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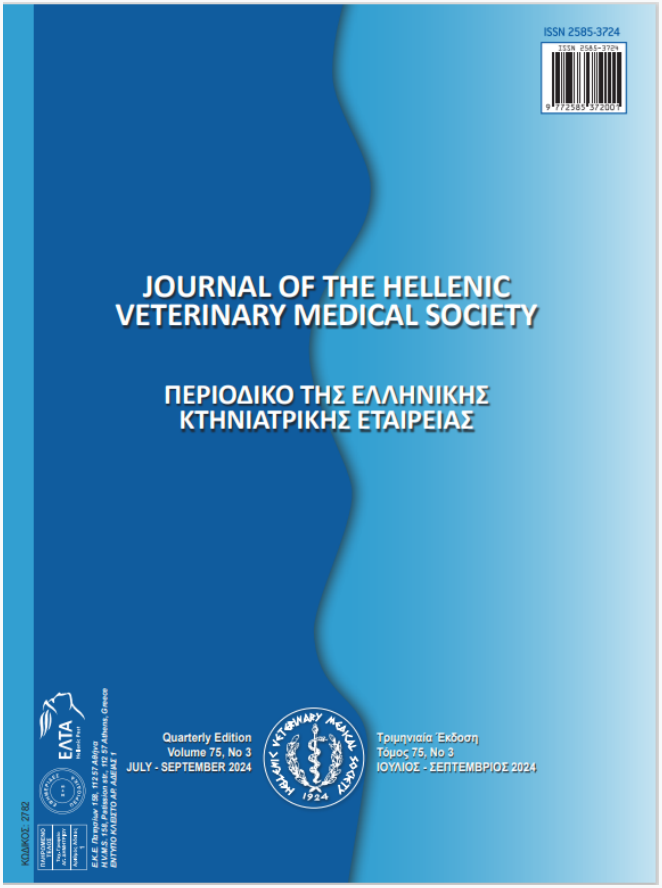

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Research article
Ερευνητικό άρθρο

The effect of Vitamin C in the therapy of haemolactia in dairy cows

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ABSTRACT: The aim of this study was to evaluate the effects of intravenous administration of vitamin C in the therapy of haemolactia in dairy cows. Haemolactia is often of unknown origin, and it can occur due to vitamin C deficiency. The research was conducted on twenty-eight dairy cows having clinical signs of haemolactia, with a clinical scores of 2 or 3. The cows of the group A (n=10) were treated intravenously with 2000 mg vitamin C, those of the Group B (n=10) with 3000 mg vitamin C intravenously, whereas cows of group C (n=8) were served as controls and remained untreated. The Vitamin C was administered intravenously once per day until symptoms disappeared. The appearance of milk and the therapeutic effects of vitamin C were monitored during milking, based on the visual appearance of milk. The average duration of haemolactia in both treated groups A and B was significantly lower (72 h and 68 h, respectively) compared to the control group C (102 h) ($p<0.05$ for both). Vitamin C was shown to be beneficial in the treatment of haemolactia; no statistical difference was observed regarding the administered doses of vitamin C (2000 vs. 3000 mg). The results demonstrate the importance of vitamin C administration to shorten the duration of haemolactia in dairy cows.

Keywords: Cows; haemolactia; haemostasis; vitamin ; bloody milk.

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INTRODUCTION

Haemolactia is characterized by the presence of blood in milk (red milk) (Radostitis et al., 2007). Many causes can lead to the occurrence of blood in milk such as udder trauma, rupture of capillary blood in the mammary gland, infectious disease (e.g. leptospirosis), diapedesis due to hyperemia after parturition, deficiencies (blood platelets, vitamin C, vitamin K), and diet contaminated with toxins (Hungerford 1990; Radostitis et al., 2007; Fraile et al., 2019). The presence of blood in milk leads to economic losses due to the milk rejection. Vitamin C is well established as one of the key components with an antioxidative role in the body; it has diverse physiological functions and plays a role in the coagulation process (Ranjan et al., 2012; Sathler et al., 2016). The high concentration of vitamin C in platelets facilitates platelet aggregation (Mohammed et al., 2017). Numerous drugs can be used to treat haemolactia, such as vasoconstrictors, antioxidants, anticoagulants, calcium supplements and vitamins (Muhammad and Rashid, 2015). Vitamin C is an essential co-factor for many enzymatic reactions during wound repair, providing overlapping stages: haemostasis, inflammation, proliferation and maturation (Mohammed et al., 2016). Supplementation with antioxidant vitamins such as vitamins A, E, and C is very effective to help the recovery of animals (Yang and Li, 2015). So far, only a few research evaluating the effect of vitamin C on the process of haemostasis. More specifically, there is a lack of studies exploring the use of vitamin C as a therapy for haemolactia in cows, although it has been known for a long time that this can occur due to vitamin C deficiency. Therefore, the present research aimed to evaluate the effects of the administration of different doses of vitamin C in the therapy of haemolactia dairy cows.

MATERIALS AND METHODS

The study was conducted in compliance with Serbian Law on Animal Welfare (Official Gazette of the Republic of Serbia No 41/09) and the Ordinance (Official Gazette of the Republic of Serbia No 39/10).

Animals and management

A total of 28 Simmental and Holstein cows were included in the study; 16 (57.1%) primiparous and 12 (42.9%) multiparous. The 28 cows came from 6 dairy farms, ranging from 15 to 450 milking cows. Two of those farms raised Simmental and Holstein cows, three farms Simmental, and one farm Holsteins. All farms were situated in different geographical parts in the Republic of Serbia. The nutrition varied among herds, and all herds had tie-stall housing. The 28 enrolled cows were clinically examined and, apart from haemolactia, there were no other obvious signs of clinical disease. The average annual milk yield ranged from 6000 to 8500 L, and all cows were milked three times daily (at 06:00, 13:00 and 20:00 h). The study took place from November 2020 up to February 2022.

Experimental design

The selected cows were monitored by the main investigators M.N and S.A, who followed the therapeutic effects of vitamin C in coordination with a local veterinarian. The appearance of milk and the therapeutic effects of vitamin C were monitored during milking, based on the visual inspection of the milk. A clinical examination of the udders was performed in

Figure 1. Haemolactia clinical score 2 and clinical score 3.

all selected cows in order to determine the presence of udder edema. Clinical examination of the affected quarters revealed normal consistency and redish or pinkish discoloration of the milk. This study included cases of haemolactia with clinical scores of 2 and 3 (Figure 1) according to Fraile et al., (2019). In parallel, milk samples were collected for microbiological analysis, and the the study excluded cows with mastitis. All cows were negative in the California mastitis test.

All cows included in the study were randomly assigned to groups that met the conditions for inclusion in the research based on the clinical score of haemolactia. The 28 cows with haemolactia were distributed into 3 group as follows:

- Control group: n= 8 cows that were not treated

- Group A: n=10 cows that were treated with 2000 mg of vitamin C intravenously single daily

- Group B: n=10 cows that were treated with 3000 mg of vitamin C intravenously single daily.

Intravenous vitamin C (ascorbic acid 100 mg/mL, Veterinary Institute, Subotica, Serbia) was injected in jugular vein and had zero days as withdrawal period in milk and meat. Treatment in groups A and B was continued single daily until symptoms disappeared.

Statistical analysis

Descriptive statistics and the significance of differences between groups were calculated in Prism®6 (GraphPad®) software. Average times of recovery were compared by log rank test (Hazra and Gotay, 2017). Probabilities of $p \leq 0.05$ were considered significant.

RESULTS

The results indicated that the average recovery time from haemolactia for cows treated with vitamin C in the groups A and B were 72 h and 68 h, respectively; these recovery times were significantly shorter (both $p<0.05$) than the control group (104 h) (Figure 2), but without significant difference between the two treated groups ($p>0.05$). The distribution of haemolactia cases based on the age and stage of lactation is shown in (Table 1). Udder edema was detected only in cows that presented haemolactia within the first 7

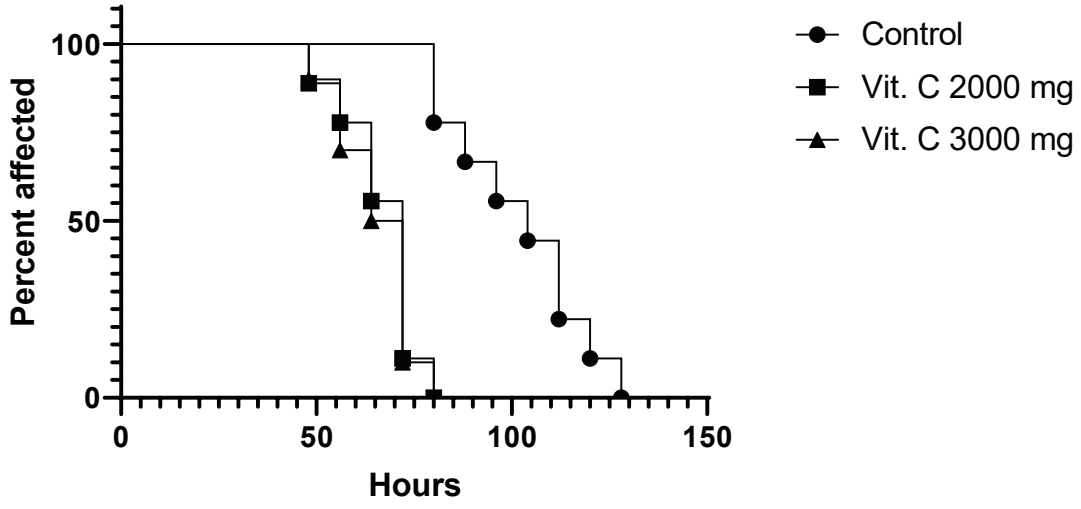

Figure 2. Dynamics of haemolactia resolution in treated groups and control. Average recovery times of Vit. C treated groups were 68 h (3000 mg), 72 h (2000 mg) and 102 h (without treatment).

Table 1: Distributions of the population of cows by days in lactation and parity

Days in lactation	*Parity*					
	I	*II*	*III*	*IV*	*V+*	*Sum*
1-7	13	3	3	1	-	20
8-30	2	1	1	-	1	5
>30	1	2	-	-	-	3
Sum	16	6	4	1	1	28

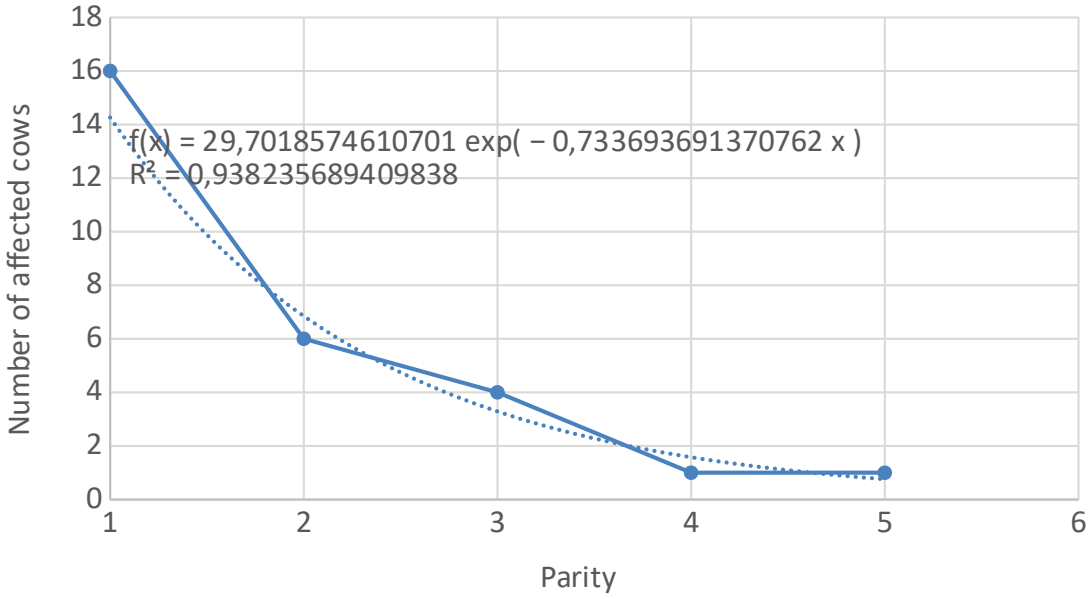

Figure 3. Parity associated frequency of haemolactia exponential curve ($y = 29.702e^{-0.734x}$ $R^2 = 0.9382$)

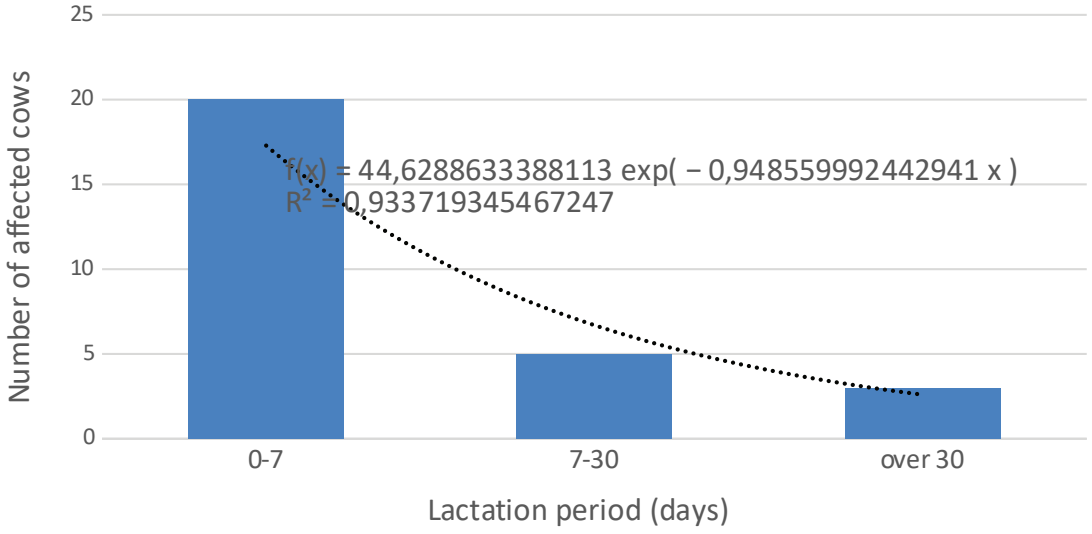

Figure 4. Days in lactation period associated frequency of haemolactia exponential curve ($y = 44.629e^{-0.949x}$ $R^2 = 0.9337$)

days in lactation; more specifically, it was found in 15 out of the 20 (75%) haemolactic cows at days 1-7 in lactation. The distribution of haemolactia occurrence revealed that in 20 (71.4%) cases it appeared in the first 7 days in lactation, 5 (17.9%) in the range 8 to 30 days in lactation and 3 (10.7%) cases were noted after the first month in lactation. The frequency of haemolactia decreased exponentially with the next parity as well as with the progress of days in lactation (Figure 3 and 4, respectively). Affected cows showed no decrease in average daily milk production or differences.

DISCUSSION

The occurrence of haemolactia has been described in cows, goats and buffalo (Ayaz 1999, Radostitis et al., 2007). Haemolactia is often of unknown origin, and mostly occurs at the beginning of lactation, though it can occur at any stage of lactation (Radostitis et al., 2007). Several studies have reported a deficiency of vitamin C as one of the causes of haemolactia (Radostitis et al., 2007; Fraile *et al*., 2019). Although many options for the treatment of haemolactia are available, there is no universal treatment protocol for haemolactia in dairy cows. Studies have demonstrated role of

vitamin C in the coalgulation pathway (Kwon et al., 2019). The direct influence of vitamin C is implicated in the process of clot formation, from the initiation of coalgulation to fibrinolysis (Sathler et al., 2016). Vitamin C has antioxidant properties and it is known that oxidative stress may play an important role in the pathogenesis of bloody milk in dairy cows (Bani Ismail et al., 2020), Moreover, vitamin C is essential for the metabolic function of plateles (Mohammed et al., 2017). Besides having a positive effect on reducing the duration of haemolactia, intravenous administration of vitamin C has been beneficial in treating other udder health challenges (Chaiyotwittayakun et al., 2002). The presence of udder edema in the first days can be a predisposing factor for the occurrence of haemolactia. In the current research, udder edema was present in 75% of cows with haemolactia at 1-7 days in lactation, while it was not present in later stages of lactation in haemolactic cows. However, Bani Ismail and co-authors (2016) stated that there was no association among cows with bloody milk and udder edema. George et al. (2008) recommended to milk haemolactic cows only once a day. In contrast, the present study showed that cows can remain in the daily milking schedule followed by the farms. Maybe that was helpful to avoid additional stress and milk retention.

CONCLUSION

In conclusion, the administration of vitamin C promotes rapid recovery of affected cows and shorten the duration of milk rejection due to the presence of blood. Differences between the administered intravenous doses of vitamin C (2000 or 3000 mg) were not observed. Vitamin C provides a quick and cheap treatment option for haemolactia of dairy cows.

ACKNOWLEDGMENT

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CONFLICT OF INTEREST

The authors declare no conflict.

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