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Research Article

Evaluation of the prophylactic efficacy of oral calcium gel in preventing milk fever relapse and hypocalcemia in post-calved dairy cows

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Abstract

Oral Calcium Gel (OCG) is a promising prophylactic and supportive supplement for milk fever and Downer syndrome in postcalved dairy cows. This study evaluated the efficacy of OCG supplementing in improving rumen motility, feed intake, parturition/calving, Retention of Placenta (ROP), and product performance and safety. A total of 30 postcalved dairy cows were randomly divided into three groups: G1, cows selected immediately after calving (*n* = 7); G2, cows with milk fever (*n* = 14); and G3, cows with milk fever and Downer syndrome (*n* = 9). The cows in G1 and G2 were supplemented with OCG 300 g; 8 – 12 h apart; repeat 2 – 4 supplementation for 1 – 2 days only. Conversely, the cows in G3 were supplemented with 300 g of OCG + IV calcium injection; + 8 – 12 h apart; repeat 1 – 3 supplementation of OCG (300 g). OCG supplementation improved rumen motility, feed intake, parturition/calving, and ROP in all three groups. The mean product performance and safety scores were also good. Notably, OCG supplementation was effective in preventing ROP, which is a common postpartum complication in dairy cows. Overall, the findings of this study suggest that OCG supplementation is a promising prophylactic and supportive agent for milk fever and Downer syndrome in postcalved dairy cows.

Introduction

Milk fever is a metabolic disease that occurs in parturient dairy cows. It is caused by a temporary imbalance between calcium availability and high calcium demand associated with calving and the onset of lactation. In the periparturient period, dairy cattle suddenly require more calcium. During the late stages of pregnancy, about 10 g of calcium per day is needed for fetal growth, but at calving, the required amount increases to 30 – 50 g/day for the production of colostrum [1]. When the homeostatic mechanisms regulating calcium concentration in the blood are slow to respond to this need, hypocalcemia can develop, either subclinically (8 – 6 mg/dL) or clinically (5 mg/dL). Between 5% and 10% of dairy cows develop clinical milk fever, whereas between 23% and 39% of them develop subclinical milk fever (hypocalcemia) [2]. The association between milk fever and the risk of peripartum disorders, namely, dystocia, Retention of The Placenta (ROP), displaced abomasum, mastitis, and ketosis, is well established [3,4]. Furthermore, hypocalcemia has been associated with weakened immunity [5].

In dairy cattle, the majority of hypocalcemic episodes occur within the first 24 h of calving. The economic implications to the dairy industry due to the incidence of milk fever include the cost of medication for the affected cow, increased susceptibility of cows to other periparturient disorders, reduced or impaired milk production during the subsequent lactation, and reduced fertility among the affected cows [1,6]. The milk fever control principles that are currently used in dairy farms are as follows; [I] To bolster calcium reserves around calving, oral supplements of readily absorbable calcium can be administered, [II] During the final weeks of pregnancy, acidifying rations can be fed through the supplementation of anionic salts, [III] Low-calcium rations can be fed during the final weeks of pregnancy to reduce the dietary intake of calcium, and [IV]

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Prepartum administration of vitamin D, vitamin D metabolites, or analogs can be employed to enhance calcium mobilization and absorption. Regardless of the method used to prevent milk fever, the producer of dairy products will benefit economically from the decrease in the incidence of diseases associated with milk fever as well as the increase in milk production [7].

Supplementation of oral calcium preparation to parturient cows significantly reduced the incidence of milk fever. The majority of documented preventive programs recommend supplementing at 3 – 4 time intervals spaced out evenly from 12 to 24 h before calving to 24 h after calving. Oral calcium supplementation can also support a significant reduction of cases of milk fever relapse when given as a 1 or 2 times supplement to IV calcium therapy for milk fever [7]. With this scenario, the present study aimed to assess the prophylactic efficacy of Oral Calcium Gel (OCG) in preventing milk fever relapse and hypocalcemia in postcalved dairy cows.

Materials and methods

Oral calcium gel

OCG is a proprietary poly-herbal feed supplement, called HimCal Gel is a proprietary ionic calcium gel formulation developed by Himalaya Wellness Company, Bengaluru, India. It is mainly composed of ionic calcium and phosphorus and other minerals (magnesium, potassium, cobalt) and vitamin D3 fortified with the following herbs, *Allium satium* (Lasuna), *Trigonella foenum-graecum* (Methi), *Anethum sowa* (Shatapushpa), *Zinger officinale* (Shunti).

Ethical committee approval

The present study was conducted according to the guidelines on the care and use of animals, and the study protocol was approved by the Committee for control and supervision of experiments on animals (Protocol No. AHP/LA/12/22).

Animal selection

This study included 30 multiparous postpartum dairy cows of Holstein–Friesian and Jersey cross-breeds aged between 3.0 and 6.0 years and having parity between 1 and 6 at the Mysuru district headquarters, Karnataka. The inclusion criteria were postpartum dairy cows of any breed within 48 h of calving and/or immediately after calving with symptoms of milk fever and Downer syndrome and cows with an intact gag reflex. Alternatively, the exclusion criteria were cows with severe hypocalcemia, simple indigestion and ruminal acidosis, ascites and fatty liver syndrome, and any severe disease condition, such as TB, metritis, or prolapse.

Study design and experimental details

A total of 30 multiparous postpartum dairy cows were divided into three groups: G1, cows selected immediately after calving (n = 7); G2, cows with milk fever (n = 14); and G3, cows with milk fever and Downer syndrome (n = 9). The cows in G1 and G2 were fed with 300 g of OCG; 8 – 12 h apart; repeat 2 – 4 supplementation for 1–2 days only. The cows in G3 were fed with 300 g OCG + IV calcium injection + 8 – 12 h apart repeat 1 – 3 supplements of OCG (300 g). No control group was maintained, individual animals were maintained as self-control, and pre-supplementation was considered as control followed by supplementation. When OCG was administered to postcalved dairy cows, concurrent supplementation with other ionic calcium gel-based products was not given.

Assessment parameters

The assessment parameters (rumen motility, feed intake, parturition/calving, ROP, uterine prolapse, and product safety and performance) were assessed on the day of supplementing (day 1) of OCG to dairy cows and subsequently days 2, 3, 4, 5, 6, 7, 14, and 21, as described in Table 1 By the trained veterinarian. The efficacy of OCG was assessed based on overall improvement in the assessment parameters.

Suggestive usage

For postcalved cows: Supplementing 300 g OCG; 8 – 12 h apart; 2 – 4 times; 1 – 2 days only.

Table 1: Assessment parameter grading system.

Parameter	Description	Score
A. Ruminal motility	Normal – 2–5 contractions per 2 min	3
	Hypermotility – >5 contractions per 2 min	2
	Hypomotility – <2 contractions per 2 min	2
	Ruminal stasis – no motility	1
B. Feed intake	Normal – takes full feed	4
	Mild anorexia – takes 50% feed	3
	Moderate anorexia – takes 25% feed	2
	Severe anorexia – takes no feed	1
C. Parturition/calving	Normal calving	2
	Assisted calving	1
D. ROP (more than 12 h)	Absent	2
	Present	1
E. Uterine prolapse	Absent	2
	Present	1
F. Product performance/ satisfaction score	Highly satisfied	4
	Moderately satisfied	3
	Neither satisfied nor dissatisfied	2
	Not satisfied (no relief)	1
G. Product Safety	Very safe, no irritation	4
	Moderately safe, no irritation	3
	Safe, slight irritation	2
	Irritates cows after drenching (continuous head shaking)	1

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For milk fever support: Supplementing 300 g OCG; 8 – 12 h apart; 2 – 4 times; 1 – 2 days only.

For milk fever + Downer syndrome support: Supplementing 300 g OCG + IV calcium injection + 8 – 12 h apart 1 – 3 times OCG (300 g).

Direction for usage

A drenching bottle nozzle was placed into the back of the cow's mouth while holding the cow's head in a normal to slightly elevated position. The entire contents of one bottle were given per feeding. It was noted that cows that are unable to swallow should not be given.

Statistical analysis

The collected data were expressed as mean ± SEM. The statistical analysis was performed using the Statistical Package for the Social Sciences (SPSS) Statistics software Version.21.0; SPSS Inc., Chicago, IL, USA.

Results

The rumen motility score indicated that the rumen motility of dairy cows in all groups exhibited improvement as early as day 5 after supplementation of OCG. However, it returned to normal on day 5 in G2 and on day 6 in G1 and G3 (Table 2). Furthermore, the feed intake score showed an improvement as early as day 5 in G1 and G3 and day 6 in G2 (Table 3).

In addition, an improvement was observed in the parturition/calving score on day 6 in G1 and on day 14 in G3 (Table 4). ROP exhibited an improvement as early as day 6 in G1 and day 14 in G3 (Table 5). Conversely, the uterine prolapse score showed an improvement in G1 on day 6 (Table 6).

The product performance scores in G1, G2, and G3 were 3.43 ± 0.30, 3.64 ± 0.23, and 3.00 ± 0.33 and the product safety scores were 3.29 ± 0.29, 3.71 ± 0.16, and 3.22 ± 0.22, respectively (Table 7).

Table 2: Effect of OCG on rumen motility in dairy cows.

Group	Rumen Motility Score								
	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 14	Day 21
G1 - Oral Calcium Gel (Prevention cases; *n* = 7)	2.71 ± 0.18	2.71 ± 0.18	2.71 ± 0.18	2.71 ± 0.18	2.86 ± 0.14	3.00 ± 0.00	3.00 ± 0.00	3.00 ± 0.00	3.00 ± 0.00
G2 - Oral Calcium Gel (Milk fever cases; *n* = 14)	2.93 ± 0.07	2.93 ± 0.07	2.93 ± 0.07	2.93 ± 0.07	3.00 ± 0.00	3.00 ± 0.00	3.00 ± 0.00	3.00 ± 0.00	3.00 ± 0.00
G3 - Oral Calcium Gel (Milk fever + Downer cases; *n* = 9)	2.56 ± 0.24	2.67 ± 0.17	2.78 ± 0.15	2.78 ± 0.15	2.89 ± 0.11	3.00 ± 0.00	3.00 ± 0.00	3.00 ± 0.00	3.00 ± 0.00
Values are expressed as mean ± SEM.									

Table 3: Effect of OCG on feed intake in dairy cows.

Group	Feed Intake Score								
	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 14	Day 21
G1- Oral Calcium Gel (Prevention cases; *n* = 7)	2.71 ± 0.18	2.71 ± 0.18	2.86 ± 0.14	2.86 ± 0.14	3.29 ± 0.36	3.43 ± 0.30	3.43 ± 0.30	3.43 ± 0.30	3.29 ± 0.36
G2 - Oral Calcium Gel (Milk fever cases; *n* = 14)	2.50 ± 0.14	2.50 ± 0.14	2.43 ± 0.14	2.64 ± 0.13	2.93 ± 0.13	3.57 ± 0.17	3.71 ± 0.16	3.71 ± 0.16	3.71 ± 0.16
G3 - Oral Calcium Gel (Milk fever+ Downer cases; *n* = 9)	2.22 ± 0.15	2.22 ± 0.15	2.33 ± 0.17	2.67 ± 0.17	3.00 ± 0.17	3.22 ± 0.22	3.33 ± 0.24	3.44 ± 0.24	3.44 ± 0.24
Values are expressed as mean ± SEM.									

Table 4: Effect of OCG on parturition/calving in dairy cows.

Group	Parturition/Calving Score								
	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 14	Day 21
G1- Oral Calcium Gel (Prevention cases; *n* = 7)	1.71 ± 0.18	1.71 ± 0.18	1.71 ± 0.18	1.71 ± 0.18	1.71 ± 0.18	1.86 ± 0.14	1.86 ± 0.14	1.86 ± 0.14	1.86 ± 0.14
G2 - Oral Calcium Gel (Milk fever cases; *n* = 14)	1.50 ± 0.14	1.50 ± 0.14	1.50 ± 0.14	1.50 ± 0.14	1.50 ± 0.14	1.50 ± 0.14	1.50 ± 0.14	1.50 ± 0.14	1.50 ± 0.14
G3 - Oral Calcium Gel (Milk fever + Downer cases; *n* = 9)	1.33 ± 0.17	1.33 ± 0.17	1.33 ± 0.17	1.33 ± 0.17	1.33 ± 0.17	1.33 ± 0.17	1.33 ± 0.17	1.56 ± 0.18	1.56 ± 0.18
Values are expressed as mean ± SEM.									

Table 5: Effect of OCG on ROP in dairy cows.

Group	ROP Score								
	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 14	Day 21
G1- Oral Calcium Gel (Prevention cases; *n* = 7)	1.14 ± 0.14	1.14 ± 0.14	1.14 ± 0.14	1.14 ± 0.14	1.43 ± 0.20	1.86 ± 0.14	1.86 ± 0.14	1.86 ± 0.14	1.86 ± 0.14
G2 - Oral Calcium Gel (Milk fever cases; *n* = 14)	1.36 ± 0.13	1.36 ± 0.13	1.36 ± 0.13	1.50 ± 0.14	1.64 ± 0.13	1.93 ± 0.07	1.93 ± 0.07	1.86 ± 0.10	1.86 ± 0.10
G3 - Oral Calcium Gel (Milk fever+ Downer cases; *n* = 9)	1.22 ± 0.15	1.22 ± 0.15	1.22 ± 0.15	1.22 ± 0.15	1.22 ± 0.15	1.44 ± 0.18	1.56 ± 0.18	1.78 ± 0.15	1.78 ± 0.15
Values are expressed as mean ± SEM.									

Table 6: Effect of OCG on parturition/calving in dairy cows.

Group	Uterine Prolapse Score								
	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 14	Day 21
G1- Oral Calcium Gel (Prevention cases; n=7)	1.86 ± 0.14	1.86 ± 0.14	1.86 ± 0.14	1.86 ± 0.14	1.86 ± 0.14	2.00 ± 0.00	2.00 ± 0.00	2.00 ± 0.00	2.00 ± 0.00
G2-Oral Calcium Gel (Milk fever cases; n=14)	1.71 ± 0.13	1.71 ± 0.13	1.71 ± 0.13	1.79 ± 0.11	1.79 ± 0.11	1.86 ± 0.10	1.93 ± 0.07	1.93 ± 0.07	1.93 ± 0.07
G3-Oral Calcium Gel (Milk fever+Downer cases; n=9)	1.78 ± 0.15	1.78 ± 0.15	1.78 ± 0.15	1.78 ± 0.15	1.89 ± 0.11	1.89 ± 0.11	1.89 ± 0.11	1.89 ± 0.11	1.89 ± 0.11
Values are expressed as mean ± SEM									

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Table 7: Effect of OCG on product performance and product safety score.

Group	Product Performance Score	Product Safety Score
G1- Oral Calcium Gel (Prevention cases; *n* = 7)	3.43 ± 0.30	3.29 ± 0.29
G2 - Oral Calcium Gel (Milk fever cases; *n* = 14)	3.64 ± 0.23	3.71 ± 0.16
G3 - Oral Calcium Gel (Milk fever+Downer cases; *n* = 9)	3.00 ± 0.33	3.22 ± 0.22

Values are expressed as mean ± SEM.

Discussion

Dairy cows need to adjust to the dramatic increase in calcium requirements of the mammary gland at the onset of lactation. Insufficient calcium intake can cause milk fever in cows. Cows that have recovered from milk fever upon treatment with IV injection of calcium salt solutions are less productive and more prone to other metabolic and infectious diseases [8]. Although dietary changes can reduce the incidence of milk fever [8,9], they are not always practically feasible, and their efficacy is questionable if feed intake decreases. To increase blood calcium concentration during the periparturient period, large doses of calcium salts can be administered orally to passively diffuse calcium into the blood. Therefore, this study aimed to assess the prophylactic efficacy of "Oral Calcium Gel (OCG)" in preventing milk fever relapse and hypocalcemia in postcalved dairy cows.

The results of our study indicated that supplementing OCG played a pivotal role in the restoration of normal rumen motility functioning and feed intake of postcalved dairy cows and cows with milk fever and hypocalcemia. The parturition/calving score improved after supplementing OCG in both postcalved dairy cows and cows with milk fever and Downer syndrome. Furthermore, alleviation of symptoms of ROP was observed in postcalved dairy cows and cows with milk fever. These findings indicated that a static calcium level was maintained through the supplementation of OCG in dairy cows with milk fever and precalved cows. On the basis of these outcomes, clients/veterinarians who supplemented OCG were satisfied with its ameliorating effects on milk fever relapse and hypocalcemia and therefore recommend supplementation of OCG to postcalved dairy cows and cows with milk fever + Downer syndrome.

During the postpartum period, hypocalcemia potentially leads to excessive calcium mobilization to the fetus, which reduces the calcium's availability to uterine tissues [10,11] and causes atony of the uterus, ROP, and uterine prolapse [12,13]. Previous studies reported that oral calcium drenching increased myometrial contractions, resulting in placental expulsion [14]. Concurrently, the results of our study were interesting in that postcalved dairy cows supplemented with OCG did not exhibit ROP, uterine prolapse, or symptoms of milk fever and hypocalcemia. This might be because oral ionic calcium supplements helped to maintain a constant calcium level, whereas IV calcium salt infusions initially increased the calcium level and later led to transient hypocalcemia; thus, it was not effective in preventing ROP or uterine prolapse [14].

Previous studies have demonstrated that administration of ionized calcium using a stomach tube results in sudden absorption of calcium from the rumen and abomasum and exerts a prophylactic effect against hypocalcemia and milk fever relapses [7]. This effect is supported by our study finding: OCG supplementation restored normal rumen motility functioning and improved feed intake in postcalved dairy cows and cows with milk fever and hypocalcemia.

In our study, OCG supplementation improved the parturition/calving scores in postcalved cows and cows with milk fever and Downer syndrome. These results could be attributed to the fact that the ability of calcium to quickly enter the systemic circulation facilitates the calving process. In addition, herbs such as *Allium satium*, *Trigonella foenum-graecum*, *Anethum sowa*, and *Zinger officinale* were used to strengthen OCG. Galactogogue promotes lactation in dairy animals. It influences the adrenal–hypothalamo–hypophyseal–gonadal axis by blocking hypothalamic dopaminergic receptors or dopamine-producing neurons. Furthermore, galactogogue enhances prolactin secretion by antagonizing dopamine receptors [15]. Bakshi, et al. reported that herbal plants with mimicking galactogogue activities, such as *Trigonella foenum-graecum*, are widely used as animal feed additives [16]. For centuries, *Trigonella foenum-graecum* has been used as a galactogogue. This herb reportedly affects the lactation performance of ruminants [15]. Ghosh et al. also reported that administration of *Allium satium* essential oil at a dose of 5 g/day enhanced feed digestibility in the rumen [17], and hence, an improvement in feed intake was observed after OCG supplementation to dairy cows. These findings could be correlated with the restoration of feed intake to normalcy in our study.

The product safety and performance score indicated that OCG can be safely used as a supplement for postcalved dairy cows with milk fever and hypocalcemia. Clients/veterinarians who used OCG were satisfied with its prophylactic efficacy in preventing milk fever and treating hypocalcemia in postcalved dairy cows.

The study has certain limitations as follows; samples were taken based on the availability of cases in the field, and hence number of parity (lactations) and breed or crosses are not able to be controlled.

Conclusion

Supplementation of OCG to postcalved dairy cows and cows with milk fever + Downer syndrome improved the assessment parameters, particularly parturition/calving, and ROP. This indicates that OCG helped to induce smoother calving and reduced the incidence of fetal membrane retention. Alternatively, IV infusion in cows with Downer syndrome could not maintain calcium homeostasis. Hence,

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OCG supplementation is recommended over IV infusion for postcalved dairy cows to prevent milk fever and support the treatment of hypocalcemia and Downer syndrome.

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