambing Jawa Randu. Penelitian menggunakan 4 kambing betina sehat yang memiliki siklus estrus normal. Analisa elektrolit, hormon dan bersihan elektrolit dilakukan pada siklus estrus hari pertama, ketiga-kelima, keenam-keenambelas, dan hari ketujuhbelas-kedelapanbelas. Estrogen dan propgesteron dianalisa dengan ELISA, sedangkan Na, K, Cl dianalisa dengan spektofotometer. Rataan perbedaan setiap parameter periode siklus estrus dianalisa dengan analisis ragam dilanjutkan dengan Tukey BNJ. Rataan estrogen dalam siklus estrus adalah 211,25-247,77 pg/dl, dengan potensi peningkatan di sekitar estrogen dan penurunan di fase luteal (siklus estrus hari ke 3-5, dan 6-16), dan rataan progesteron adalah 0,21-0,70 nd/dl dengan peningkatan nyata selama fase luteal (siklus estrus hari ke 3-5, dan 6-16). Na, K, Cl dalam plasma disiklus estrus tidak berbeda nyata. Hasil penelitian menyimpulkan bahwa tingkat progesteron di akhir fase luteal dalam siklus estrus kambing Jawa Randu jauh lebih tinggi dari pada fase lain pada periode estrus. Level estrogen cenderung meningkat sebelum dan selama periode estrus dan menurun selama fase luteal meskipun tidak menunjukkan perubahan nyata, begitu pula pada status elektrolit plasma dan kinerja ginjal terhadap elektrolit.

Kata kunci: Elektrolit, kambing, hormon, estrus

Introduction

To date, research on the changing levels of estrogen and progesterone during the estrous cycle and its effects on electrolyte metabolism in Bligon Goats in Indonesia has not been reported yet. Factors affecting clinical parameters are location, type of livestock, reproductive cycle, food and environment and others. Not all livestock including Bligon Goats in Indonesia have the parameters of estrogen, progesterone and electrolyte metabolism. While the necessity accelerates, accurate and economic diagnosis of reproductive status and gynecological clinical examination in goats are needed in relation to increase production of goats. These parameters are part of a valuable

parameter in predicting reproductive status (phase of the estrous cycle) and gynecological clinical examination on Bligon Goats in Indonesia.

To answer these demands, this study aimed to assess the status of plasma electrolytes and renal electrolytes during the estrous cycle in Bligon Goats in Indonesia. The development studies of other animals found variations in hormone and electrolyte parameters. A research on monkey Cynomolgus Monkeys showed changes of serum progesterone and vaginal cytology during the estrous cycle. Research in monogastric animals (rats) and lambs indicated that the estrogen hormone could affect the metabolism of electrolytes (sodium, potassium, chloride), water retention, and increase blood circulation (Arthur et al., 1996; Frandson et al., 2003; Keller Wood, 2000 ; Krajnicakova et al., 1994). In monogastric animals, it is known that the increased estrogen results in changes on plasma volume, sodium/natrium level, and water retention (Stachenfeld and Taylor, 2003; De Souza et al., 1989; Ganong, 1993). Moreover, Stachenfeld and Taylor (2003) asserted that the increase in progesterone results in sodium increase.

Materials and Methods

Four female adult Bligon goats, non-pregnant, clinically healthy, about 2-3 years old and weighed between 25 and 35 kg were used in this study. The goats had 2-3 time lambing and showed normal estrous cycle (19-21 days). Each goat was kept in a cage and given feed stage freely form a mixture of *Panicum maximum, Gliricidia sepium, Leucenea leucocephala* and concentrate as much as 150 g/head/day. Drinking water was provided by adlibitum. During the study, animal health was controled and given antiparasitic periodically to prevent infestation of endo and ectoparasites.

Daily detection of estrous in each animal was by observing the behavior and response of females to males. Estrous is based on behavioral estrous for small ruminants as described by Frendson et al. (2003) and confirmed by the willingness to ride male goats. During estrous period, (day 1), day 3-5, day 10-16, and day 17-18 after estrus, blood sampling via jugular vein and clearance testing were conducted. During the clearance test, each goat was fasted and placed in metabolism cages for urine collection. Test were performed on electrolyte clearance at 08.00-12.00 a.m using method described by Widiyono (1995). Plasma was separated by centrifugation and stored at -20^{0}C through the analysis. Similarly, urine samples collected at each test period clearance was stored at -20^{0}C through the analysis. Examination of electrolytes (Na, K, Cl) and creatinine in plasma and urine was performed by spectrophotometric (Kraft and Duerr, 1999). Filtration, reabsorption and excretion of electrolytes through the kidneys were calculated by the method described by Widiyono (1995).

Data of electrolyte and hormone levels in plasma and filtration, reabsorption and excretion of electrolytes by the kidneys during the estrous cycle are presented in mean and standard deviation. The influences of various parameters of the study period were subject to anova followed by Tukey HSD to analyze differences among mean parameters of the study period in a single estrous cycle, in which $P < 0.05$ indicated significant difference.

Results and Discussion

Results of this study (Table 1) shows average concentrations of progesterone and estrogen at various periods during the estrous cycle. Average progesterone and estregon levels ranged from 0.21 to 0.70 ng/dL and 211.25 to 247.77 pg/dl, respectively. In contrast, Bligon goat's estrogen levels in this study did not significantly change during the estrous cycle, instead showing a tendency to increase

towards and during the period of estrous and decrease during the luteal period (Table 1). Glomerular filtration rate, renal excretion and tubular reabsorption of Na in some periods during the estrous cycle in Bligon goats are presented in Table 2. Data on filtration rate and excretion of K during the estrous cycle in Bligon goat are in Table 3 while the data rate of filtration, excretion and reabsorption of Cl in some periods during the estrous cycle in Bligon goats are shown in Table 4.

Plasma progesterone level in in the late luteal period was significantly higher (0.70 ng/dl) than in other estrus (P<0.05). The results are consistent Airin (2006) that in Ettawah cross bred goats reached peak progesterone levels on the 10th day of estrous cycle. Furthermore, Pant (1977) reported that progesterone level before estrus was 1.86 ± 0.43 ng/ml and peaked in mid-period namely 3.7±0.28 ng/ml. Similarly, Akusu and Ajala (2000) reported that progesterone levels during estrous was <1

Table 1. Plasma level of estrogen, progesterone, natrium, kalium and cloride

Parameters	1st day (estrous)	3rd-5th day (first luteal)	6th-16th day (last luteal)	17th-18th day (proestrous)
Estrogen (pg/dl)	246.17±220.50	216.78±176.62	211.25±191.86	247.77±218.25
Progesterone (ng/dl)	0.29±0.32	0.21 ±0.18	0.70±0.69**	0.37±0.35
Natrium (mM)	142.68±1.93	142.40±2.58	142.28±1.36	142.67±1.64
Kalium (mM)	4.22±0.27	4.34±0.64	4.30±0.24	4.24±0.36
Cloride (mM)	112.84±1.94	113.74±0.92	113.87±2.55	111.31±1.21

** : (P<0.01)

Table 2. Glomerular filtration, renal excretion and tubular reabsorption of Na

Parameters	Observation periods				Statistical analysis
	1st day (estrous)	3rd-5th day (first luteal)	6th-16th day (last luteal)	17th-18th day (proestrous)	
Rate filtration of Na glomerular	7.05±1.53	11.35±4.08	10.66±3.48	9.47±1.15	NS
Rate excretion of Na renal	0.03±0.03	0.12±0.11	0.09±0.12	0.07±0.09	NS
Fractional excretion of Na (%)	0.08±0.12	1.07±1.13	0.76±0.66	0.63±0.77	NS

NS : Non Significant

Table 3. Filtration rate and excretion of K

Parameters	Observation periods				Statistical analysis
	1st day (estrous)	3rd-5th days (first luteal)	6th-16th day (last luteal)	17th-18th day (proestrous)	
Filtration rate of K glomerular	0.21±0.05	0.34±0.12	0.33±0.09	0.31±0.04	NS
Excretion of K renal	0.16±0.04	0.25±0.08	0.33±0.17	0.22±0.12	NS
Fraktional excretion of K (%)	45.07±43.00	74.52±17.05	98.43±31.35	68.95±33.97	NS

NS : Non Significant

Tabel 4. Filtration rate excretion and reabsorption Cl

Parameters	Observation periods				Statistical analysis
	1st day (estrous)	3rd-5th days (first luteal)	6th-16th day (last luteal)	17th-18th day (proestrous)	
Filtration rate of Cl glomerular	5.24±1.21	8.93±3.42	8.57±2.50	7.10±0.91	NS
Excretion rate of Cl renal	0.06±0.03	0.08±0.04	0.19±0.26	0.10±0.09	NS
Fractional excretion of Cl (%)	0.47±0.42	0.91±0.54	0.86±0.09	1.26±1.00	NS
Reabsorption rate of Cl tubular	5.18±1.21	8.25±3.40	8.49±2.48	6.99±0.88	NS
Reabsorption of Cl (%)	98.76±0.60	99.08±0.58	99.14±0.09	98.62±1.23	NS

ng/ml whereas at 0.5 ± metestrus 0.03 ng/ml and peak levels (2.2±0.005 ng/ml) was indicated on day 15 after estrus. Changes in progesteron levels has been reported to occur during the estrous cycle in a few races of Alpine goat, Red Sokoto, Black Bengal, Dutch White and Damascus goats (Bono et al., 1983; Pathiraja et al., 1991; Kumbhakar and Prasad, 1998; Van De Wiel et al., 1991; Zarkawi and Soukouti, 2001). In Damascus goat, progesterone concentrations at the end of the estrous cycle and the beginning of the estrous cycle was low, but experienced high level in the luteal period for approximately 15 days (Zarkawi and Soukouti, 2001). Estrogen levels in Bligon goat in this study, however, did not show significant changes during estrus but tend to increase towards and during estrus and decrease during the luteal period (Table 1). As noted by Frandson (1995) and Bearden and Fuquay (1984) that estrogen production increased during proestrus. In period after ovulation, corpus luteum function, a decline in estrogen and progesterone increase was established by the ovaries. This period occurred soon after the end of estrus approximately 3 days after estrus signs of ending (Partodihardjo, 1982; Bearden and Fuquay, 1984; Shearer, 2003; Cunningham, 2002).

Review on the status of electrolytes in plasma during estrus showed that average concentrations of Na and K in plasma was 142.28 to 142.68 mmol/L and 4.22 to 4.34 mmol/L, respectively. Both electrolyte showed normal levels for sheep at 140-160 mmol/L and 3.5 to 4.5 mmol/L (Bickhardt, 1992).

At various periods during the estrous cycle levels of Na, K, and Cl in the plasma did not change significantly even found a picture of change progesterone levels during the estrous cycle. Preview electrolyte status in goats Bligon above picture is different electrolyte status in sheep that showed close links with the status of progesterone in the plasma. Keller Wood (2000) conducted research on sheep on Na, volume, and vasopressin plasma adrenocorticotropic hormone on the condition of rest and hypotension. Increased plasma progesterone resulted in increased levels of plasma sodium and vasopressin, but the plasma volume and blood pressure did not change. Further stated that if progesterone decreased the Na in the plasma will decrease as well. This is likely related to estrogen status in goat plasma Bligon in this study are quite high and showed no significant changes throughout the estrous cycle or in connection with the effect of combined estrogen and progesterone affecting the status of electrolytes and plasma volume.

According to Stachenfeld and Keefe (2002) and Stachenfeld et al. (1999), estrogen and progesterone lead to increased Na reabsorption in the kidney, so it was probable that the increase in plasma volume in such hormonal condition linked with an increased volume of extracellular fluid. Stachenfeld and Taylor (2003) also reported that if estrogen increases a decline in the rate of albumin transkapiler expenditure resulting in elevated levels of albumin, water retention and increased plasma volume, but on the condition of increased estrogen and progesterone, the occurrence of a combination of expenditure reduction in the rate of transcapillary albumin, elevated levels of albumin, water retention and increased plasma volume and increased volume extracelullar fluid (water and sodium retention).

Further studies in rats conducted by De Vito et al. (1989) showed that estrus also caused increase in renin activity. In contrast, De Sotiza et al. (1989) and Michelakis et al. (1975) reported that in the midluteal period levels of aldosterone and renin activity increased due to an increase in progesterone. According to Bickhardt (1992) increase in renin caused increase in aldosterone that could spur increased reabsorption of Na, Cl and water, and in turn increased blood volume or plasma.

Fitsimons (1980) also found that angiotensin in rats resulted in increased salt appetite to

consume. Although no significant rate of Na excretion through the kidneys, the rate of renal Na excretion in goats Bligon in the early luteal period (days 3-5) and late luteal (days 6-16), showed a larger value, namely 0.12 mmol/min or 1.07% and 0.09 mmol/min or 0.7% of Na glomerular filtration rate (Table 2) compared to renal Na excretion rate in estrus period of 0.03 mmol/min or 0.08% of Na glomerular filtration rate (Table 2), providing support to a possible involvement of aldosterone and stimulation of the renin-angiotensin system in handling electrolytes in Bligon goats during the luteal period. Moreover, Table 3 also shows fractional excretion of K, which tends to be higher to 74.52% and 98.43% in early and late luteal period (days 3-5 and 6-16) than the excretion factional K in estrus period namely 45.07%. It also reinforced the alleged involvement of aldosterone on electrolyte homeostasis in sheep estrous cycle Bligon which experience this. According to Myles and Funder (1996), in the luteal period occurs barrier mediated by progesterone on Na reabsorption associated with aldosterone and this resulted in a mild natriuresis and stimulate the renin-angiotensin system compensation. Bickhardt (1992) also asserted that stimulating aldosterone secretion of K ions in the distal tubules and collecting dustus in the kidneys. In addition, Kucharwyk (1984) also suggested that gonadal steroid hormones influenced fluid and electrolyte homeostasic through the mechanism of behavior and kidney. Estrogen and angiotensin II affects the regulation of body fluids through changes in drinking behavior and mechanism of the kidney. On examination by renal electrolyte handling in goats Bligon in this study (Table 2, 3, and 4) found that at all periods of the estrous cycle reabsorption of Na and Cl levels high enough (about 99%). Similarly, fractional excretion of electrolytes Na and K was at low levels and equivalent to the normal value for healthy ruminants or the physiological condition of 0.1-2% for Na and 30-80% for K (Bickhardt, 1992), except on day 6-16 (late luteal period) fractional excretion of K increased beyond normal value i.e. 98.43% (Table 3) and this indicated alignment with tangible increase in progesterone during the period which amounted to 0.7 ng/dl (Table 1). As a result, plasma electrolyte levels during estrous cycle in goat Bligon did not significantly change.

Conclusion

Plasma progesterone level of Bligon goat during the estrous cycle in the late luteal period was significantly higher than that in other periods of estrus. Estrogen levels tended to increase prior to and during the period of estrus and decrease during the luteal period although the figure does not show significant changes during the estrous cycle. Status of plasma electrolytes (Na, K, and Cl) and renal handling electrolytes did not undergo significant change as well.

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