DIFFERENT DOSE INULIN FEEDING EFFECT ON CALF DIGESTION CANAL STATE AND DEVELOPMENT

Astra Ārne, **Aija Ilgaža**
Latvia University of Agriculture
arne.astra@gmail.com

Abstract
The aim of this study was to determine the influence of Jerusalem artichoke flour feeding on the general health status of calves (*Bos Taurus*), the animal live weight gain and digestive canal morphological development in the first four months of life, as well as to find out the optimal of three inulin doses. Jeruslem artichoke (*Helianthus tuberosus)* concentrate produced in Latvia contains the prebiotic – inulin. The study was performed on four groups of animals - a control group of 10 animals and three prebiotic groups, 10 animals in each group. All groups were fed the whole milk, but the $PreG_6$ group animals were fed daily with 6 grams of prebiotic, calves $PreG_{12}$ group were fed with 12g of prebiotic, but each calf in $PreG_{24}$ group – 24g of prebiotic per day. CoG control animals did not receive feed supplement. Faecal mass consistence of $PreG_{6,}$ $PreG_{12}$ groups of animals was more stable within the whole research period than CoG. We found that the control group animal weight gain on the 56th research day is statistically significantly ($p<0.05$) lower than of those calves that received inulin as a food supplement. The highest growth rates have shown $PreG_{12}$ and $PreG_{24}$ group of animals, significantly ($p<0.05$) being ahead of $PreG_6$ group of calves, the highest average daily live weight gain was observed in $PreG_{24}$ group (0.95 ± 0.093 kg).
Key words: calves, different doses, inulin, weight growth.

Introduction

In Europe they are trying to reduce the use of antibiotics in animal feed to achieve more rapid growth of the animal live weight, besides, since 2006 the use of antibiotics for productive animals is prohibited. Looking for alternative means which could contribute to a faster increase in live weight of calves and their healthier development, prebiotics are being studied as one of the alternatives. Interest in prebiotic feeding and their positive influence on the calf digestive canal and general state of health development increases more and more in recent years (Yutaka *et al*., 2015; Zábranský *et al*., 2015; Samanta, 2013; Masanetz *et al*., 2010).

A relatively large number of studies takes place shortly after the animal birth, the period when calves are fed with milk (Zábranský *et al*., 2015), but we would like to study the transition period from preruminant to ruminant when milk feeding decreases and fodder consumption increases. This is one of the periods when calves are re-located and re-grouped. At the same time the animal organism is exposed to very large changes due to changes in the proportion of feed materials, role of forestomach in feed digestion increases, the intestinal microflora changes take place - all that makes stressful situations more acute, most often displaying digestive channel impairment, diarrhea. It is researched that stress reduces immunity and increases the proliferation of pathogenic micro-organisms into the digestive canal and animal diseases (Salak-Johnson & McGlone, 2007).

It is known that the digestive canal is the largest immune organ that is equipped with a specific, complex immune cells in the mucous membrane, so the strengthening of this system and pathogenic micro-organism limitation by using feed supplement of natural origin is the direction, in which scientists are working to prevent stress-induced diarrhea, improve the organism's general immunity, accelerate the growth and development of calves in this difficult transition period from preruminant to ruminant.

As one of such influences for feed supplement may be prebiotics, which are not digested in the digestive canal, and digestive canal microflora uses them for its growth and development. They limit such pathogenic microorganism as *Salmonella sp.* or *Escherichia coli* spreading by improving the host organism's health (Gibson & Roberfroid, 1995; Patel *et al*., 2012; Ghosh & Mehla, 2012).

One of the more studied prebiotics is inulin, which is a classic oligo-saccharide and it contains many plants. Influence of inulin contained in the Jerusalem artichoke (*Helianthus tuberosus*) on the single-chamber stomach animals e.g. piglets (Flickinger *et al*., 2003) and birds (Kleessen, 2003; Valdovska *et al*., 2012) has been studied, but the data on whether and how it affects multi-chamber stomach of animal organism is lacking. Inulin can be able to modulate intestinal bacterial population towards a healthier flora (Gibson & Roberfroid, 1995).

The aim of this study was to determine the influence of Jerusalem artichoke flour feeding on the general health status of calves, the animal live weight gain and morphological development of the digestive canal in the first four months of life, as well as to find out the optimal inulin doses.

Materials and Methods

The research was carried out in one of the 420 cow farms of Latvia, in the district of Bauska.

At the beginning of research we formed four study groups, each group consisted of 10 randomly selectedclinically healthy 23 +/- 5 days old male calves with weight of 50 +/- 5 kg. During the study, animals were kept under the same conditions in groups of 10. The four-week-old calves were fed twice a day, each time for each animal feeding out on the average 3-3.5 l of whole milk. Animals had free access to drinking water and hay all day round. Two weeks after the start of the study or when the animals reached the age of 6 weeks, they were also offered fodder.

Feed of the research groups animals differed only in feed supplements - inulin doses. In this reasearch as prebiotic we used artichoke flour concentrate, produced in Latvia at the University of Latvia Institute of Microbiology and Biotechnology, where the inulin is 48.5 to 50.1% out of the dry weight. $PreG_6$ group (n = 10) animals were fed daily with 6 grams of prebiotic (it means 12 g of Jerusalem artichoke flour), calves $PreG_{12}$ group (n = 10) were fed with 12 g of prebiotic, but each calf in $PreG_{24}$ (n = 10) group - 24g of prebiotic per day. CoG control animals (n = 10) did not receive feed supplements. Artichoke powder for eating was added to milk for each animal individually. The study lasted 8 weeks or 56 days. A similar study framework has been used by other authors (Król, 2011).

Health state of the calves was evaluated daily during the whole research time period, with a particular focus on the stool consistency. Animal faeces were evaluated in points, where 0 points score was for solid faeces without diarrhea sign, 1 point was for soft faeces with maintained consistency, 2 points were for liquid ones with lost solidity, but 3 points – for watery faeces (Larson *et al*., 1977).

We fixed animal body weight at the study beginning (calves 4 weeks old) and after every two weeks (at the age of 6, 8, 10, 12 weeks). Every two weeks, during the weight checking, a general health check, in determining the physiological background characteristics, was also carried out.

A planned slaughter of calves at the age of 12 weeks was carried out, after slaughtering the cold carcass weight was determined. *MS Excel* 2008 and the *R-Studio* were used for the data processing.

Results and Discussions

Animal general health indicators corresponded to the physiological normal range in all groups animals. Calf faecal mass consistency was evaluated in points each day of the research. Faecal mass liquefaction on the seventh week of life was observed in all groups of animals, which could be due to the fact that the change in feed ration happened and calves began to eat the fodder. However, the data testified that faecal mass consistence of the prebiotic group $PreG_6$ and $PreG_{12}$ of animals was stable within the whole research period (Figure 1.).

As Figure 1 shows, after the seven weeks of life, when the calves were used to the new feed product, in all calf groups faecal mass consistency becomes firmer and more stable, there appear less and less animals with more soft species-appropriate faecal mass consistency than normal. It is interesting that the animals which were fed with 6g of prebiotic, had more stable faecal weight throughout the study than the groups that were fed with higher quantity of the feed supplement. This could indicate that the digestive canal needs a longer adaptation time to get used to such a high insulin dose and bacteria to breed at a sufficient level and adapt in digestive canal. Strong faecal mass liquefaction and diarrhea within a week was not observed in the studied animals. At about ten weeks of life, calves started receiving intensive fodder – hay, and animal faecal mass consistency began to stabilize. At the end of the research, steady faecal mass of about 0.5 points for all animals was observed.

B. Król (2011) study also showed that the faecal mass consistency of calves treated with prebiotic inulin (6g/day/head) and mannon-oligisaccharides

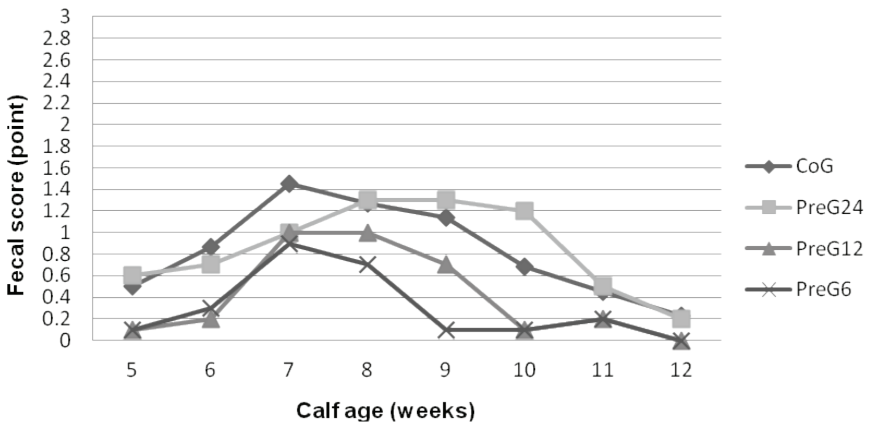

Figure 1. Various animal group faecal mass consistency comparisons.

Table 1

Calf weight gain and cold carcass weight

Group	Animal average live weight, kg at the research day			Average daily live weight gain, kg	Cold carcass weight, kg
	1	28	56		
CoG	50.8 ± 3.58	68.0 ± 6.63	87.6 ± 8.17	0.63 ± 0.13	42.6 ± 6.88
PreG6	49.8 ± 0.84	76.8 ± 3.11	93.2 ± 4.97	0.76 ± 0.99	44.8 ± 1.00
PreG12	54.0 ± 3.40	77.8 ± 5.63	101.6 ± 5.95	0.85 ± 0.10	54.0 ± 1.66
PreG24	49.8 ± 0.84	79.6 ± 3.11	102.8 ± 5.63	0.95 ± 0.09	50.2 ± 1.82

is more stable and steady (typical to animal species) than of the control animals, but significant differences between the control group and prebiotic animals were not found ($p>0.05$). Statistically significant differences between different prebiotic dose groups also were not found in this study.

Calf live weight was checked every second week. The live weight of all groups at the research start – on the first study day, in the mid-period – on the 28th study day and at the reasearch conclusion – on the 56th day are shown in Table 1. Daily live weight gain of calves and cold carcass weight average indexes also were calculated for each calf group.

Table 1 shows live weight gain average indices for different study groups of animals. We found that the control group animal weight gain on the 56th research day is statistically significantly ($p<0.05$) lower than of the calves that received inulin as a feed supplement. The highest growth rates were shown by $PreG_{12}$ and $PreG_{24}$ groups of animals, significantly ($p<0.05$) being ahead of $PreG_{6}$ group of calves, the highest average daily live weight gain was observed in $PreG_{24}$ group (0.95 ± 0.093 kg), but in comparison with the second largest growth rate of $PreG_{12}$ group calves (0.85 ± 0.10 kg), it is not statistically significantly higher. Both groups showed a very high daily live weight gain, which can be explained by the sustained action of the digestive canal. N. Stolić (2012), by feeding calves with prebiotic mannon-oligosaccharides, has also demonstrated that a statistically significantly greater increase of live weight can be gained in comparison with the control group.

When making animal cold carcass mutual comparison, we stated that cold carcass weight of the control group of animals and $PreG_{6}$ animal group was not statistically significantly higher, but having mutually compared $PreG_{6}$ against $PreG_{12;24}$ and CoG against $PreG_{12;24}$, we stated that the cold carcass weight was statistically significantly higher in $PreG_{12;24}$ than in $PreG_{6}$ and CoG ($p<0.01$).Having compared $PreG_{12}$ and $PreG_{24}$ we calculated that cold carcass weight of $PreG_{24}$ group animals was statistically significantly higher ($p<0.05$) than of $PreG_{12}$ one.

Conclusions

Feeding calf with inulin improves digestive channel functionality by reducing faecal mass liquefaction due to feed change or other stress influence. It makes animal gain live weight. Animals which were fed with inulin had higher cold carcass weight outcome. The animals included into our study indicated that the fed quantities of inulin statistically significantly increased the animal live weight gain, but not faecal mass consistency. We can conclude that when feeding an animal with a higher dose of inulin, digestive channel requires a longer adaptation and faecal consistency mass normalization period. In this research we found out that optimal inulin dose (for 4 – 12weeks old calves) is 6g/day/head or 12g/day/head of Jerusalem artichoke powder. In general, we can conclude that the increase of inulin quantity that is fed from the 4th – 12th week of calf life significantly influences the calf live weight gain and cold carcass weight, but does not statistically significantly affect the faecal mass consistency.

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