Research article

DOI: 10.48165/ijar.2024.45.01.10

The Indian Journal of Animal Reproduction

The official journal of the Indian Society
for Study of Animal Reproduction

ACS Publisher
www.acspublisher.com

Year 2024, Volume-45, Issue-1 (June)

ISSN 0970-2997 ***(Print)***

ISSN 2583-7583 ***(Online)***

Comparative Blood Mineral Profiles in Infertile and Normal Cyclic Buffaloes of Northwestern Himalayan Region

Pravesh Kumar[1]*, Madhumeet Singh[1], Akshay Sharma[1] and Geetanjali Singh[2]

[1]Department of Veterinary Gynaecology & Obstetrics,
[2]Department of Veterinary Physiology and Biochemistry,
DGCN College of Veterinary and Animal Sciences, CSKHPKV, Palampur (H.P) – 176062, INDIA

ABSTRACT

Present study was undertaken in buffaloes (n=176) of different districts of Himachal Pradesh to study the effect of different minerals attributes on buffalo infertility. These profiles of different types of infertile (endometritis and anestrus) buffaloes were evaluated and compared with normal cyclic. In present study the levels of P, Cu, Zn and Na in buffaloes suffering with anestrus were significantly low in comparison to normal cyclic and endometritic buffaloes. The level of Ca was significantly low in anestrus buffaloes than normal cyclic ones. Similarly the levels of K and Mg were also low in anestrus buffaloes in comparison to normal cyclic and endometritis showing buffaloes but the level of significance was non-significant. So the deficiency of different minerals had shown their impact in causing infertility in buffaloes.

Key words: Anestrus, Buffaloes, Endometritis, Normal cyclic.

How to cite: Kumar, P., Singh, M., Sharma, A., & Singh, G. (2024). Comparative Blood Mineral Profiles in Infertile and Normal Cyclic Buffaloes of Northwestern Himalayan Region.
The Indian Journal of Animal Reproduction, 45(1), 6–9. 10.48165/ijar.2024.45.01.10

INTRODUCTION

Infertility is the one of major problem in bovine reproduction and the reason of this problem still remains an enigma in many animals and is also responsible for low reproductive performance of such affected animals (Dutta *et al*., 2001). Endometritis and anestrus are considered as main reasons of repeat breeding and infertility in bovine reproduction and are responsible for causing huge economical losses to dairy farmers due to increased inter-calving interval, increased number of insemination up to next calving and reduced milk production (Parkinson, 2001; Kumar and Singh, 2020). In maximum field conditions where managemental practices are not up to the mark, the

*Corresponding author.
E-mail address: pk9919@gmail.com (Pravesh Kumar)
Received 02-08-2023; Accepted 07-03-2024

nutritional deficiencies can cause anestrus, early embryonic mortality and failure of conception rate in such animals (Singh *et al*., 2006; Pandey *et al*., 2009). The metabolic and mineral profile of animals can be used to check the nutritional and health status of animals. Normal levels of different mineral are considered essential for normal functioning of different body systems including reproductive system. So any change in these essential parameters may cause reproductive failure. Therefore, the estimation of these profiles is helpful in characterization of these reproductive problems (Guzel and Tanriverdi, 2014; Kumar 2018). The present study was conducted to determine the mineral profiles of normal cyclic and infertile buffaloes suffering with endometritis and anestrus under field conditions of Himachal Pradesh.

MATERIALS AND METHODS

Blood samples were collected from buffaloes of different districts suffering from reproductive abnormalities. Overall, 176 blood samples were collected from buffaloes suffering from different reproductive disorders like endometritis (n=30), anestrus (n=110) and also collected from normal cyclic buffaloes (n=36) (Table 1). Blood samples were collected through jugular venipuncture in centrifuge tubes for separation of plasma. Approximately 10 ml blood was collected in heparinised vial for separation of plasma. These blood samples were centrifuged at 3000 rpm for 10 minutes in portable centrifuge and the harvested plasma at the spot. The plasma samples were stored at -20°C for pending analysis. The macro minerals *i.e.* calcium (Ca), magnesium (Mg) and micro minerals *viz*. copper (Cu), Zinc (Zn) were estimated from plasma using atomic absorption spectrophotometer (Perkin Elmer Analyst 400). The wavelengths used for estimation of Ca, Mg, Cu and Zn were 422.7 nm, 285.2 nm, 324.8 nm and 213.9 nm, respectively. Plasma sodium (Na) and potassium (K) were estimated by Flame photometer (Model T-129, Systronics India Ltd.). P was estimated by using fully automatic biochemistry analyzer Mispa nano (Agappe Diagnstics Ltd., India) by using standard kits (Agappe Diagnostics Ltd., India) at wavelengths 340 nm.

STATISTICAL ANALYSIS

The obtained data was statistically analyzed using Student's t-test for parametric data with Computer Software Instat Graphpad Software, 2008.

RESULTS AND DISCUSSION

In our study the ratio of Ca:P were lying within the normal range and were varying from 1:1.61 to 1:1.69. The concentration of calcium in buffaloes suffering with endometritis (8.15±0.25 mg/dl) were almost similar and in anestrus (6.90±0.40 mg/dl) conditions were significantly ($p<0.05$) low in comparison to normal cyclic (8.62±0.12 mg/dl) one. The low levels of calcium can also cause anestrus whereas, excess of Ca can affect the reproduction of the animals by impairing absorption of P, manganese, zinc, copper and other elements from gastro intestinal tract (Yasothai, 2014). Reproductive disorders due to Ca deficiency are always associated with P deficiency. Ca:P ratio play important role in animal reproduction. The normal ratio of Ca:P is between 1.5:1 and 2.5:1 for lactating cows and healthy animals, respectively (Yasothai, 2014). Any change in normal ratio may cause decrease in absorption of other minerals (Ugyen *et al*., 2016). The serum Ca and P ratio observed by Ugyen *et al.* in 2016 was higher in cyclic cows (1.35:1) compared to cows in postpartum anestrus (1.32:1).

In present study the levels of P in buffaloes suffering with anestrus (4.31±0.22 mg/dl) were significantly ($p<0.05$) low in comparison to normal cyclic (5.02±0.10 mg/dl) and endometritis (5.06±0.15 mg/dl) suffering buffaloes. Low intake of P can cause decreased fertility rate, reduced feed intake, decreased ovarian activity, low milk production, irregular estrous cycles, increased occurrence of cystic ovaries, delayed sexual maturity and low conception rates (Cromwell, 1997). Similar results of lower concentration were noticed in anestrus animals (Modi *et al*., 2017).

Overall, the values of Copper (Cu) and Zinc (Zn) both were significantly ($p<0.01$) low in buffaloes suffering with anestrus in comparison to normal cyclic and endometritis buffaloes. However, Ceylan *et al*. (2008) and Ahmed *et al*. (2017) found no significant difference in Cu and Zn concentrations of normal and repeat breeder animals. Cu and Zn can help in the progesterone synthesis by luteal cells under the control of superoxide dismutase (Sales *et al*., 2011). Copper along with Zn plays a major role in maintaining reproductive rhythm (Prasad *et al*., 1989). Hypocuprosis in bovines is associated with reproductive disorders including fertility failure. Deficiency of Cu along with Zn causes anestrus, poor conception rate and non-functional ovaries (Chesworth, 1992).

Mostly zinc (Zn) plays role in the repair and maintenance of the endometrium after parturition and helps in return to normal reproductive function and estrus

Table 1: Blood plasma concentration of minerals (Mean±SE) in buffaloes with different reproductive clinical conditions.

Clinical Condition	Calcium (mg/dl)	Inorganic Phosphorus (mg/dl)	Ca:P Ratio	Magnesium (mg/dl)	Copper (ppm)	Zinc (ppm)	Sodium (mEq/l)	Potassium mEq/l)
Endometritis (n=30)	8.15±0.25^{abc} (7.40-10.50)	5.06±0.15^{abc} (4.10-6.70)	1:1.61	2.42±0.29 (1.67-3.38)	0.670±0.0318^{abc} (0.45-1.12)	1.34±0.06^{xy} (0.95-1.85)	112.99±2.51^{xy} (90.83-136.06)	3.21±0.08 (2.28-4.17)
Anestrus (n=110)	6.90±0.40^{ab} (5.46-8.60)	4.31±0.22^{ab} (3.70-5.20)	1:1.61	2.46±0.11 (0.71-4.16)	0.510±0.0411^{ab} (0.40-0.62)	1.29±0.01^{x} (0.98-1.78)	106.59±6.11^{x} (82.70-121.19)	2.93±0.21 (2.22-3.73)
Normal Cyclic (n=36)	8.62±0.12^{c} (7.30-11.20)	5.02±0.10^{c} (4.60-6.20)	1:1.69	2.70±0.24 (2.28-4.56)	0.70±0.02^{c} (0.41-1.31)	1.60±0.04^{z} (1.00-2.03)	115.63±1.17^{z} (90.64-147.83)	3.26±0.04 (1.80-4.28)

^{a,b,c} values with different superscripts within a column differ significantly ($p<0.05$)

^{x,y,z} values with different superscripts within a column differ significantly ($p<0.01$)

(Greene *et al*., 1998). The plasma concentrations of Zn were reported to be significantly higher in normal cyclic cows than in repeat breeder cows (Ahmed *et al*., 2017). However, Parmar *et al*. (1986) recorded higher level of serum Zn in repeat breeding animals than in normal cyclic. Lower values of Cu and Zn were also reported in cattle showing silent heat in comparison to cycling normally (Das *et al.,* 2002).

The levels of sodium were significantly ($p<0.01$) low in anestrus buffaloes (106.59±6.11) in comparison to normal cyclic (115.63±1.17) and buffaloes suffering with endometritis (112.99±2.51). Inadequate supplementation of salt in animals can alter the efficiency of digestion and indirectly affects the reproductive performance of buffaloes (Elrod and Butler 1993). The normal physiological values of plasma Na in bovines are 121-152 mEq/l (Pandey *et al*., 2009). However, in a study by Pandey *et al.* (2009) in normal cyclic animals, the plasma Na concentrations were found significantly low (100.5 ± 0.11 mEq/l) than repeat breeder (125.8 ± 6.3 mEq/l).

The levels of potassium were non-significantly low in anestrus showing buffaloes than in endometritis and normal cyclic buffaloes. Also the levels were found low than the normal range in all categories of buffaloes. Similarly the deficiency of potassium (K) can cause impairment in normal reproductive process as it play role in maintaining the muscle integrity (Yasothai, 2014). In contrast, feeding of high levels of K delays onset of puberty and ovulation, poor formation of CL and increases the incidence of anestrus in heifers (Bindari *et al*., 2013). The normal physiological values of plasma K in bovines are 3.9 – 5.8 mEq/l (Pandey *et al*., 2009; Bonia 2014). Pandey *et al*. (2009) reported that in normal cyclic animals the plasma K concentration was found significantly low (3.1 ± 0.4 mEq/l) than repeat breeder (4.7 ± 0.3 mEq/l). The low levels of Na and K in present study might be due to deficiency of these minerals in soil, feed and fodder or might be due to the reason that animals are fed with less quantities of common salt and other sources of potassium.

Magnesium (Mg) does not affect the reproduction of farm animals directly as it remains always in antagonistic relation to Ca. Changes in Ca-P-Mg ratio affect reproduction (Reddy, 2010). Mg deficiency leads to loss of appetite and alters the reproductive efficiency (Yasothai, 2014). Normal levels of serum Mg varies from 1.50 to 2.90 mg/dl in healthy bovines (Merck Veterinary Manual 2005). In cyclic animals, the levels of serum Mg levels were reported to be significantly higher than anestrus animals (Dutta *et al*., 2001; Ugyen *et al*., 2016). A similar trend was recorded in our study but the difference was however non-significant.

CONCLUSIONS

Nutrition plays a major and pivotal role in enhancing reproductive efficiency in buffaloes. The impact of nutrition on reproduction of livestock is of vital importance and reflects directly on reproductive performance of both male and female animals. The relationship between nutrition and reproduction is important and is a matter of concern among dairy producers, veterinarians, feed dealers and extension workers. The deficiency of different minerals and other nutrients in maximum animals may cause infertility. So estimation of different minerals will be helpful for determining the health and reproductive status of such animals.

CONFLICT OF INTEREST

Authors declare no conflict of interest in the conduct of experiment.

REFERENCES

Ahmed, M.E., Ahmed, F.O., Frah, E.A.M. and Elfaki I. (2017). Blood biochemical profile of Sudanese crossbred repeat breeder cows. *African J. Biotech*., **16(8)**: 366-370.

Bindari, Y.R., Shrestha, S., Shrestha, N. and Gaire, T.N. (2013). Effect of nutrition on reproduction-a review. *Adv. Appl. Sci. Res*., **4(1)**: 421-429.

Bonia, K.K. (2014). A comparative study on some biological constituents in serum during normal and sub-oestrous cycles of crossbred cows of Assam. *International Research J Natural and App. Sci*., **1(7)**: 1-12.

Ceylan, A., Serin, I., Aksit, H. and Seyrek, K. (2008). Concentration of some elements in dairy cows with reproductive disorders. Bull. Vet. *Inst. Pulawy.,* **52**: 109-112.

Chesworth, J. (1992). Ruminant Nutrition: Book Series. The Tropical; Agriculturist. McMillan Press Ltd. London, UK.

Cromwell, G.L. (1997). Handbook of copper compounds and applications. pp: 177-202.

Das, S., Bondopadhaya, S.K., Ghose, B.B. and Dasgupta, R. (2002). Blood mineral profile of normal cyclic and repeat breeder crossbred cows under rural condition. *Indian J. Anim. Repro*., **23(2)**: 167- 169.

Dutta, A., Baruah, B., Sharma, B.C., Baruah, K.K. and Goswami, R.N. (2001). Serum macro mineral profile in cyclic and anestrus local heifers in lower Brahmaputra valley of Assam. *Indian J. Anim. Resource*, **35(1)**: 44-46.

Elrod, C.C. and Butler, W.R. (1993). Reduction of fertility and alteration of uterine pH in heifers fed excess ruminally degradable protein. *J. Anim. Sci*., **71**: 694-701.

Greene, L.W., Johnson, A.B., Paterson, J.A. and Ansotegui, R.P. (1998). Role of trace minerals in cow-calf cycle examined. *Feedstuffs* **70**: 34.

Guzel, S. and Tanriverdi, M. (2014). Comparison of serum leptin, glucose, total cholesterol and total protein levels in fertile and repeat breeder cows. *Revista Brasileira de Zootecnia* **43(12)**: 643-647.

Kumar, P. and Singh, M.M. (2020). Sensitivity pattern of commonly used antibiotics for treatment of endometritis in buffaloes. *Haryana Vet.*, **59(2)**: 185-188.

Kumar, P. (2018). Infertility in bovines of Himachal Pradesh-Prevalence, diagnosis and therapeutic management. *PhD thesis*, submitted to Chaudhary Sarwan Kumar Himachal Pradesh Krishi Vishvavidyalaya Palampur, India.

Merck Veterinary Manual (2005) Serum Biochemical Reference Ranges. 9th ed. Merck & Co., Inc., USA.

Modi, L.C., Suthari, B.N., Sharma, V.K., Nakhashi, H.C., Panchasara, H.H. and Modi, F. (2017). Comparative biochemical profile of blood serum and estrual mucus in normal and repeat breeding Kankrej cow. *Indian J. Anim. Health*, **56(1)**: 53-58.

Pandey, V., Singh, A.K. and Sharma, N. (2009). Blood biochemical profile in fertile and repeat breeding crossbred cows under field conditions. *Vet. Pract.,* **1**: 45-48.

Parkinson, T.J. (2001). Infertility. In Arthur's veterinary reproduction and obstetrics. 8th edition. Noakes DE, Parkinson TJ and England GCW. Eds Saunders Company, USA.

Parmar, K.S., Mehta, V.M. and Patel, J.M. (1986). Biochemical profile of repeat breeding cattle in relation to different phases of oesrous cycle. *Indian J. Anim. Reprod.,* **7**: 31-35.

Patel, R.K. (2015). Role of nutrients in animal reproduction. *The Blue Cross Book* **31**: 23-27.

Prasad, C.S., Sarma, P.V., Reddy, O.A. and Chinnaiya, G.P. (1989). Trace elements and ovarian hormonal level during different reproductive condition in crossbred cattle. *Indian J. Dairy Sci*., **42**: 489-492.

Reddy, D.V. (2010). Principles of Animal Nutrition and Feed Technology, 2nd Ed. New Delhi, India: Oxford & IBH Publishing Company Pvt. Ltd.

Sales, J.N.S., Pereira, R.V.V., Bicalho, R.C. and Baruselli, P.S. (2011). Effect of injectable copper, selenium, zinc and manganese on the pregnancy rate of crossbred heifers (*Bos indicus* × *Bos taurus*) synchronized for timed embryo transfer. *Livestock Sci*., **142(1–3)**: 59–62.

Singh, A.P., Sah, R.S., Singh, R.B., Singh, Akhtar, M.H., Roy, G.P., Singh, C. and Kunj, V. (2006). Response of mineral mixture, prajana and GnRH on serum biochemical constituents and conception rate in anoestrus buffalo. *Indian J. Anim. Reprod.,* **27(1):** 51-54.

Ugyen, P., Penjor and Dorji, R. (2016). Effect of serum calcium, magnesium and phosphorous levels in cyclic and postpartum anestrus jersey cross cow. *Bhutan J. Nat. Resor. Dev*., **3(1):**1-5.

Yasothai, R. (2014). Importance of minerals on reproduction in dairy cattle. *Intern. J. Sci. Envir. Tech*., **3(6)**: 2051-2057.