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Selenium concentration in plasma and milk in different lactational and reproductive states in buffaloes

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Abstract

The buffaloes in different lactational and reproductive status were categorised in nine different groups comprising 12 animals each. Blood and milk samples were collected and analysed for the level of selenium using Inductively Coupled Plasma Atomic Emission Spectroscopy. The Selenium in blood and milk in different lactational and reproductive states of buffaloes were within normal physiological limits. Plasma Selenium levels were significantly different in lactation as well as reproductive states whereas milk Selenium was significantly different only in lactational state.

Keywords: Selenium, lactation, reproduction, plasma, milk

Introduction

Selenium is a trace element that plays an important role in the health and performance of animals. In cattle, selenium deficiency can have economically significant impacts such as reduced fertility, placental retentions and the incidence of mastitis and metritis^[30] (Sordillo L.M. 2013). A large number of factors such as species, breed, sex, age malnutrition, illness, reproductive status, and physiological variations, can affect the serum chemistry values^[28] (Swenson *et al.*, 2004). Similar to soil and plants, animal tissue or fluid mineral concentrations are influenced by many factors, including kind and levels of production, level and chemical form of elements, mineral intake, interrelationships with other nutrients and animal adaptation^[18] (Mc Dowell, 2003).

Other factors such as animal physiological status, seasons, region, year and forage species affect the mineral status of animal tissues or fluids^[15] (Khan *et al.*, 2009). Selenium (Se) is a semi-metal that is very similar to sulphur in its chemical properties. It is an essential constituent of the glutathione enzyme system; and a deficiency of Se will leave cells vulnerable to oxidation and increase the requirement for Vitamin E. Selenium is a natural antioxidant. It protects organelle and cell membranes containing lipids from oxidation by reactive oxygen species (ROS)^[19].

Considering the importance of selenium in animals^[16] milk the present investigations was carried out with respect to assessment of concentrations of selenium in plasma and milk of buffaloes in different lactational as well as reproductive states.

Materials and Methods

Buffaloes maintained at well organized "Takawale Private Buffalo Farm", Pargaon, Taluka, Shirur, Dist. Pune (Maharashtra), were used for the present investigation. The experimental animals were categorized into different groups according to phase of lactation and reproductive states.

Blood and milk samples, as the case may be, from experimental animals were collected at the same time and carried immediately on ice to the Department of Veterinary Physiology KNP College of Veterinary Science, Shirwal-412 801, Dist. Satara (Maharashtra State) for digestion and preparation of aliquots. The aliquots were analysed for selenium by using Inductively Coupled Plasma Atomic Emission Spectroscopy at Sophisticated Analytical Instrument Facility (SAIF) of Indian Institute of Technology (IIT), Powai, Mumbai-400076.

The data obtained was statically analysed by applying Completely Randomized Design (CRD) and Simple correlation (Snedecor and Cochran, 1989)^[27] from the groups assigned in Table 1 and Table 2.

Results

Plasma Selenium (Se) in Reproductive states: The mean \pm SE values of plasma selenium (ppm) in different reproductive states in buffaloes are presented in Table 3. The concentration of plasma selenium (ppm) in different reproductive states in buffaloes ranged from 0.160 ± 0.002 to 0.179 ± 0.002 with an average value of 0.168 ± 0.001 during pregnancy. Statistical analysis of present data revealed that there was a significant ($P < 0.01$) difference in the values of plasma selenium among different reproductive states in buffaloes. Among the first three groups the value for Group II (0.179 ± 0.002) was significantly higher than Group I (0.162 ± 0.001) and Group III (0.160 ± 0.002) with no significant difference between the latter two Groups.

Plasma Selenium in Lactational states: The mean \pm SE values of plasma Selenium (ppm) in different lactational states in buffaloes are presented in Table 4.

The concentration of plasma Selenium (ppm) in different lactational states in buffaloes ranged from 0.154 ± 0.003 to 0.169 ± 0.002 with an average value of 0.162 ± 0.002 during lactation. Statistical analysis of present data revealed that the level of plasma selenium during different periods of lactation differed significantly ($P < 0.01$) and there was a decreasing trend in the values of plasma Selenium (ppm) from Group I (0.169 ± 0.002) through Group II (0.163 ± 0.002) to Group III (0.154 ± 0.003).

Milk Selenium (Se) in Reproductive states: The mean \pm SE values of milk Selenium (ppm) in different reproductive states in buffaloes are presented in Table 3. The concentration of milk Selenium (ppm) in different reproductive states in buffaloes ranged from 0.029 ± 0.001 to 0.035 ± 0.002 with an average value of 0.032 ± 0.01 during pregnancy. Statistical analysis of the present data revealed that the level of milk Selenium (ppm) during different reproductive states in buffaloes did not differ significantly among the groups. The value of milk Selenium (ppm) in Group III (0.034 ± 0.003) was higher than the values in Group II (0.029 ± 0.001); during pregnancy the values were Groups IV (0.033 ± 0.002), V (0.035 ± 0.002) and VI (0.030 ± 0.002).

Milk Selenium (Se) in Lactational states: The mean \pm SE values of milk Selenium (ppm) in different lactational states in buffaloes are presented in Table 4. The concentration of milk Selenium (ppm) in different lactational states in buffaloes ranged from 0.027 ± 0.001 to 0.035 ± 0.001 with an average value of 0.029 ± 0.001 during lactation. Statistical analysis of present data revealed that the level of milk Selenium (ppm) during different periods of lactation differed significantly ($P < 0.05$) and the values show an increasing trend among the three groups Viz. Early (0.027 ± 0.001), Mid (0.030 ± 0.001) and Late (0.035 ± 0.001) lactation.

Discussion

Plasma Selenium (Se) in Reproductive states: Higher value of plasma selenium in normally cyclic buffaloes than in anestrus buffaloes was corroborated with the reports of (Akhtar *et al.*) who reported the selenium level in the cyclic buffaloes was $0.10 \pm 0.008 \mu\text{g/ml}$ (ppm) and in anestrus buffaloes it dropped significantly to $0.07 \pm 0.010 \mu\text{g/ml}$ (ppm) [1]. Among various reproductive defects infertility is reported to be responsive to selenium supplementation [11] (Ibtisham F. *et al.*, 2018). The plasma selenium value (ppm) of post

pubertal cyclic buffaloes in present study was higher than those reported by (Kumagai *et al.*, 1996) in buffaloes [16] and in cattle by (Barui *et al.*, 2015) [3].

The level of plasma selenium during different periods of pregnancy differed significantly ($P < 0.01$). The values in Groups IV, V and VI were 0.175 ± 0.001 , 0.167 ± 0.002 and 0.164 ± 0.002 (ppm), respectively, with decreasing trend. The decreasing trend in the value of plasma selenium with the advancement of pregnancy may be due to placental transfer of selenium for intrauterine development of calves which, passes in considerable amounts through the placental barrier to the fetus, thus reducing the body pool of selenium in a pregnant female (Gunter *et al.*, 2003) [8]. This is why in late pregnancy, when fetuses develop and increase their weights most intensively, cows have much lower serum selenium concentrations compared to non-pregnant heifers and cows [26] (Slavic *et al.*, 2008) reported that in the body of a pregnant female, mainly in the last third of pregnancy, the uterus is given priority to other organs in the distribution of some substances, according to the homeorhetic principle. When the cow has a marginal level of Se, the fetus still receives adequate amounts of Selenium. However, when the cow is deficient in this element, deficiency is also observed in the fetus [8] (Gunter *et al.*, 2003). The value of plasma selenium in Group VI is in close agreement with the records of (Akhtar *et al.*, 2012) in buffaloes. The average value during pregnancy in present study agreed with [2] (Akhtar *et al.*, 2012) in healthy control group of pregnant buffaloes. However, the average value during pregnancy in present finding was higher than those reported by (Kumagai *et al.*, 1996) in cows [16]. Among different reproductive states in buffaloes the value of plasma Selenium (ppm) of present study in Group I (0.162 ± 0.001) was corroborated with the finding of [7] (Gadberry *et al.*, 2003) in cows. However, the present finding was higher than those reported by [26] (Slavik *et al.*, 2007) in cows.

Plasma Selenium in Lactational states: The average value during lactation in present findings were higher than those reported by (Kumagai *et al.*, 1996) in cows [16]. Thus, there was a significant decrease in the level of plasma Se with the advancement of lactation. The findings were in accordance with (Pilarczyk *et al.*, 2012) in cows who reported a lower concentration of selenium compared to early-lactation cows [24]. Thus, the kind of decreasing trend in plasma Selenium may be ascribed to the transfer of considerable amounts of Se to the milk produced, at least in part. (Pilarczyk *et al.*, 2012) [24]. Secondly, there exists a reverse trend in the level of selenium in plasma and milk in present study during lactation as has been discussed later which clearly supports the view of selenium drain through milk. The value in Group I (0.169 ± 0.002) was higher than the value in early lactation (0.069 ppm) reported by (Pavlata *et al.*, 2004) [22]. The average value of plasma Selenium during lactation (0.162 ± 0.002) was congruent with the value reported by (Pechova *et al.*, 2008) [23] in cows.

Milk Selenium (Se) in Reproductive states: No values were available in the literature to compare the level of milk Selenium during pregnancy. It is interesting to note that there was almost a reverse trend of milk selenium as compared to plasma selenium in the same groups of present study except in Group VI, supports the assumption of milk drain of Selenium resulting in its reflection on plasma Selenium values. No reports are available in the literature to compare the milk

values in different reproductive states, either in buffaloes or in cows.

Milk Selenium (Se) in Lactational states : The average value of milk selenium during lactation was closely (± 0.010 ppm) in agreement with the findings of in buffaloes and (Pechova *et al.*, 2008) in cows and also with (Pavlata *et al.*, 2004) [22] in cows but in Colostrum. However, present finding was lower than those reported by (Quadri and Dakshinkar, 2014) [25] in cows. These findings were closely corroborated with findings of (Merkel *et al.*, 1991) in buffaloes as well as in cows who reported significant increase in the values of milk Selenium from early (6-8 weeks) to late (32-34 weeks) lactation in both, cows and buffaloes. The value of milk Se in Mid lactation in present study (0.030 ± 0.001 ppm) was almost in accordance with (Dobrzanski, *et al.*, 2005) [4] in cows. The increasing trend in milk Se during lactation supports the earlier finding of decreasing plasma Se during lactation indicating drain of Selenium through milk in the present study. This was supported by (Faye *et al.*, 2011) who has stated that one reason of the decrease in Se in the mother serum after delivery, independently of Se form received by the animals could be attributed to the active placental transfer of Se and to the milk selenium excretion [6].

Interrelationship of Selenium in blood plasma and milk: Simple correlation coefficients of selenium in blood plasma and milk in different reproductive and lactational state when

calculated, was found to be a non - significant positive correlation with r value as 0.068. Similar positive correlation was reported by (Pechova *et al.*, 2008) [23]. However, (Grace *et al.*, 2001) [9] found a statically significant linear correlation between blood selenium concentration and milk selenium.

It is concluded that the micro-mineral selenium in blood and milk in different lactational and reproductive state of buffalo were within normal physiological limits. However, Plasma Selenium was influenced by different lactational as well as reproductive state whereas Milk Selenium was influenced only by different lactational state.

Table 1: According to Reproductive state:

Groups	Reproductive State	No. of Animals
I	Prepubertal buffalo heifers	12
II	Postpubertal cyclic buffaloes	12
III	Postpubertal true anestrus buffaloes	12
IV	Buffaloes in early pregnancy	12
V	Buffaloes in mid pregnancy	12
VI	Buffaloes in advance pregnancy	12

Table 2: According to phase of Lactation

Groups	Lactational State	No. of Animals
I	Buffaloes in early lactation.	12
II	Buffaloes in mid lactation	12
III	Buffaloes in late lactation	12

Table 3: Levels of Selenium (ppm) in blood plasma and milk in different reproductive States in Buffaloes:

Gr	Reproductive State	Se (ppm) In blood plasma (1)	Se (ppm) In milk (2)
I	Prepubertal buffalo heifers	0.162 ± 0.001^c	-----
II	Postpubertal cyclic buffaloes	0.179 ± 0.002^a	0.029 ± 0.001^{NS}
III	Postpubertal true anestrus buffaloes	0.160 ± 0.002^c	0.034 ± 0.003^{NS}
IV	Buffaloes in early pregnancy	0.175 ± 0.001^a	0.033 ± 0.002^{NS}
V	Buffaloes in mid pregnancy	0.167 ± 0.002^b	0.035 ± 0.002^{NS}
VI	Buffaloes in advance pregnancy	0.164 ± 0.002^c	0.030 ± 0.002^{NS}
	Average value during pregnancy	0.168 ± 0.001	0.032 ± 0.01

(In column No. 1 and 2, similar super scripts indicates Non Significant difference & dissimilar super scripts indicates significant difference at 1% level of significance)

Table 4: Levels of Selenium (ppm) in blood plasma and milk in different lactational states in buffaloes

Gr.	Lactational State	Se (ppm) In blood plasma	Se (ppm) In milk
I	Buffaloes in early lactation.	0.169 ± 0.002^a	$0.027 \pm 0.001^{*a}$
II	Buffaloes in mid lactation	0.163 ± 0.002^b	$0.030 \pm 0.001^{*b}$
III	Buffaloes in late lactation	0.154 ± 0.003^c	$0.035 \pm 0.001^{*c}$
	Average	0.162 ± 0.002	0.029 ± 0.001

(In column No. 1 similar super scripts indicates Non Significant difference & dissimilar super scripts indicates Significant difference at 1% level of significance and in column 2 1 similar super scripts indicates Non Significant difference & dissimilar super scripts indicates Significant difference at 5% level of significance)

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