The Indian Journal of Animal Reproduction; 26(2): 145-148; December 2005

Reproductive performance and mineral profile of postpartum fertile and infertile Surti buffaloes*

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Received : August 8, 2004
Accepted : August 1, 2005

ABSTRACT

The reproductive performance and plasma profile of macro-micro-minerals was studied in fertile (n=12) and infertile (n=11) Surti buffaloes at weekly interval from the day of calving till 15 weeks postpartum. The occurrence of first oestrus, service period and calving interval were significantly shorter ($P < 0.01$) in fertile than the infertile buffaloes. The pooled mean plasma levels of calcium, inorganic phosphorus and magnesium in fertile and infertile groups of buffaloes were 10.21±0.16 and 10.15±0.17 mg/dl; 6.23±0.19 and 6.35±0.21 mg/dl, and 3.86±0.08 and 3.70±0.09 mEq/l, respectively, which neither varied significantly between groups nor between weeks postpartum. The overall mean plasma iron, copper and manganese levels in fertile and infertile groups of buffaloes were found to be almost identical between groups (3.48±0.11 vs 3.69±0.11; 1.44±0.03 vs 1.43±0.03 and 0.08±0.01 vs 0.11±0.01 ppm, respectively) whereas the mean zinc level was significantly higher (1.95±0.06 vs 1.66±0.06 ppm) and cobalt lower (0.52±0.02 vs 0.61±0.02 ppm) in infertile than the fertile group. The weekly profile for any of these traits did not vary significantly in any of the groups. The plasma calcium had significant negative correlation with phosphorus (-0.71, -0.62) in both fertile and fertile groups, and with Cu (-0.62), postpartum first oestrus, service period and calving interval (-0.67, -0.74, -0.74) only in fertile group. Inorganic phosphorus and magnesium did not show significant correlation with any of the traits. Amongst trace minerals, significant correlations were observed for Mn with Zn (0.61); and Cu with service period and calving interval (0.65, 0.63), and Fe with uterine involution (0.59) only in fertile group.

Key words : Blood plasma, fertility status, macro-micro minerals, postpartum period, Surti buffalo

Minerals play an important role in the regulation of reproduction and production in animals through their involvement in certain enzyme system. About one half of the total plasma calcium available as Ca^{+} is physiologically active. Similarly, inorganic phosphorous forming only a small fraction of total phosphorus is practically entirely found in the plasma.

Both are essential for bone formation and are usually inversely related to one-another. Magnesium is equally essential in all enzyme reactions catalyzed by ATP and in maintaining the physical integrity of RND-DNA (Aikawa, 1978). It has reciprocal relationship with calcium. Trace elements, viz. Zn, Fe, Cu, Co and Mn are the integral parts of many metalloenzymes and carrier proteins, and play an important role in body metabolism, protein synthesis, haemopoiesis, immunocompetence and even in the maintenance of vascular and skeletal integrity and structure and function of the central nervous system (Hidiroglou, 1979). The imbalance or deficiency of trace elements leads to inactive ovaries and repeat breeding in dairy animals (Rogers, 1992). Very meager literature is available on predictive value of macro-micro minerals towards postpartum fertility status in buffaloes (Sato, 1978; Setia *et al.*, 1994; Shah, 1999). Hence, this study was aimed to investigate the weekly profile of certain macro-micro minerals over first 15 weeks postpartum in buffaloes in relation to their reproductive status.

* Part of Ph.D. thesis of first author presented in XX ISSAR Annual Convention and National Symposium held at Veterinary College, Anjora, Durg, November 24-26, 2004.

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MATERIALS AND METHODS

This study was undertaken at Livestock Research Station, Gujarat Agricultural University, Navsari, from August 2001 to January 2003, on a total of 23 normally calved postpartum Surti buffaloes to monitor their postpartum period through clinical diagnosis and weekly plasma profile of certain macro-micro mineral constituents from the day of calving till 105 days postpartum. The animals were fed green fodder, hay, compounded concentrates and mineral mixtures (30-35 g/head) as per the routine feeding schedule of the farm through out the experimental period. They were also subjected to weekly rectal palpation to evaluate the uterine involution and postpartum ovarian activity. Oestrus was detected daily in from day 40 postpartum onwards with the help of teaser bull. The animals detected in oestrus were bred by natural service and were palpated per rectum for pregnancy 45-60 days later. The ovarian events and ovarian dysfunctions of these buffaloes were evaluated according to Barkawi *et al.* (1995). The buffaloes that conceived normally without any interference within 105 days postpartum were considered as normal fertile (n=12) and those that did not conceive by that time were taken as infertile buffaloes (n=11). Blood samples were collected by jugular vein puncture in heparinzed tubes from all the animals at weekly interval from the day of calving till 15th week postpartum. The plasma samples obtained from the blood were used for the estimation of calcium, phosphorus and magnesium using standard assay kits and an autoanalyser. The levels of trace minerals, viz. Zn, Fe, Cu, Co and Mn were determined in wet oxidized samples by using atomic absorption spectrophotometer (Oser, 1979). The data so obtained were analyzed statistically using CRD, Duncan's NMRT and 't' test and their correlation coefficients were worked out using animal-wise means.

RESULTS AND DISCUSSION

The period for initiation of postpartum ovarian follicular activity (49.08±5.49 vs 92.18±12.21 days), first oestrus postpartum (69.00±7.36 vs 141.82±21.32 days), service period (77.83±6.40 vs 155.91±26.28 days) and calving interval (388.92±6.13 vs 466.45±26.39 days) were significantly shorter ($P < 0.01$) in fertile group of buffaloes than the infertile ones, although the time required for uterine involution (30.00±1.36 vs 33.73±1.65 day) and number of services per conception (1.42±0.19 vs 1.55±0.21) did not differ between them. A little delayed uterine involution in infertile group was probably due to failure of early resumption of ovarian activity or mild uterine infection in that group.

Macro-minerals profile : The overall means of plasma calcium, inorganic phosphorus and magnesium levels in fertile and infertile groups of buffaloes were 10.21±0.16 and 10.15±0.17 mg/dl; 6.23±0.19 and 6.35±0.21 mg/dl, and 3.86±0.08 and 3.70±0.09 mEq/l, respectively. The weekly means of all three traits fluctuated non-significantly in the normal physiological limits between different weeks postpartum both in fertile and infertile groups. Further, none of these traits differed significantly between fertile and infertile groups at any of the postpartum intervals. Apparently the levels of calcium were low during early postpartum phase up to 8 weeks and thereafter the phosphorus levels were found low resulting in widened / elevated Ca:P ratio two months postpartum, whereas magnesium levels depicted more or less a constant trend over groups or periods.

The trend of calcium and phosphorus levels observed from calving through early postpartum period is well comparable with the findings of Sarvaiya and Pathak (1992) and Shah (1999) in Surti buffaloes. Our findings on magnesium are also in close agreement with the constant levels reported in dairy cows from 3 weeks before till 10 weeks after calving (Sato, 1978). Arneja *et al.* (1977) noted low blood inorganic phosphorus at postpartum, which increased non-significantly up to 26 to 35 days postpartum in suckled Murrah buffaloes. Sen *et al.* (1989), however, reported significant decrease in calcium level during early lactation (30-40 days postpartum) in dairy cows, whereas Belyea *et al.* (1975) recoded increase in calcium and decrease in magnesium levels from parturition to 60 days postpartum in cows.

Plasma calcium levels had significant negative correlations with plasma inorganic phosphorus and copper (-0.71, -0.62) as well as with interval for first oestrus postpartum, service period and calving interval (-0.67, -0.74, -0.74) only in fertile group. Inorganic phosphorus and magnesium, on the other hand, did not show significant correlation with any of the mineral constituents or reproductive traits studied, except a negative (-0.59) and positive (0.60) correlation, respectively, with zinc levels in infertile group. These correlations of calcium proved its role in enhancing reproductive efficiency. Rowlands *et al.* (1977), however, did not observe any correlation of calcium, phosphorus and magnesium with the number of services per conception and/or service period, while El-Belely *et al.* (1994) found negative correlation of phosphorus with number of services per conception. Hurley *et al.* (1980) and Khattab *et al.* (1995) found reduction in fertility with drop in plasma inorganic phosphorus level and improvement in ovarian activity with rise in phosphorus.

Micro-minerals profile : The pooled mean concentration of plasma zinc was significantly higher (1.95±0.06 vs 1.66±0.06 ppm) and cobalt was lower (0.52±0.02 vs 0.61±0.02 ppm) in infertile than the fertile group, though the weekly profile did not vary for these traits in any of the groups. Further, the overall mean plasma iron, copper and manganese levels in fertile and infertile groups of buffaloes were found to be almost identical without significant difference between groups (3.48±0.11 vs 3.69±0.11; 1.44±0.03 vs 1.43±0.03 and 0.08±0.01 vs 0.11±0.01 ppm, respectively) or between different weeks postpartum, except iron at 5th week and manganese at all odd weeks postpartum, where the values were significantly higher in infertile than the fertile group. Saxena and Gupta (1995) also found higher zinc, iron and copper levels in post-parturient buffaloes and cows conceiving than non-conceiving within 120 days postpartum.

The zinc levels of the present study were in close agreement with the reported values in cyclic/oestrus buffaloes (Eltohamy *et al.*, 1989; Khattab *et al.* 1995), but were comparatively higher than those reported earlier in normal cyclic, repeat breeder or postpartum bovines (Singh *et al.*, 1991; Chauhan and Nderingo, 1997). Manickam *et al.* (1977) and Fayez *et al.* (1992) reported higher values of plasma zinc in regular than repeat breeder cows and Egyptian buffaloes, respectively, which is in contrast to the present findings, probably because our values of zinc in both the groups were much higher than the critical requirement. Zinc level was found to be relatively lower in fertile group and higher in infertile group from 8th week postpartum, where the animals of fertile group were in various stages of early pregnancy, but those of infertile group remained anoestrus or suboestrus and did not conceive.

Present findings with respect to identical values (3.48±0.11 vs 3.69±0.11 ppm) and weekly trend of iron in fertile and infertile groups were in agreement with the reported work in fertile and infertile buffaloes (Shah, 1999), cyclic buffaloes (Khattab *et al.*, 1995) and in oestrus, dioestus, and pregnant cows (Reddy and Reddy, 1988; Singh *et al.*, 1991). The low level of plasma iron could possibly result in improper tissue oxygenation to the uterus resulting in impaired nutrition for the conceptus causing its death. A deficiency of iron might also interfere with enzymatic reaction on the release of LH, which is highly essential for maintenance of pregnancy in cows (Reddy and Reddy, 1988).

Average copper concentration of postpartum period (1.44±0.03 vs 1.43±0.03 ppm) and the weekly trend of non-significant variation between fertile and infertile animals found in the present study compared well with some of the previous reports in cattle and buffaloes (Arneja *et al.*, 1977; Saxena and Gupta, 1995). However, Singh *et al.* (1991) observed comparatively lower concentrations in peri-parturient buffaloes. Copper level in circulation appears to be influenced by hormones of reproduction (Underwood, 1977) and its concentration in blood serves as an indicator of gonadal hormones and pituitary gonadotropins (Sato and Henkin, 1973). Copper deficiency leads to reproductive disturbances. The positive association of serum copper level and resumption of ovarian activity and fertility has also been reported by Manickam *et al.* (1977). The mean cobalt concentration was significantly higher in fertile than the infertile buffaloes (0.61±0.02 vs 0.52±0.01 ppm). Tambe *et al.* (1996), however, found identical levels of cobalt during follicular and luteal phases of normal cycling cows.

The present findings on manganese concentration in fertile and infertile groups of buffaloes (0.08±0.01 vs 0.11±0.01 ppm) were comparable to the levels reported by previous workers in dioestrus, oestrus and early pregnant cows (Singh *et al.*, 1991) and in parturient and early lactating buffaloes (Setia *et al.*, 1994), but are lower than those reported by others in cyclic buffaloes (Eltohamy *et al.*, 1989). Manganese is an activator of a number of enzymes both of somatic cells and gonads and thus in its deficiency there may be signs of disturbed or depressed reproduction (Underwood, 1977). Amongst plasma trace minerals, few significant correlations observed were for manganese with zinc (0.61), and copper with service period and calving interval (0.65, 0.63) only in fertile group, and for iron with uterine involution (0.59) and manganese with number of service per conception (0.67) in infertile group. Rogers (1992) opined that the imbalance or deficiency of trace elements leads to inactive ovaries and repeat breeding in dairy animals.

In general, the profile of none of the macro-micro mineral elements studied gave any clue whether the animal would conceive or not within stipulated period of 60-90 days postpartum, probably because of their levels being much above the critical limits that may reflect fertility status.

ACKNOWLEDGEMENTS

We are grateful to Dr. P.M. Desai, Research Scientist and Head, LRS, GAU, Navsari, as well as Dr. D.J. Sthanki, Asstt. ADIO, Navasari and Dr. K.P. Patel, Associate Research Scientist & Head, Micronutrient Project (ICAR), BACA, Anand and their staff for their kind permission, co-operation and help extended in clinical work and lab analysis of samples.

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