



Original Research

Plasma and Milk Copper Levels in Different Lactational and Reproductive Status in Buffaloes

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Abstract

Present study was conducted to estimate the plasma and milk copper level of the buffaloes in different lactation and reproductive stage. Buffaloes were categorised in nine different groups comprising 12 animals each. Blood and milk samples as the case may be were collected and analysed for the level of copper using Atomic Absorption Spectrophotometer (Elico, SL-194). The copper in blood and milk in different lactational and reproductive states of buffalo were within normal physiological limits. However, marginally higher overall plasma copper content than the reported values in literature was observed in present study. Plasma and milk copper levels were influenced by different lactational as well as reproductive states.

Key words: Buffaloes, Copper, Reproduction, Lactation

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Introduction

Trace element like copper (Cu) being integral part of metal-enzymes is needed for vitamin synthesis, hormone production, enzyme activity, collagen formation, tissue synthesis, oxygen transport, energy production, and other physiological processes related to growth, reproduction and health. Infertility has been commonly recorded in Cu and Mn deficiencies resulting in depressed or delayed oestrus and poor conception rate in cows (Underwood, 1977). Copper is also an essential component of many metalloenzymes including cytochrome oxidase and tyrosinase and it is involved in haemopoiesis, maintenance of vascular and skeletal integrity and structure and function of central nervous system. It plays an important role in haemoglobin synthesis, melanin formation and phospholipid and collagen synthesis. The Cu concentration behaves specifically during foetal organogenesis and its association with physiology



of endocrine glands relates it to pregnancy establishment and its successful termination (Pathak *et al.*, 1986).

There is scanty information about the electrolyte and micro mineral status during pregnancy and lactation in buffaloes. Much less information is known on the status of copper content in blood and milk during different lactational and reproductive status in buffaloes. Hence, the present investigation was undertaken to assess the mineral composition of blood and milk in different physiological states i.e. lactational and reproductive. Thus the objectives of this study is to estimate the copper level in blood plasma and milk of buffaloes according to different reproductive states and phase of lactation.

Material and Method

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

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

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

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, Shirval-412 801, Dist. Satara (Maharashtra State) for estimation of Copper content by standard techniques using Atomic Absorption Spectrophotometer (Elico, SL-194).

Statistical Analysis

The data obtained were statically analysed by applying Completely Randomized Design (CRD) and simple correlation (Snedecor and Cochran, 1989).

Results and Discussion

The mean \pm SE values of plasma and milk copper (ppm) in different reproductive status in buffaloes are presented in Table 1 and The mean \pm SE values of plasma and milk copper (ppm) in different lactational status in buffaloes are presented in Table 2. The mean \pm SE values of milk copper (ppm) in different reproductive status in buffaloes are presented in Table 1. No values were available in the literature to compare the level of milk Cu during pregnancy.

Table 1: Levels of copper (ppm) in blood plasma and milk in different reproductive states in buffaloes

Gr.	Reproductive State	Cu (ppm)	Cu (ppm)
		In Blood Plasma	In Milk
		(1)	(2)
I	Prepubertal buffalo heifers	1.98 ^a \pm 0.24	-----
II	Postpubertal cyclic buffaloes	1.83 ^a \pm 0.30	1.48 ^a \pm 0.21
III	Postpubertal true anestrus buffaloes	1.65 ^a \pm 0.20	1.23 ^{ab} \pm 0.17
IV	Buffaloes in early pregnancy	1.58 ^a \pm 0.17	0.90 ^{bc} \pm 0.13
V	Buffaloes in mid pregnancy	2.15 ^a \pm 0.18	0.69 ^c \pm 0.12
VI	Buffaloes in advance pregnancy	0.96 ^b \pm 0.14	1.17 ^{ac} \pm 0.14
	Average value during pregnancy	1.56 \pm 0.12	0.92 \pm 0.08

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

Table 2: Levels of copper (ppm) in blood plasma and milk in different lactation state in buffaloes

Gr.	Lactation State	Cu (ppm)	Cu (ppm)
		In Blood Plasma	In Milk
		(1)	(2)
I	Buffaloes in early lactation.	1.60 ^b \pm 0.17	1.90 ^a \pm 0.19
II	Buffaloes in mid lactation	2.06 ^a \pm 0.11	0.98 ^b \pm 0.15
III	Buffaloes in late lactation	2.29 ^a \pm 0.09	1.19 ^b \pm 0.15
	Average	1.99 \pm 0.09	1.35 \pm 0.11

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

Plasma Copper

An average value of plasma copper (ppm) during pregnancy was 1.56 \pm 0.12 and it was comparable (\pm 0.25) to the findings reported (Haldar *et al.*, 1995) in cows. However, values reported in buffaloes (Pankaj Kumar *et al.*, 2007) and in cows (Yatoo *et al.*, 2013) were lower and those reported in cows (Sarmah *et al.*, 1999) were higher than the present findings. Among different reproductive states in buffaloes the value of plasma copper (ppm) in Group I (1.98 \pm 0.24) of present study is comparable with a difference of \pm 0.25 to the values reported in buffaloes (Kumar *et al.*, 2005) and collectively in cows and buffaloes (Tiwarly *et al.*, 2010). Statistical analysis of present data revealed that there was a significant difference ($P < 0.01$) in the values of plasma copper among different reproductive states in buffaloes. Among the first three groups there was no significant difference with the value for Group I, Group II and for Group III with decreasing trend. Lower values in Group III (true anestrus buffaloes) than Group II (cyclic buffaloes) in present study

were corroborated with the reports (Akhtar *et al.*, 2009 and Jayachandran *et al.*, 2013) in buffaloes. Oestrogen hormone has been reported to increase the level of copper and the lower level of copper in true anoestrus buffaloes (Group III) in present study than Group II may be due to lower oestrogen level in anoestrus animals. In support, Kulkarni *et al.* (1994) noticed highest serum Cu concentration in the follicular phase of the animals as compared to the animals with non-functional smooth ovaries. The significant fall in Cu content of blood in pregnant buffaloes as compared to Group I and II might be due to the physiological changes which accompany pregnancy. An increase in blood volume and demand of the developing foetus are considered to be responsible for these changes to a great extent.

The level of plasma Cu during different periods of pregnancy differed significantly ($P < 0.01$) and present findings were closely related with the findings of in cows (Patil, 2008), although reported values were far higher than present study. Results of the present study were in accordance with those of Ghergariu *et al.* (1986) who observed decrease in Cu values to 0.67 ppm at 8 weeks before calving and with Pathak *et al.* (1986) who reported decrease in serum Cu level from day 275 of pregnancy till parturition. Similarly, in Surti buffaloes recorded that blood serum Cu concentration maintained an elevated plateau from 65 to 95 days of gestation (Pathak and Janakiraman, 1986) as Cu is involved in development of brain and nervous system of foetus. Rajora *et al.* (1997) reported decreasing trend of Cu and Yokus and Cakir (2006) who reported increasing trend of Cu during pregnancy. The rising level of Cu during pregnancy seems to be closely related with accelerated development of the growing foetus because increasing concentrations of Cu in the serum of the mother during gestation ensures continuous and sufficient supply of copper to the developing foetus. Foetal growth and development are associated with increased production of dehydroepiandrosterone sulphate by foetal adrenal gland which in turns leads to increased placental production of estradiol-17 β and estrone. The mean \pm SE values of plasma copper (ppm) in different lactational status in buffaloes are presented in Table 2. The average value during lactation (1.99 ± 0.09) was closely (± 0.50 ppm) associated with the findings of in lactating buffaloes (Dhore and Udar, 2007).

Statistical analysis of present data reveals that the level of plasma copper (ppm) during different periods of lactation differed significantly ($P < 0.01$), and there was an increasing trend in the values of plasma copper (ppm) from Group I to Group III. Thus, there was a gradual increase in the level of plasma copper (ppm) with the advancement of lactation. These findings were congruent with those reported from their month wise observation of Cu level that after parturition the whole blood plasma concentration of Cu reflected the increasing trends with advancement of lactation in buffaloes and cows, respectively. However, the average value of plasma copper during pregnancy seems to be lower than average value during lactation. These findings are similar to those reported (Parshad *et al.*, 1979) in buffaloes in late pregnancy and in early lactating buffaloes (Rakesh Kumar *et al.*, 2000).

Gradual increase in the level of plasma copper (ppm) was reported with significantly lower value in Group I as compared to Group II and III, with no significant difference between Group II and III in the present research in buffaloes but with increasing trend with advancement of lactation could be due to decreased secretion of Cu into milk. Decreased milk Cu with the progress of lactation in both, cows and buffaloes also been reported (Singh *et al.*, 1991). Further, it was also supported by the findings reported latter in the present research which indicated almost a decreasing trend in the values of milk Cu with the advancement of lactation.

Milk Copper (Cu)

The mean \pm SE values of milk copper (ppm) in different reproductive status in buffaloes are presented in Table 1. No values were available in the literature to compare the level of milk Cu during pregnancy. Statistical analysis of the present data revealed that the level of milk copper (ppm) during different reproductive states in buffaloes differed significantly ($P < 0.01$) among the groups. The values of milk copper (ppm) in Groups II, III and VI did not vary significantly. No significant difference between the latter two Groups (III and VI) was observed. Group V of present study had significantly ($P < 0.01$) lower values than the Group II, Group III and Group VI. The value of Group V was also lower than Group IV but with no significant difference.

It is interesting to note that the level of milk copper (ppm) in Group III was lower than II with no significant difference and is not exactly reverse to that of plasma copper (ppm) level of the present research work. However, the levels of milk copper (ppm) during pregnancy among the Groups IV, V, and VI were with apparently increasing trend. Exactly, reverse trend is recorded in plasma copper (ppm) level in Group IV to VI of the present research work. This latter reverse trend in the levels of plasma copper (ppm) in the present study supports the view that the Cu drain through milk reduces the level of plasma Cu and is reflected in higher concentration of milk Cu during the same periods. No reports are available in the literature to compare the milk values in different reproductive states, either in buffaloes or in cows. The mean \pm SE values of milk copper (ppm) in different lactational status in buffaloes are presented in Table 2. The average value during lactation was closely (± 0.25) associated with the findings in buffaloes (Hussain *et al.*, 2001). However, Shahriar *et al.* (2014) have reported milk copper values which were lower than the present findings. On the contrary far higher values than the present findings were observed in cows as well as in buffaloes (Mousa *et al.*, 2006).

It seemed that the findings of most of the workers in the literature were not in agreement with the present findings since the reported plasma Cu level in buffaloes in present study were higher. Recent survey work indicated that in cattle & buffaloes, sufficient levels of Copper existed in soil, feed and fodders, concentrates and the serum of animals content in Shirur tehsil of Pune district (Patodkar, 2013) in which the farm of

buffaloes used for present study is located. Secondly, wide variation in the mineral content of milk by various workers could be due to variety of factors such as season, nature of soil, cattle race, type of feeding milk yield, physiological state, age and parity.

Statistical analysis of present data revealed that the level of milk copper (ppm) during different periods of lactation differed significantly ($P < 0.01$) among the three groups with significantly higher value in early than mid and late lactation but with no significant difference in the latter two groups, the values show apparently decreasing trend. These findings were closely corroborated with findings of which reported decrease in milk copper from early to mid-lactation in first five months and with the reports of (Anilkumar *et al.*, 2003, Patino *et al.*, 2007) which reported that the level of Cu in milk decreased by 31% and 11% in the second and third trimesters of lactation stage, with respect to first trimester, respectively, in buffaloes. In support, decreasing trend of copper in cow milk from early (from 15 to 90 days) to mid- late (105 to 300 days) lactation (Phukan *et al.*, 2000). However, present findings could not be corroborated with those in buffaloes (Merkel *et al.*, 1991) where reported higher copper content in milk at 30-32 weeks than at 6-8 weeks of lactation. Milk copper content in early lactating buffaloes in present study was higher than those of in buffaloes (Ahmad *et al.*, 2007).

Thus, the present findings of apparently decreasing level of milk copper (ppm) confirm the earlier discussion regarding gradual increase in plasma copper (ppm) levels with the progress of lactation.

Conclusion

The present study states that copper in blood and milk in different lactational and reproductive states of buffalo were within normal physiological limits. However, marginally higher overall plasma copper content than the reported values in literature was observed in present study. Plasma and Milk Copper levels were influenced by different lactational as well as reproductive states.

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