Effect of Rumen Mega Mineral Bolus Insertion at Calving on Blood Biochemical and Minerals Profile and Postpartum Fertility in Kankrej Cows

Mehrajuddin Naikoo1*, Arjun J Dhami2, Bhupendra C Parmar3

ABSTRACT

A study was conducted on 12 pluriparous parturient Kankrej cows of the University Farm, in Anand, randomly divided into two equal groups (n = 6 each). Group-I cows were administered on the day of calving with a sustained release 80 g mega mineral rumen bolus (Prepavel 1 bolus/animal, Neolait, France) intra-ruminal through a specially designed applicator, while group-II animals served as untreated control. The animals were monitored periodically from the day of calving till 140 days postpartum along with other herd mates. Blood samples were obtained at 10 days interval in heparinized vacutainers for plasma progesterone, biochemical, and macro-micro mineral profiling. Among the six Kankrej cows of group-I, only one animal exhibited prominent estrus signs on day 96 postpartum and conceived at first service (AI) giving CR of 16.66%, while in group-II three cows exhibited estrus between day 73 and 86 postpartum, and conceived with one or two AI giving CR of 50% by 150 days postpartum. In both the groups, all other cows remained subestrus for more than 150 days postpartum and conceived very late, though mostly with single service at spontaneous estrus. The mean values of plasma progesterone (0.74 ± 0.32 to 5.57 ± 0.78 ng/mL), total cholesterol (103.88 ± 3.20 to 237.17 ± 24.66 mg/dL) and triglycerides (17.07 ± 1.6 to 28.29 ± 1.75 mg/dL) differed significantly (p < 0.01) between postpartum intervals in both the groups, but not between groups at any of the intervals. The values of plasma total protein, calcium, inorganic phosphorus, and magnesium as well as trace elements, viz., zinc, iron, copper, cobalt, and manganese, however varied insignificantly and inconsistently between intervals and also between groups from day 0 to day 140 postpartum. Thus, the insertion of Mega mineral ruminal bolus on the day of calving did not influence the plasma profile of biochemical/metallic constituents and macro-micro minerals profile in lactating postpartum Kankrej cows and was not beneficial in improving postpartum fertility. However, further study on a larger sample size is required to draw a valid conclusion.

Keywords: Blood profile, Intra ruminal placement at calving, Kankrej cow, Mega mineral bolus, Postpartum fertility.

INTRODUCTION

Mineral supplementation is an important factor influencing reproduction in ruminants (Underwood and Suttle, 1999). Mineral deficiencies in the diet or in the uptake may indirectly decline ovulation rate, by its primary influence on basic health status (Upadhyay et al., 2006; Sprinkle et al., 2006). Adequate trace mineral intake and absorption are needed for growth physiology and reproduction. In ruminants, maternal copper deficiency may cause infertility, delayed or suppressed estrus, and decreased conception rate (Underwood and Suttle, 1999). Manganese deficiency increases infertility, abortion, silent estrus, and anestrus in cattle. Selenium deficiency leads to silent estrus, early embryonic death, stillbirth or weak offspring, and abortions (Upadhyay et al., 2006). Cobalt/vitamin B12 status during pregnancy has also been shown to affect the calf viability at birth (Mitchell et al., 2007).

A long-acting reticuloruminal trace mineral bolus ‘Cosecure’ (Telsol Ltd., Leeds, UK) and ‘Ferrobloc’ (Laprovit, Town, France) containing Ca, Mg, Na, Cu, Mn, I, Fe, Co, Zn, and Se has been developed and has shown promise for helping alleviate trace mineral deficiencies (Hidiroglou et al., 1987; Abdollahi et al., 2014; Abdollahi et al., 2015). A long-acting means of trace mineral delivery could be advantageous for production and reproduction in extensively managed systems. Nevertheless, no experiments have been performed...
on Kankrej, a zebu cattle, to investigate the effect of multi-
mineral rumen bolus on the postpartum fertility and its
plasma profile. Hence, this study was designed to investigate
the effect of mega mineral rumen bolus (Prepavel®, Neolait,
France) insertion at calving on blood biochemical and
minerals profile and postpartum fertility in Kankrej cows.

**Materials and Methods**

The study was conducted on 12 pluriparous parturient
Kankrej cows of the University Farm, in Anand after approval
of the Institutional Animal Ethics Committee. The animals
were randomly divided into two equal groups. In group I six
pluriparous cows were administered on the day of calving
with a sustained release 80 g rumen mega mineral bolus
(Prepavel® 1 bolus per animal, Neolait, France; bolus size
85 × 25 mm) intraruminal through the oral cavity with a
specially designed applicator, while group II (n = 6) animals
served as untreated control. The animals were monitored
from the day of calving till 140 days postpartum along with
other herd mates. All the animals were maintained identically
under loose housing system and received green fodder
(20 kg/day), hay (5–6 kg/day), compounded concentrate
mixture (40% of milk) mixed with mineral mixture (50 g/
day - Amul brand), and had free access to pure wholesome
drinking water. Hand milking and suckling by the young ones
was followed till dry off of cows. The reproductive/ovarian
status of the cows was assessed by palpation per rectum
of the genitalia periodically. The animals were inseminated
only after 60 days of calving, if found in estrus with good
quality frozen-thawed bull semen upon detected estrus. The
occurrence of the first estrus postpartum and service period
for each animal were recorded.

Jugular blood samples were collected from all animals
at an interval of 10 days from the day of calving till day 140
postpartum. The samples were immediately centrifuged at
3000 rpm for 15 minutes, and the plasma samples were stored
at −20°C by adding a drop of 0.01% sodium merthiolate until
analyzed. Plasma progesterone was determined by Radio-
Immuno-Assay technique of Kubasic et al. (1984) using kits
procured from Immunotech-SA, France. Plasma total protein,
total cholesterol, triglycerides, and macro-minerals (Ca, P, Mg)
were determined as per standard procedures using kits
procured from Crest Biosystems, Goa, on Chemistry
Analyzer (Mindray, BS 120). The trace elements, viz., iron,
zinc, copper, cobalt, and manganese were determined on
wet digested plasma samples on an Atomic Absorption
Spectrophotometer (Model-3110, Perkin Elmer) (Oser, 1979).
The data was analysed statistically using CRD and DMRT, and
paired ‘t’ test to see the differences between periods and
between groups at significance level of p < 0.05 (Snedecor
and Cochran, 1994).

**Results and Discussion**

**Effect of Mineral Bolus on Reproductive Performance**

The effects of rumen mega mineral bolus insertion
intraruminal at calving on various reproductive traits in
Kankrej cows are shown in Table 1. Among the six cows of
both groups in any of the reproductive parameters studied.
However, in a recent study on Iranian Afshari ewes during
the breeding season, the sustained release multi-trace
element ruminal bolus administration showed superiority on
reproductive performance in terms of lambing rate (150%)
and litter size (150%) (Abdollahi et al., 2015). Srivastava,
(2008), supplemented 30–40 g commercial mineral mixture
in concentrate for 20 days, which induced ovulatory estrus
in 93.33% (28/30) of anestrus crossbred heifers with first
AI conception rate of 32.14%. Joshi et al., 2020, recorded
significant (p < 0.05) improvement in conception rates after
supplementation of chelated mineral mixture @ 50/d/h for
60 days in lactating anoestrous buffaloes as compared to
control group.

**Table 1.** Postpartum reproductive performance of Kankrej cows with and without rumen mega mineral bolus insertion at calving (mean ± SE)

<table>
<thead>
<tr>
<th>Reproductive traits</th>
<th>Group-I (n = 6)</th>
<th>Group-II (n = 6)</th>
<th>Normal control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uterine involution (days)</td>
<td>37.50 ± 1.53</td>
<td>36.66 ± 1.73</td>
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</tr>
<tr>
<td>FOPP by plasma P4 (days)</td>
<td>51.66 ± 4.00</td>
<td>53.33 ± 4.83</td>
<td></td>
</tr>
<tr>
<td>FOPP clinically (days)</td>
<td>96.00 ± 0.00 (1)</td>
<td>78.50 ± 3.24 (3)</td>
<td></td>
</tr>
<tr>
<td>Service period (days)</td>
<td>96.00 ± 0.00 (1)</td>
<td>97.33 ± 4.17 (3)</td>
<td></td>
</tr>
<tr>
<td>No. of AI/conception</td>
<td>1.00 ± 0.00</td>
<td>1.33 ± 0.75</td>
<td></td>
</tr>
<tr>
<td>First service conception rate (%)</td>
<td>16.66 (1/6)</td>
<td>33.33 (2/6)</td>
<td></td>
</tr>
<tr>
<td>Overall CR by 150 days PP</td>
<td>16.66 (1/6)</td>
<td>50.00 (3/6)</td>
<td></td>
</tr>
</tbody>
</table>

FOPP - first oestrus postpartum; PP – postpartum.
Effect of Mineral Bolus on Plasma Profile

The findings on plasma progesterone, biochemical/metabolic, and macro-micro minerals profile of Kankrej cows treated with rumen mega mineral bolus at calving and of control group are presented in Tables 2 and 3, and Figs. 1–3.

The mean values of plasma progesterone concentrations varied significantly between different intervals postpartum in both the groups from day 0 (day of calving/ bolus insertion) till day 140 postpartum, however, there was no significant difference between groups at any of the intervals (Table 2). The progesterone profile of individual animals in each group presented in Figs. 1 and 2 reveal that most of the animals were cyclic with silent ovulation at varying postpartum intervals from day 30-40 onwards, but the behavioral signs were not expressed as long as they were suckled by the calves. Similar were the observations of Patel and Dhami (2005a) on ovarian status in weaned postpartum HF cows.

Among the biochemical constituents, the mean values of total cholesterol (103.88 ± 3.20 to 237.17 ± 24.66 mg/dL) and triglycerides (17.07 ± 1.16 to 28.29 ± 1.75 mg/dL) varied significantly between postpartum intervals in both the groups, but not between groups at any of the intervals. There was no influence of the postpartum period or rumen bolus on the plasma total protein profile (Table 2). Comparable findings on plasma cholesterol and triglycerides were also reported by Patel and Dhani (2005b) in routinely managed parturient HF cows. Further, the mean values of calcium, inorganic phosphorus, magnesium and all trace elements, viz., zinc, iron, copper, cobalt and manganese varied insignificantly and inconsistently between different intervals as well as between two groups from day 0 to day 140 postpartum (Fig. 3 and Table 3), suggesting that there was no any beneficial effect of sustained release rumen mega mineral bolus inserted intraruminally on the day of calving. Patel and Dhami (2005b) noted comparable
Effect of rumen mega mineral bolus insertion at calving on blood biochemical and minerals profile and postpartum fertility in kankrej cows

Table 2: Postpartum plasma progesterone and biochemical profile in postpartum Kankrej cows of control group and those given intra-ruminal Mega mineral bolus at calving (mean ± SE)

<table>
<thead>
<tr>
<th>Days</th>
<th>Normal control</th>
<th>Mega bolus</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>00</td>
<td>0.72 ± 0.05</td>
<td>0.73 ± 0.03</td>
<td>P = 0.67</td>
</tr>
<tr>
<td>10</td>
<td>0.75 ± 0.03</td>
<td>0.80 ± 0.03</td>
<td>P = 0.67</td>
</tr>
<tr>
<td>20</td>
<td>0.76 ± 0.07</td>
<td>0.84 ± 0.08</td>
<td>P = 0.67</td>
</tr>
<tr>
<td>30</td>
<td>0.76 ± 0.07</td>
<td>0.84 ± 0.08</td>
<td>P = 0.67</td>
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<tr>
<td>40</td>
<td>0.75 ± 0.03</td>
<td>0.80 ± 0.03</td>
<td>P = 0.67</td>
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<tr>
<td>50</td>
<td>0.75 ± 0.03</td>
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<td>P = 0.67</td>
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<tr>
<td>60</td>
<td>0.75 ± 0.03</td>
<td>0.80 ± 0.03</td>
<td>P = 0.67</td>
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<tr>
<td>70</td>
<td>0.75 ± 0.03</td>
<td>0.80 ± 0.03</td>
<td>P = 0.67</td>
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<tr>
<td>80</td>
<td>0.75 ± 0.03</td>
<td>0.80 ± 0.03</td>
<td>P = 0.67</td>
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<tr>
<td>90</td>
<td>0.75 ± 0.03</td>
<td>0.80 ± 0.03</td>
<td>P = 0.67</td>
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<tr>
<td>100</td>
<td>0.75 ± 0.03</td>
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<td>P = 0.67</td>
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<tr>
<td>110</td>
<td>0.75 ± 0.03</td>
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<td>P = 0.67</td>
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<tr>
<td>120</td>
<td>0.75 ± 0.03</td>
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<td>P = 0.67</td>
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<tr>
<td>130</td>
<td>0.75 ± 0.03</td>
<td>0.80 ± 0.03</td>
<td>P = 0.67</td>
</tr>
<tr>
<td>140</td>
<td>0.75 ± 0.03</td>
<td>0.80 ± 0.03</td>
<td>P = 0.67</td>
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</tbody>
</table>

Table 3: Postpartum plasma micro-mineral concentrations in postpartum Kankrej cows of control group and those given intra-ruminal Mega mineral bolus at calving (mean ± SE)

<table>
<thead>
<tr>
<th>Days</th>
<th>Normal control</th>
<th>Mega bolus</th>
<th>Significance</th>
</tr>
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<tbody>
<tr>
<td>00</td>
<td>0.74 ± 0.08</td>
<td>0.84 ± 0.04</td>
<td>P = 0.67</td>
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<tr>
<td>10</td>
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inconsistent trends of plasma macro-micro minerals status of postpartum fertile and infertile HF cows with routine feeding management though values were higher in the fertile group.

The published evidence on fertility and blood profiling following feeding single rumen multi-mineral bolus is scanty in literature. Abdollahi et al. (2014) fed Afshari cycling ewes a single multi-mineral rumen bolus (Ferrobloc bolus) four weeks prior to synchronization and found that boluses increased the status of copper, selenium, and iodine on mating day and days 90 to 100 of gestation, but ruminal bolus did not significantly increase the number of different classes of ovarian follicles. The cows supplemented via a
long-acting trace mineral rumen bolus had successfully increased liver copper content in cows and blood selenium in cows and calves, but the response varied between years (Sprinkle et al., 2006). Similarly, Joshi et al. (2020) reported significant (p < 0.05) improvement in serum total protein, cholesterol, progesterone, and macro (Ca, P) – micro (Zn, Fe, Cu, Co, Mn) mineral status at day 45 and 90 after supplementing chelated mineral mixture @ 50 g/d/h for 60 days in postpartum aneoustrus buffaloes compared to control group. However, we did not find any positive results of rumen mineral bolus supplementation. Following use of single rumen mega mineral bolus (Prepavel®) improvement in reproductive efficiency of infertile cattle and buffaloes was experienced by a district cooperative dairy in Gujarat (personal communication), but they did not study the serum/plasma profile of minerals contained in the bolus.

Few scientists have reported significant improvement in postpartum reproductive health, with early onset of postpartum first estrus, shorter service period and enhanced pregnancy rate with some improvement in plasma mineral and biochemical status of cattle and buffaloes following peripartum oral and injectable minerals and other nutrients supplementation (Kalasariya et al., 2017; Crowe et al., 2018; Vala et al., 2019). But, we could not find any improvement in postpartum fertility or blood biochemical/mineral profile in Kankrej cows following feeding long-acting single multi-mineral rumen bolus. This may be due to difference in feed composition, rumen microbial population, and the rumen/blood pH affecting the solubility and bioavailability of minerals from rumen mineral bolus and chelated free mineral mixtures. Based on the findings of our experiment, it is concluded that the insertion of rumen mega mineral bolus orally on the day of calving did not influence the plasma profile of biochemical/metabolic constituents and macromicro minerals profile and in fact suppressed the postpartum estrus and fertility in lactating postpartum Kankrej cows. There is a need to investigate further the effect of rumen multi-mineral bolus on nutritional and reproductive status using more number of animals of different breeds and with different feeding regimens.

Acknowledgment

We thank the authorities of Anand Agricultural University, Anand for the farm and lab facilities provided and the Neolait, France for free supply of rumen mega mineral bolus.

References


