EFFECT OF PERORAL SUPPLEMENTATION WITH SELENIUM AND VITAMIN E DURING LATE PREGNANCY ON UDDER HEALTH AND MILK QUALITY IN DAIRY COWS

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ABSTRACT

The aim of the experiment was to study selenium and vitamin E sources in the diet of dairy cows in late phase of pregnancy and their effects on udder health and milk quality during the first two weeks after calving. The experiment included 48 cows of Holstein breed divided into four equal groups (n = 12). The first experimental group (D1) was fed with addition of vitamin E in total dose of 1020 dl-a-tocopherol acetate Se/cow per day. The second group (D2) was added the selenium at a dose of 0.3 mg kg⁻¹ of DM in form of sodium selenite. The third group (D3) was supplemented with addition of vitamin E in combination with sodium selenite in total dose of 1020 dl-a-tocopherol acetate Se/cow per day and of 5.0 mg Se/cow per day, respectively. The control group (C) was without the addition of selenium and vitamin E. In group (D2) with addition of selenium at a dose of 0.3 mg kg⁻¹ of DM and vitamin E a dose of 50 mg dl-a-tocopherol acetate/kg of DM in diet, increased the plasmatic concentration of selenium and vitamin E and reduced the incidence of mastitis by 13.3% and number of somatic cells during peripartal period in comparison with other groups.

Keywords: dairy cows; selenium; vitamin E; mastitis; SCC

INTRODUCTION

Cows that are especially highly efficient are predisposed to metabolic, infectious and reproductive diseases during the periparturient period because of immune system suppression, rapid hormonal changes during birthing, and metabolic stress associated with lactation. The periparturient period is a time during which dairy cows are at risk, and they are prone to diseases that could affect their productivity. Mastitis, hypocalcemia, fatty liver syndrome, retained placenta, metritis, ketosis and other related diseases occur frequently in this period. Due to immune system suppression during the periparturient period, such diseases cause decreases in productivity and even culling of cows (Kafilzadeh et al., 2014; Horký, 2015).

Vitamins and minerals are micro-nutrient components that play important functions in all organisms, especially during reproduction. Selenium (Se) and vitamin E (VTE) are often deficient in compound feeding stuffs during dry period. Biological functions of selenium are complemented by VTE, which also shows the effects of a cellular antioxidant (Mohri et al., 2005; Meyer et al., 2014).

It has been reported that the supplementation of Se and VTE during late pregnancy provides increased fertilization in the number of service per conception and pregnancy rate, decreased open days, ovarian cysts, incidence of mastitis and retained placenta (Lacetera et al., 1996).

According Nutrient requirements of dairy cattle (NRC, 2001) dietary recommendations for VTE and Se intake are 1000 IU VTE/head/day and 0.3 mg Se/kg of DM for dry cows. Diets containing under 0.2 mg Se/kg of DM, and 500 IU of VTE/head/day are deficient for antioxidant effect and immunostimulation of organism in transition period. Fresh green forages are excellent sources of VTE, usually containing 80-200 IU VTE/kg of DM. Diets of cows in total confinement housing depend on ensiled forages and hay as a source of roughage. These forages contain only one-fifth to one-sixth the amount of vitamin E in freshly cut forages in the vegetative state.

This study aimed to determine the effects of Se and VTE application on occurrence of mastitis and the quality of the produced milk in terms of functional food into the diet of dairy cows.

MATERIAL AND METHODOLOGY

Animal management

The experiment was carried out in herd of 270 Holstein cattle in east of Slovakia. Dairy cows were kept in a free housing system with a separate calving barn and equipped
with individual boxes with bedding and were allowed ad libitum access to water.

The mean daily intake for the dry period and at 5th day after calving under study was 10 kg and 18 kg of DM, respectively. The average milk yield of the dairy cows was 7,500 ±48 kg per lactation. Milking took place in the parallel parlour Boumatic 2 x 10 Xpressway (Wisconsin, USA). Before drying was applied intramammary antibiotic preparation Orbenin Dry cow a.u.v. (Pfizer, IT) to every quarter of udder.

The experiment included 48 Holstein dairy cows divided into four equal groups received the diets based on a total mixed ration (TMR). All animals received the diets based on a TMR that is required for the cows during the dry period and the beginning of lactation containing grass hay, corn silage, clover-grass silage, grass haylage, triticale grain, soybean meal and concentrate.

During pre partum and post partum, all cows received the diets containing 31 and 36 mg of vitamin E per kg of DM, respectively, but with the same amount of selenium (Se) (0.2 mg.kg⁻¹ DM) in both diets.

Peroral application of Se and VTE

Four weeks prior to the expected parturition were the cows in groups D1, D2 and D3 peroral supplemented as follows:

- the first group (D1) of cows (n = 12) was supplemented with addition of Hydrovit E forte (PharmaGal, SR) in the dose 50 mg dl-a-tocopherol acetate/kg of DM in total dose of 1020 dl-a-tocopherol acetate Se/cow per day).
- the second group (D2) of cows (n = 12) was added the selenium at a dose of 0.3 mg.kg⁻¹ of DM in form of sodium selenite (Centralchem, SR) in total dose of 5.0 mg Se/cow per day.
- the third group (D3) of cows (n = 12) was supplemented with addition of Hydrovit E forte (PharmaGal, SR) in the dose 50 mg dl-a-tocopherol acetate/kg of DM and of 0.3 mg Se/kg in form of sodium selenite (Centralchem, SR) in total dose of 1020 dl-a-tocopherol acetate and 5.0 mg Se/cow per day, respectively.
- the control group (C) of cows (n = 12) was without the addition of selenium and vitamin E (this group of animals received only selenium and vitamin E from native sources). Selenium and vitamin E were mixed to the basic ration (TMR) and fed in the morning dose.

Collection of samples and laboratory examination

Blood samples were collected into 12 mL heparinised test tubes from the jugular vein of cows four weeks before the expected time of calving, on parturition day and at 14th day after calving. We also collectedcolostrum into 10 ml tubes immediately after the parturition.

On the basis of the comprehensive examinations on the 14th day according to Jackson and Cockcroft (2002) which consisted of a clinical examination, California mastitis test (CMT) and laboratory examination was analysed milk from each quarter of the udder. For the purpose of determining the values selected vitamin-mineral elements, was taken 1 kg comprehensive sample of TMR from feed according to Van Soets et al. (1991).

Laboratory analysis

The blood plasma obtained by high speed centrifugation of heparinised blood at 3000 rpm during 15 min. The concentration of the selenium in samples of feed, plasma, colostrum were determined by atomic absorbive spectrometer Zeman 4100 (Perkin Elmer, USA) according to the analytical procedure standardised by Pechova et al. (2005).

The concentration of α-tocopherol in the samples of feed, plasma and colostrum were analysed by HPLC method according to Hess et al. (1991). Determination of vitamin E from the homogenized sample from TMR after saponification and extraction by HPLC method was carried out by Politis et al. (1996). The SCC were analysed in a commercial laboratory using a MilkoScan FT2 (Foss Electric, Hillerod, Denmark).

Milk samples (0.05 mL) were inoculated onto blood agar (Oxoid, UK) and cultivated at 37 °C for 24 h. Based on the colony morphology, bacteria Staphylococcus spp. were selected for the tube coagulase test (Staphylo PK, ImunaPharm, SR). Suspect colonies Staphylococcus spp., Streptococcus spp. and Enterobacteriaceae spp were isolated on blood agar, cultivated at 37 °C for 24 h and identified biochemically using the STAPHY-test, STREPTO-test, resp. ENTERO-test and identification by software TNW Pro 7.0 (Erba-Lachema, CZ). Dry matter was acquired by 48 h drying sample at 105 °C.

Statistical analysis

Tukey’s post hoc tests were used to compare all four experimental groups and significant effect of peroral treatment was indicated by ANOVA. Differences between the mean values of the different treatment groups were considered assuming significance levels of 0.05 and 0.01. Values in tables are means (M) and standard deviation (SD).

RESULTS AND DISCUSSION

Selenium and vitamin E are important nutrients in animal and human areas. The receiving adequate level of selenium and vitamin E in the diet is essential for the maintaining of good health and reproduction parameters. Selenium is a part of the enzyme GPx transforming hydrogen peroxide to water and molecular oxygen. The food is low on selenium content and the total amount of antioxidants, which are associated with civilization diseases in many cases (Horký, 2015).

Selenium plasma concentrations of cows is shown in Table 1. In assessing the blood selenium status we can use the mean values of the different treatment groups were considered assuming significance levels of 0.05 and 0.01. Values in tables are means (M) and standard deviation (SD).

Collection of samples and laboratory examination

Blood samples were collected into 12 mL heparinised test tubes from the jugular vein of cows four weeks before the expected time of calving, on parturition day and at 14th day after calving. We also collected colostrum into 10 ml tubes immediately after the parturition.

On the basis of the comprehensive examinations on the 14th day according to Jackson and Cockcroft (2002) which consisted of a clinical examination, California mastitis test (CMT) and laboratory examination was analysed milk from each quarter of the udder. For the purpose of determining the values selected vitamin-mineral elements, was taken 1 kg comprehensive sample of TMR from feed according to Van Soets et al. (1991).
reduced incidence of (sub)clinical mastitis after supplementation (Bouwstra et al. 2010).

Over the last 10 year, feeding strategies may have changed due to positive reports and new recommendations for supplementation VTE might only have a positive effect in studies where cows started with a marginal or deficient VTE status, which then improved during the trial because of the high level of VTE supplementation. Serum a-tocopherol concentrations (>4.0 mg.mL\(^{-1}\)) have been reported to be adequate in cattle. Canadian researchers testing 10 clinically normal cows from 5 different herds found mean serum vitamin E concentrations in the 5 herds to range from 3.2 – 5.3 mg.mL\(^{-1}\) (Batra et al., 1992).

Low plasma levels (<4.0 mg.mL\(^{-1}\)) in the present study have been reported in calves from the control and D1 groups (Table 2).

Table 2 shows that after oral administration of the selenium-vitamin supplements in group D3 was observed the reduction of cases of mastitis and infected quarters. In D1, D2 and C groups were observed the same occurrence of mastitis on the level 73.3%.

Similar results were found by Smith et al. (1997) who supplied dairy cows with addition of 0.3 ppm selenium to all classes of cattle and feeding 1000 IU.day\(^{-1}\) of supplemental vitamin E to dry cows and springing heifers and 500 IU.day\(^{-1}\) to lactating cows improves immunity, reduces the incidence of clinical mastitis, and reduces SCC.

Staphylococci are the main aetiologic agents of ruminant IMI and Staphylococcus aureus with coagulase-negative species (CNS) is the most frequent isolate from subclinical and clinical cases IMI. The annual incidence of clinical IMI in dairy herds is generally lower than 5%, but in a small percentage of herds the incidence may exceed 30 – 50% of the animals, causing mortality (gangrenous mastitis) or culling of up to 70% of the herd (Vautour et al. 2009).

By our analysis of the quarter samples we confirmed CPS, CNS, bacteria Streptococcus uberis, Streptococcus agalactiae, which is most often associated with the formation of the subacute and acute forms of mastitis.

CONCLUSION
Supplemental vitamin E and selenium improve immune function of dairy cattle, especially during the peripartum period. An inadequate intake of selenium and vitamin E is related with an increased their plasmatic concentration and reduced the incidence of mammary gland infections and...
REFERENCES


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