

Mineral Concentrations of Magnesium and Calcium in Relation to Diestrus and Proestrus in Ongole Crossbred Cows

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ABSTRACT

This research aims to examine the mineral concentrations of magnesium and calcium in relation to diestrus and proestrus cycles in Ongole crossbred cows. Serum was taken from 6 Ongole crossbred cows for the detection of its calcium (Ca) and Magnesium (Mg) during which the 3 cows were in diestrus cycle and the 3 other were in proestrus cycle. The results revealed that the concentration of Mg in the diestrus cycle tended to be higher (2.47 ± 0.39 mg/dL) than that in the proestrus cycle (2.40 ± 0.27 mg/dL) although the Mg concentration during these two cycles did not differ significantly ($P > 0.05$). Ca concentration in diestrus cycle (2.26 ± 0.13 mmol/L) was higher than that in proestrus (2.15 ± 0.07 mmol/L) although both of diestrus and proestrus cycles did not significantly differ ($P > 0.05$). As a conclusion, the concentration of Ca and Mg during the diestrus cycle tended to be higher compared to that during the proestrus cycle in the blood of Ongole crossbred cows.

Keywords: Calcium, Diestrus, Magnesium, Ongole crossbred cows, Proestrus

INTRODUCTION

Many efforts have been done by the Indonesian government to improve the productivity of cattle in the country (Nuryadi and Wahjuningsih, 2011), has brought some bulls from different breeds, including Ongole. The crossbreeding between Ongole bulls with Javanese bred cows produced Ongole crossbred beef cows (Subiharta *et al.*, 2012). The Ongole crossbred cows have been more reproductive, compared to the Limousin bred cows (Yulyanto *et al.*, 2014), and calving rate is also higher than that of subtropical cow descendants (Subiharta *et al.*, 2012). The high reproductive potentials in Ongole crossbred cows are greatly influenced by the nutrients especially minerals (Ceylan *et al.*, 2008). Minerals play an intermediate role in the promotion of action of hormones and enzymes at the sub cellular levels in an integrated fashion and thus regulate functions of reproduction of domestic animals (Amle *et al.*, 2014). Cyclic changes in various mineral may be utilized clinically to determine the stage of estrous cycle (Devi *et al.*, 2016). Magnesium (Mg) might have played some role in the normal ovulatory process (Das *et al.*, 2009). Mg also improved fertility (Small *et al.*, 1997). Mg deficiency delays the uterine involution (Larvor, 1983) and irregular estrus cycle in mares (Ali *et al.*, 2009). Calcium (Ca) plays an important role in gonadotropic regulation of ovarian steroidogenesis (Carnegie and Tsang, 1984). The excess in Ca may impair reproductive function by causing the secondary deficiency of phosphorus, magnesium, Zinc,

cuprum, and other trace elements, by inhibiting their absorption in the intestine (Hurley and Doane, 1989; Yasothai, 2014). The findings of Cressent *et al.* (1983) showed that calcium regulated hormones during the estrus cycle of the rat and Ca levels dropped throughout the day during the proestrus and in contrast, Ca rose transiently during the diestrus. No study has yet been conducted on Ca and Mg during the estrus, moreover during the diestrus and the proestrus in Ongole crossbred cows. Therefore, the objective of this study was to examine serum Ca and Mg concentrations in relation to the diestrus and proestrus in Ongole crossbred cows.

MATERIALS AND METHODS

Animals and Animal Management. This research used 6 Ongole crossbred cows, 3 of which were in the diestrus cycle and 3 other of which were in the proestrus cycle, aged 3-4 years. The 6 cows also have ever given birth and the estrus cycle was normal. The determination of the status of the diestrus and proestrus was done through a rectal palpation, based on Lopez-Gatius and Camon-Urgelz (1991). Each Ongole crossbred cow was kept in the individual cage or pen in a group of cattle in Caturharjo, Tamanmartani, Kalasan, Sleman Yogyakarta. Each cow got drink ad libitum and feeding in the form of green fodder and concentrate.

Sampling Procedures and Analysis. Blood samples were collected from each of the cows through a jugular vein puncture in plain glass tubes and allowed to clot. Serum samples were harvested by centrifuging the clotted blood at 3000 rpm for ten minutes, and stored in Eppendorf microtubes at -20°C until the examination commenced. Mg and Ca were analyzed with Cobas 6000 series analyzer (Roche, Japan). The data were analyzed by *one-way ANOVA*, the means and standard deviation of means were calculated for each group, and the significance was set at $P < 0.05$

RESULTS AND DISCUSSION

The data of mineral Mg and serum Ca of cows in the diestrus and proestrus cycles was presented in Table 1. The concentration of Mg in this research tended to be higher during the diestrus cycle (2.47 ± 0.39) mg/dL than that during the proestrus cycle (2.40 ± 0.27) mg/dL although there was not any significant difference ($P > 0.05$). This was in agreement with the report of Hugentobler *et al.* (2007) who found no significant difference in bovine serum Mg during the diestrus and the proestrus cycles. The tendency of high concentration of Mg in the diestrus period in this research was due to the high concentration of progesterone (Jordan *et al.*, 1983). On the contrary, the report made by Alavi-Shoushtari *et al.* (2012) showed that the level of Mg was the lowest during the diestrus cycle. In addition, the difference of Mg concentrations was influenced by the ruminant breeds. In this study, the concentration of Mg in Ongole crossbred cows during the diestrus cycle (2.47 ± 0.39 mg/dL) was lower than the level Mg in bovine from Urmia, Iran on the concentration of 3.39 ± 0.29 mg/dL (Alavi-Shoushtari *et al.*, 2012) and in buffalos with the diestrus level of 3.28 ± 0.15 mg/dL (Akhtar *et al.*, 2014).

Overall, the concentration of Mg in Ongole bred cows this research during the diestrus and proestrus cycles was in agreement with the report by Blood and Radostits (1989) and Mitruka and Rawnsley (1981) who reported 1.20 to 3.50 mg/ dL.

Table 1. Serum Magnesium and Calcium concentrations in diestrus and proestrus phases of the Ongole crossbred cows (Mean \pm SEM)

Group	Magnesium (md/dL)	Calcium (mmol/L)
Diestrus (n=3)	2.47 \pm 0.39	2.26 \pm 0.13
Proestrus (n=3)	2.40 \pm 0.27	2.15 \pm 0.07

Ca concentration in the diestrus (2.26 \pm 0.13 mmol/L) tended to be higher than that in the proestrus (2.15 \pm 0.07 mmol/L) although there was no any significant difference (P>0.05) Table 1). This result was in agreement with the report on rats revealing the higher tendency in the diestrus (Cressent *et al.*,1983). The increased tendency in blood plasma Ca content increases with elevations in plasma progesterone concentration (Jordan *et al.*, 1983; Alavi-Shoushtari *et al.*, 2012) during diestrus.

The lower tendency of concentration in serum Ca during the proestrus in this study was in agreement with the report on rats by Cressent *et al.* (1983) who revealed that Ca tended to be lower in the proestrus. This higher tendency in Ca was related to the high uterine Ca secretion (Alavi-Shoushtari *et al.*, 2012) and the growth of dominant follicle that increase the oestradiol that causes the increased intestinal absorption of calcium (Brommage *et al.*, 1993). Therefore, Ca plays an important role in gonadotropic regulation of ovarian steroidogenesis (Carnegie and Tsang, 1984).

CONCLUSIONS

From these results of this study, it was concluded that the concentration of Mg and Ca tended to be higher during the diestrus cycle than that during the proestrus cycle in Ongole crossbred cows.

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REFERENCES

- Akhtar, M., A.A. farooq, L. A. Lodhi, S.A. Muhammad, M.M. Ayaz, M. H. Lashari, S. Murtaza, I. Hussain, M. Irshad, M. Hussain and M. AsifRaza. 2014. Studies on serum macro and micro minerals status in repeat breeder and normal cyclic Nili-Ravi buffaloes and their treatment strategies. *Afr. J. Biotechnol.* 13(10): 1143–1146. doi: 10.5897/AJB12.2328.
- Alavi-Shoushtari, S. M., S. Asri-Rezaie, R. Abedizadeh, A. Khaki, M. Pak, and S. Alizadeh. 2012. Calcium and magnesium concentrations in uterine fluid and blood serum during the estrous cycle in the bovine. *Vet Res Forum.* 3(2): 137–141.
- Ali, F., A. Lodhi, Z. I. Qureshi and M. Youni. 2009. Serum macromineral levels in estrual, fertile, subfertile and pregnant mares kept under two different managerial conditions. *Pak Vet J* 30(2): 87–90.
- Amle, M., V. Patodkar, R. Shelar and H. Birade. 2014. Serum biochemical levels of repeat

- breeder cross bred cows under rural condition of Satara District of Maharashtra. *IJAVST*. 3(1): 109–113.
- Blood, D.C., O.M. Radostits. 1989. Normal laboratory values. In: Blood, D.C, Radostits O.M. Eds. *Veterinary Medicine*, 7th ed. London: Bailliere Tindall 1463
- Brommage, R, C. Binacua, A.L. Carrie. 1993. Ovulation associated increase in intestinal calcium absorption during the rat estrous cycle is blunted by ovariectomy. *Biol. Rep.* 49 (3):544-548.
- Carnegie, J. A and B. K. Tsang. 1984 The calcium calmodulin system; participation in the regulation of steroidogenesis activity at different stages of granulosa cell differentiation. *Biol. Rep.* 30: 515-522
- Ceylan, A., İ. Serin, H. Aksit, And K. Seyrek. 2008. Concentrations of some elements in dairy cows with reproductive disorders. *Bull Vet Inst Pulawy*. 52:109–112.
- Cressent, M, C. Elie, J. Taboulet, M. S. Moukhtar, and G. Milhaud. 1983. Calcium regulating hormones during the estrous cycle of the rat. In: *Proceedings of The Society For Experimental Biology and Medicine* vol 172: 158–162.
- Das, J. M., P.Dutta, K. C Deka, R. K. Biswas, B. C. Sarmah and A. Dhali. 2009. Comparative study on serum macro and micro mineral profiles during oestrus in repeat breeding crossbred cattle with impaired and normal ovulation. *Livestock Research for Rural Development*. Volume 21, Article #72. Retrieved August 24, 2017, from <http://www.lrrd.org/lrrd21/5/das21072.htm>
- Devi, I., P. Singh, S. S. Lathwal, A. Kumaresan, and K. Dudi. 2016. Evaluation of salivary electrolytes during estrous cycle in Murrah buffaloes with reference to estrus detection. *Veterinary World*. 9(10): 1157–1161. doi: 10.14202/vetworld.2016.1157-1161.
- Hugentobler, S.A, D.G. Morris, J.M. Sreenan, M.G. Diskin. 2007. Ion concentrations in oviduct and uterine fluid and blood serum during the estrous cycle in the bovine. *Theriogenol* (68):538-548
- Hurley, W. L., R.M. Doane. 1989. Recent developments in the roles of vitamins and minerals in reproduction. *J Dairy Sci*. 72: 784-804
- Jordan, E.R., T.E. Chapman, D.W. Holtan, L. V. Swanson. 1983. Relationship of dietary crude protein to composition of uterine secretions and blood in high-producing postpartum dairy cows. *J Dairy Sci* . 66(9): 1854-1862
- Larvor, P. 1983. Physiological and biochemical functions of magnesium in animals. In: *Roles of Magnesium in Animal Nutrition*. Anim Nutr Progr Virginia Polytechnic Inst. State Univ, Blacksburg, USA.
- López-Gatius, F. and Camón-Urgel, J. 1991. Confirmation of estrus rates by palpation per rectum of genital organs in normal repeat dairy cows. *J. Vet. Med. A*. 38:553–556.
- Mitruka, B. M., and H. M. Rawnsley. 1981. Clinical biochemical and hematological reference values in normal experimental animals and normal humans. New York: Masson Pub. USA. Pp 233-234
- Nuryadi and S. Wahjuningsih. 2011. Penampilan reproduksi sapi peranakan Ongole dan peranakan Limousin di Kabupaten Malang. *J. Ternak Tropika*. 12(1): 76–81.
- Small, J. A., E. Charmley, A. V. Rodd, and, A. H. Fredeen. 1997. Serum mineral concentrations

in relation to parturition in beef heifers and cows fed conserved forage. *Can J Anim Sci.* 77(1): 63–68. doi: 10.4141/A96-043.

- Subiharta, B. Utomo, P. Sudrajad. 2012. Potensi sapi peranakan ongole (PO) Kebumen sebagai sumber bibit sapi lokal di Indonesia berdasarkan ukuran tubuhnya (Studi pendahuluan). In *Prosiding Seminar Nasional Pengembangan Agribisnis Peternakan Menuju Swasembada Protein Hewani Fakultas Peternakan Universitas Soedirman dan ISPI, Purwokerto.* pp 1-9
- Yaso thai, R. 2014. Importance of Minerals on reproduction in dairy cattle. *International Journal of Science, Environment and Technology* Vol. 3. No 6: 2051 – 2057
- Yulyanto, C.A, T. Susilawati, M. N. Ihsan, 2014. Penampilan reproduksi sapi Peranakan Ongole (PO) dan sapi Peranakan Limousin di Kecamatan Sawoo Kabupaten Ponorogo dan Kecamatan Tugu Kabupaten Trenggalek. *Jurnal Ilmu Ilmu Peternakan* Vol 24 (2): 49-57