IOSR Journal of Agriculture and Veterinary Science (IOSR-JAVS)
e-ISSN: 2319-2380, p-ISSN: 2319-2372. Volume 11, Issue 3 Ver. I (March 2018), PP 28-32
www.iosrjournals.org

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

V R Patodkar[1]*, S T Bapat[2],P V Mehere[3]And L A Pangaokar[4]
[1.]Associate Professor and Head, Department of Veterinary Physiology KNP College of Veterinary Science, Shirwal-412 801 Dist. Satara, Maharashtra, India.
[2] Ex-Professor and Head, Department of Veterinary Physiology KNP College of Veterinary Science, Shirwal-412 801 Dist. Satara,
Maharashtra, India.
[3] Assistant Professor, Department of Veterinary Physiology KNP College of Veterinary Science, Shirwal-412 801 Dist. Satara, Maharashtra, India.
[4] PhD Scholar, Department of Veterinary Physiology KNP College of Veterinary Science, Shirwal-412 801 Dist. Satara, Maharashtra, India.
Corresponding author: V R Patodkar

Abstract: *The buffaloes in different lactational and reproductive status were categorised in nine different groupscomprising 12 animals each. Blood and milk samples were collected and analysed for the levelof Zinc using Atomic Absorption Spectrophotometer (Elico, SL-194). The zinc in blood and milk in different lactationaland reproductive states of Buffalo were within normal physiological limits. Level of Zn was higher in milk than that of in plasma. Plasma Zinc levels were influenced only by reproductive states. However, milk Zinc levels were were influenced by different lactational as well as reproductive state.*

Date of Submission: 24-02-2018 Date of acceptance: 12-03-2018

I. Introduction

zinc has been shown to be important for gonadal growth in rats, lambs and is responsible for infertility in ewes[1]. Role of trace minerals particularly copper and zinc in maintaining reproductive rhythm is well documented as they are specific activators of enzyme systems responsible for it [2]. Among the various roles for Zn in immunity are gene expression, mitosis, and apoptosis of lymphoid cells. Since, DNA polymerase, the major enzyme regulating DNA replication, is Zn-dependent, proliferative responses of macrophages, T cells or B cells may have use as early indicators of Zn status. Animal studies have indicated that all phases of reproduction in the female, from oestrus to parturition and lactation, are affected adversely by zinc deficiency.The most common signs of Zn deficiency is growth retardation and anorexia in all species. Reduction in plasma alkaline phosphates activity and hyperkeratinization of the epithelial cells is common low zinc concentration symptoms (parakeratosis in swine).

Pregnancy and lactation are physiological statuses considered to modify metabolism in animals. During pregnancy, maternal tissues are involved in providing energy for reproductive processes, which may affect blood serum chemistry values, affected also by several other factors as breed, age, malnutrition, foetal growth, or season[3].

Role of Zn is hardly studied in buffalo during reproductive and lactational period. This paper is shedding light on the role of Zn during crucial period of production in buffaloes.

II. Material And Methods

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.

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

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

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 Zinc content by standard techniques using Atomic Absorption Spectrophotometer (Elico, SL-194). The data obtained was statically analysed by applying Completely Randomized Design (CRD) and Simple correlation (Snedecor and Cochran, 1989).

III. Result

The mean ± SE values of plasma and milk Zinc(ppm) in different reproductive status in buffaloes are presented in Table 1 and The mean ± SE values of plasma and milk Zinc (ppm) in different lactational status in buffaloes are presented in Table 2.An average value of plasma zinc (ppm) during pregnancy was 1.71 ± 0.16. The mean ± SE values of plasma Zinc (ppm) in different reproductive status in buffaloes are presented in Table 1. The mean ± SE values of plasma Zinc (ppm) in different lactational status in buffaloes are presented in Table 2. The concentration of plasma Zinc (ppm) in different lactational status in buffaloes ranged from 1.88 ± 0.29to 2.10 ± 0.31with an average value of 2.01 ± 0.17 during lactation.The mean ± SE values of milk Zinc (ppm) in different reproductive status in buffaloes are presented in Table 1. The concentration of milk Zinc (ppm) in different reproductive states in buffaloes ranged from 2.58 ± 0.16to 3.38 ± 0.18with an average value of 2.74 ± 0.09 during pregnancy.

Table 1. Levels of Zinc (ppm) in blood plasma and milk in different reproductive States in buffaloes.

Gr.	Reproductive State	Zn (ppm) In blood plasma (1)	Zn (ppm) In milk (2)
I	Prepubertal buffalo heifers	**1.98^{a} ± 0.31**	--------
II	Postpubertal cyclic buffaloes	**2.56^{a} ± 0.37**	**2.69^{b} ± 0.14**
III	Postpubertal true anestrus buffaloes	**2.13^{a}± 0.30**	**3.38^{a} ± 0.18**
IV	Buffaloes in early pregnancy	**1.83^{a}± 0.29**	**2.58^{b} ± 0.16**
V	Buffaloes in mid pregnancy	**1.75^{a}± 0.26**	**2.81^{b} ± 0.16**
VI	Buffaloes in advance pregnancy	**1.54^{a} ± 0.29**	**2.83^{b} ± 0.14**
	Average value during pregnancy	**1.71 ± 0.16**	**2.74 ± 0.09**

Table 2. Levels of Zinc (ppm) in blood plasma and milk in different lactational states in buffaloes.

Gr.	Lactational State	Zn (ppm) In blood plasma	Zn(ppm) In milk
I	Buffaloes in early lactation.	**1.88^{a} ± 0.29**	**4.50^{a} ± 0.17**
II	Buffaloes in mid lactation	**2.06^{a} ± 0.34**	**3.25^{b} ± 0.21**
III	Buffaloes in late lactation	**2.10^{a} ± 0.31**	**2.85^{b} ± 0.13**
	Average	**2.01 ± 0.17**	**3.53 0.15**

IV. Discussion

Plasma Zinc (Zn): The concentration of plasma Zinc (ppm) in different reproductive states in buffaloes ranged from 1.54 ± 0.29to 2.56 ± 0.37with an average value of 1.71 ± 0.16 during pregnancy. Among different reproductive states in buffaloes the value of plasma Zinc (ppm) in Group I of present study was comparable (± 0.25) to the values reported by Pankaj Kumar[4,5]. in buffaloes. The value in present finding was higher than those reported by Pankaj Kumar[6]. in buffaloes, Tiwary*et al.* [7] in cows and buffaloes.

Statistical analysis of present data revealed that there was no significant difference in the values of plasma Zinc among different reproductive states inbuffaloes. Among the first three groups the value for Group II was higher than Group I and Group III. Higher value of plasma Zinc in normally cyclic buffaloes than in anestrous buffaloes was corroborated with the reports of Jayachandran and references there in buffaloes[8]. Fall in zinc level was generally associated with fall in the level steroid hormone concentrations which had indicated that there was some co-relation between plasma zinc levels and progesterone-estrogen levels for proper reproductive processes[9].Secondly, Zn is an integral part of hormone insulin and enzymes carbonic anhydrase and lactate dehydrogenase, and is therefore essential for normal fertility .

The level of plasma Zinc during different periods of pregnancy did not differ significantly. The values in Groups IV, V and VI were with decreasing trend and no significant difference. Present finding of decrease in plasma Zn level with the advancement of pregnancy was congruent with Setia *et al.*[10] who reported the concentrations of Zn, in whole blood and blood plasma of buffaloes and cows declined progressively with the pregnancy.

Finding of Abd Ellah*et al.* [11] supports the present research, since, they reported significantly lower value of serum Zn in more than 6 months (Late) of pregnancy than that of in less than 6 months (Early-Mid) of pregnancy in buffaloes. Similarly, Yokus and Cakir[3] in cows who reported nonsignificant fall in serum Zn level in late pregnancy, were in partial agreement with the present finding. Decline in plasma Zn level with the progression of pregnancy might be due to placental transfer of Zn, higher circulating levels of estrogens and or haemodilution by increased maternal plasma volume[10] .

The average value of Zn during lactation was closely associated with (± 0.25) the findings of Parshad *et al*,[12]in buffaloes. However, present findings were higher than those reported by in cows and buffaloes[7] and were lower than those reported by in buffaloes[13].

Statistical analysis of present data revealed that the level of plasma Zinc during different periods of lactation did not differ significantly. However, there was an increasing trend in the values of plasma Zinc (ppm) from Group I through Group II to Group III .Thus, there was a gradual increase in the level of plasma Zn with the advancement of lactation. Present findings were at par with the findings, who recorded increase in Zn concentration throughout the period of lactation in buffaloes[10].

These changes in the level of plasma Zinc during lactation might be associated with the fact that transition from gestation to lactation is a period of great metabolic stress for dairy animals. The noteworthy fact in the presentfindings was that not only the level of plasma Zinc during three phases oflactation showed increasing trend but the milk Zn during the same period was also having an apparently decreasing trend (reported in fore-coming discussion) which naturally means it was related with the amount of Zn excreted through milk. This reasoning for the present trend of plasma Zinc levels during lactation was supported by report who opined that reduced levels of serum Zn during lactation could be due to drain of Zn in milk during lactation[14].

Milk Zinc (Zn): No values were available in the literature to compare the level of milk Zinc during pregnancy.

Statistical analysis of the present data revealed that the level of milk Zinc (ppm) during different reproductive states in buffaloes did not differ significantly among the groups except the value in Group III (Postpubertal true anestrus buffaloes) which was significantly ($P<0.01$) higher than the values in Group II , Group IV , Group V and Group VI of present study with no significant difference among latter four Groups.

The levels of milk Zinc during pregnancy did not differ significantly among the Groups IV, V, VI although exhibited an increasing trend. No reports are available in the literature to compare the milk values in different reproductive states, either in buffaloes or in cows. The mean ± SE values of milk Zinc (ppm) in different lactational states in buffaloes are presented in Table 2.. The average value during lactation was closely (± 0.5 mg/dl) associated with the findings in buffaloes[15]. However, milk zinc content of present finding was lower than those reported by in buffaloes[16.]

Statistical analysis of present data revealed that the level of milk Zinc (ppm) during different periods of lactation differed significantly ($P<0.01$) and the values showed a decreasing trend among the three groups Viz. Early (4.50 ± 0.17), Mid (3.25 ± 0.21) and Late (2.85 ± 0.13)lactation with no significant difference between Mid and Late lactation. Present findings were well supported by the findings in buffalo milk who recorded a non significant decreasing trend in first, second and third of lactation[17.]

The value of milk Zn in present study only during early lactation was higher than in buffaloes[18].

The decreasing trend in milk Zn during lactation supports the earlier finding of increasing plasma Zn during lactation indicating drain of Zn through milk which was probably responsible for their relation. The zinc concentration in milk was higher than the blood plasma concentration. Viz 2.01 ± 0.17 ppm in plasma, 3.53 ± 0.15 ppm in milk. The findings were at par with the findings of Pavlata[19], who opined that only a few studies on the content of Zn in cow's milk have beenpublished, and the factors affecting its concentration in milk have not been describedthoroughly. In humans, 0.5 – 1.0 mg of Zn per day is transported through the mammarygland into milk [20] and Zn transportation into milk is hypothesized to be anactive process [21]. Zinc in cow's milk primarily binds tocasein (almost 90%)and, to a small extent, citrate. The level of Zn in milk was associated with

Glucocorticoids, Since increase in the level of this hormone at parturition causes an increase transfer of Zn from blood to mammary gland then into colostrum and milk [22]

It is interesting that overall (Reproductive as well as lactational status) values of Zinc in milk (3.119 ± 0.0081) are higher than in plasma (1.98 ± 0.057) in present study (not mentioned in tables). This finding of higher milk Zn concentration than plasma Zn along with positive correlation was supported by Hui Wang [23] who opined that Zinc-dependent proteins are found in the nucleus, the endoplasmic reticulum, Golgi, secretory vesicles, and mitochondria of mammary alveoli;. Zn homeostasis is complex process involving both Zn import protein (Zip3) and Zn transporters (ZnT-1, ZnT-2, and ZnT-4) and reported that milk Zn concentrations are considerably higher than in serum.

Secretory, mammary epithelial cells must tightly regulate Zn transport to ensure optimal Zn transport to suckling neonate [21]. Thus, during lactation a substantial amount of zinc is transferred by the mammary gland from maternal circulation into milk.

V. Conclusion

.Zinc in blood and milk in different lactational and reproductive state of Buffalo were within normal physiological limits. Zn levels were influenced by different lactational as well as reproductive state.

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V R Patodkar " Plasma and Milk Zinc Levels in Different Lactational and Reproductive Status in Buffaloes." IOSR Journal of Agriculture and Veterinary Science (IOSR-JAVS) 11.3 (2018): 28-32.