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Probiotic and prebiotic feed additives in calf nutrition

Probiotická a prebiotická krmná aditiva ve výživě telat

Luboš ZÁBRANSKÝ[1] (✉), Anna POBORSKÁ[1], Gabriela MALÁ[2], Branislav GÁLIK[3], Eva PETRÁŠKOVÁ[1], Naděžda KERNEROVÁ[1], Ondrej HANUŠOVSKÝ[3], Josef KUČERA[1]

[1] University of South Bohemia in České Budějovice, Faculty of Agriculture, Department of Zootechnical Sciences, Studentská 1668, 370 05 České Budějovice, Czech Republic

[2] Institute of Animal Science, Department of Technology and Management of Ruminants, Přátelství 815, 104 00 Praha Uhříněves, Czech Republic

[3] Slovak University of Agriculture in Nitra, Faculty of Agrobiology and Food Resources, Department of Animal Nutrition, Trieda A. Hlinku 2, 94976 Nitra, Slovakia

✉ Corresponding author: zabransky@zf.jcu.cz

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ABSTRACT

The target of the research was to analyze the effect of antidiarrheal feed additives on calves average daily weight gain. In the study, 120 calves were analyzed. Newborns were selected into 3 treatment groups, control (without supplementation) and group with *Ascophyllum nodosum* (prebiotics), and mixture of *Lactobacillus sporogenes*, *Enterococcus faecalis* and *Bifidobacterium bifidum* (probiotics). Individual body weight of animal were determined after 2 hours *post-partum*. Monitoring of the growth intensity, as well as health status were done till 56 days of age. Significant effects (P<0.01) of additive supplementation were found in the group with probiotics, in body weight at the age 21 days, as well as at the age of 56 days of life. Significant effect (P<0.01) of probiotics supplementation was found also in daily weight gains of animals. On the base of analyzed results, probiotics in calves nutrition stimulate the body weight.

Keywords: calves, probiotics, prebiotics, health, nutrition

ABSTRAKT

Cílem této studie bylo prokázání vlivu krmných aditiv s protiprůjmovým účinkem na hmotnostní přírůstky a zdraví telat. Do experimentu bylo zařazeno celkem 120 telat. Po narození byla telata rozdělena do tří skupin: A*scophyllum nodosum* (hydrolyzát hnědých mořských řas, prebiotikum), kombinaci *Lactobacillus sporogenes*, *Enterococcus faecalis* a *Bifidobacterium bifidum* (probiotikum) a kontrolní skupinu. Všechna telata byla zvážena do dvou hodin po narození. Přírůstky a zdravotní stav byly sledovány od narození do 56. dne věku. Ve srovnání s kontrolní skupinou byl nalezen signifikantní vliv aplikovaných krmných aditiv u probiotické skupiny u hmotnostních přírůstků 21. den po otelení (P<0,01), u hmotnostních přírůstků 56. den po otelení (P<0,01) a průměrných denních přírůstků (P<0,01). Z této studie výplývá, že užívání probiotik, má významný pozitivní vliv na zvýšení přírůstků u telat.

Keywords: telata, probiotika, prebiotika, zdraví, výživa

INTRODUCTION

Health of the calf is an important factor in the animal production area. Risks of the health prior to weaning are very sensitive factor to disease and environmental stress during this period (Hammon et al., 2020). Calves diarrhea, pathogens infection, is a high mortality and morbidity critical points of neonatals (He et al., 2017). Livestock intensive management system, mainly in calf rearing without dams, beneficial microflora is negative affected by pathogens to intestinal microflora colonization (Renaud et al., 2019; Rosmini et al., 2004). The occurrence of dairy calves metabolic problems in the Czech Republic is very actual. An important factor in this field is insufficient colostral nutrition of the calves (Podhorský et al., 2007; Šlosárková et al., 2014). Many studies (f.e. Svensson et al., 2003; Kamal et al., 2014) shows that, growth intensity, as well as occurrence of diarheas are affected by dams parity and year season of the birth.

Probiotics and prebiotics are feed additives with the beneficial effects to intestinal microflora stabilization, as well as calf health status and welfare improves. The positive impact of *Lactobacillus sporogenes* on *Salmonella dublin* was published by Frizzo et al. (2011), beneficial effect of *Lactobacillus* on growth intensity by Higginbotham and Bath (1993). The positive effect of *Pediococcus acidilactici*, *Enterococcus faecium*, *Lactobacillus acidophilus*, *Lactobacillus casei* and *Bifidobacterium bifidum* on calf diarrhoeas reduction was published by Renaud et al. (2019).

Probiotics nutritional supplementation can help in balanced microflora with the improving the health status of calf (Soto et al., 2011). These additives are live microorganisms with positive effect on host health (Kaur et al., 2002). Probiotics mode of action is that, they are pathogenics competitors in intestinal space colonization, in nutrient sources; they reduce intestinal pH value by the organic acids production, and stimulate the host immunity. These supplements decrease the risk of many intestinal infections and other problems (Ewaschuk et al., 2004). Ohasi and Ushida (2009) suggest using probiotics in calves nutrition so long as possible is. Interesting way of probiotics utilization is in using of a specific oils in the feed rations (Hajiaghapour and Rezaeipour 2010; Rolinec et al., 2020).

Prebiotics are feed supplement with selective effects in the large intestine, in composition and growth of selected bacteria in the gastrointestinal tract. Large intestine is an very important internal organ, prebiotics can affect functions of this organ (Geigerová et al., 2019; Wang 2009). Prebiotics have a positive effect on the short-chain fatty acids production in the intestine (Scheid et al., 2013).

Feed additives like probiotics and prebiotics have a positive effects on calves, they can reduce the diarrheal disease incidence, as well as improve the health status of animals. The goal of this research was to analyze the effect of these supplements on the growth intensity of calves.

MATERIAL AND METHODS

One hundred twenty Holstein calves (40 in probiotic group, 40 in prebiotic group and 40 in control group) were included in the experiment. All calves were after birth absolutely randomly divided into three treatment groups: group 1 *Ascophyllum nodosum*, group 2 combination *Lactobacillus sporogenes*, *Enterococcus faecalis* and *Bifidobacteriunm bifidum* and control group 3. The calves were detached and weaned from mothers within two hours after birth. All calves were moved to outdoor individual boxes, where they remained until the age of 56. The Colostrum received they ad libitum 3 times a day from a bucket with rubber nipple. From the fifth day after birth they were receiving 4.5 kg of milk replacer (concentration 1:8) per day divided into 3 portions, a starter mixture (crushed wheat 20%, crushed barley 15%, whole maize grains 10%, whole oat grains 19.5%, extracted rapeseed meal 15%, extracted soybean meal 15%, Tetravit (Nita-Farm, Saratov, Russia) – vitamin-mineral premix 5%, calcium 0.5%) and *alfalfa* hay *ad libitum* until weaning. The calves drank colostrum and intermediate milk replacer from plastic buckets with rubber puppies. These buckets were placed at a height of

40 cm above the ground. All calves had *ad-libitum* access to drinking water. The experiment was conducted from April 2019 to August 2019.

The probiotic experimental group received orally 3 g *Lactobacillus sporogenes* (4,1 x 10^7 CFU/g) + 1g *Enterococcus faecalis* (4,1 x 10^7 CFU/g) + 1g *Bifidobacterium bifidum* (4,1 x 10^7 CFU/g). The probiotics were added to colostrum from the first to the fifth day after birth. Then were added to milk replacer and thoroughly mixed to the fourteenth day of age. These feed supplements were served with once a day at the second feeding. The calves from the control group received 1.5 kg of milk replacer per feeding (totally 4.5 kg), starter mixture and alfalfa hay *ad libitum*. The calves from experimental groups and control group were observed from the birth to the 56th day of age.

Experimental group with prebiotic received orally 5 ml *Ascophyllum nodosum* to colostrum and milk replacer from the first to the fourteenth day after birth.

The longest two hours after birth were all calves weighed. Then again on the 21st day and on the 56th day after birth. In this experiment was used the classical method for the evaluation and expression of diarrhea according to Larson et al. (1977). Health assessment was performed mainly according to the type of feces, measuring the temperature in the rectum and the state of respiration. The condition of the coat, brightness in the eye and symptoms of dehydration (exhaustion, sunken eyes and inelastic skin) were also monitored.

In the case of long-lasting diarrhea, calves were given Argivo Se at a dose of 40 g per day and per piece.

The values obtained were analyzed using a General Linear Model ANOVA (four ways with the interactions) of the statistical package STATISTIC 12 (Statistix Analytical Software. Tallahassee, Florida, USA).

RESULTS AND DISCUSSION

The probiotic group had the highest live body weight at the 21st day and 56th day The data obtained were statistically significant compared to the control group and showed better but not significantly results wit the first group at the 21st day (54.43±5.08 kg vs 51.75±5.16 kg vs 52.23±5.21, P<0.01, P<0.05). The data obtained were statistically significant compared to the control group and showed better but not significantly results wit the first group at the 56th day (86.24±5.08 kg vs 81.33±5.16 kg vs 82.65±5.21, P<0.01, P<0.05). Also, the overall average of daily live weight gain was the most significant in the probiotic group, significant was in comparing with control (3nd) group (486.1±78.0 g vs 435.7± 86.0 g, P<0.01) and in comparing with prebiotic (1st) group 486.1±78.0g vs 448.4±67.0 g, P<0.05) (Table 1). A number of studies are described which report the positive effect of the use of probiotic feed supplements on the health and live weight gain of calves (Zhang et al., 2016; Raabis et al., 2019; Renaud et al., 2019). The expected effect of feeding with probiotic and prebiotic feed additives was as in Bayatkouhsar et al. (2013) reduction in the incidence of diarrheal diseases and the associated increase of weight gain. Froehlich et al. (2017) report in their study that the combination of prebiotics and essential oils in milk replacer had a positive effect on live weight gain. The combination of prebiotics and essential oils in starter feed resulted in increased growth performance, probably due to better intestinal health, rumen fermentation, and improved immune status Liu et al. (2020). The use of probiotic and prebiotic feed additives did not have a statistically significant effect on the incidence of diarrheal diseases in calves but we can observed positive trends in the combination of probiotic feed supplements p=0.07. He et al. (2017) did not prove a positive effects combination probiotic or prebiotic on diarrhea in calves. Stefańska et al. (2020) demonstrated in his study the positive effect of probiotics and phytobiotics on the reduction of the development of diarrheal diseases but the effect of the combination of these feed supplements on live weight gain was not demonstrated.

Table 1. The effect of nutrition supplements on body weight gain and health condition

Variables	N	Treatment groups			P	Significance
		1. Prebiotic	2. Probiotic	3. Control		
		$\bar{x} \pm SD$	$\bar{x} \pm SD$	$\bar{x} \pm SD$		
BW at birth (kg)	120	37.81±5.21	37.63±5.08	37.76± 5.16	0.4642	
BW in 21st day (kg)	120	52.23±5.21	54.43±5.08	51.75±5.16	0.0012**	2:3**, 2:1*
BW in 56th day (kg)	120	82.65±5.21	86.24±5.08	81.33±5.16	0.0012**	2:3**, 2:1*
ADG from birth to 56th day (g)	120	448.4±67.0	486.1±78.0	435.7± 86.0	0.0012**	2:3**, 2:1*
Duration of diarrhea (day)	120	1.65±3.37	1.29±3.09	2.36.4±3.54	0.1845	
Total number of diarrheas (frequency)	120	0.20±0.38	0.14±0.32	0.33±0.45	0.0692	

*P<0.05; **P<0.01; SD - standard deviation; ADG - average daily gains; BW - body weight; P - significance; N - number (1 – *Ascophyllum nodosum*, N=40, 2 - *Lactobacillus sporogenes*, *Enterococcus faecalis*, *Bifidobacterium bifidum*, N=40; and 3 – control, N=40)

CONCLUSION

The use of probiotic and prebiotic feed additives to increase weight gain was statistically demonstrated in this study, as in several others. Unfortunately, no significant effect on reducing the incidence of diarrheal diseases has been demonstrated. The combination of probiotics, prebiotics and phytobiotics could be achieve more convincing results in the future.

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