

The effect of feeding raw and extruded feed containing soyabean meal on pancreatic juice digestive enzyme activities in young calves

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ABSTRACT

The aim of this study was to determine the influence of raw and extruded feed containing soyabean meal on pancreatic juice enzyme activities in young calves. Experiments were carried out on twelve calves cannulated 3 weeks after birth. The calves from the control group were fed a semiliquid diet (milk and cereal mixture). The calves from the experimental groups received a semiliquid diet containing additionally soyabean meal in either raw or extruded form. A significant increase of protein and trypsin output as well as proteolytic activity in the pancreatic juice was observed in calves fed the diet with raw soyabean meal.

KEY WORDS: antinutritional factors, pancreatic feedback, trypsin activity, calf

INTRODUCTION

Preruminant calves under 3 weeks of age digest proteins of plant origin poorly in comparison with milk proteins, a result that may be due to the levels of pancreatic juice secretion and its proteolytic activity. Soyabean proteins are often used in feeding young calves (Sissons, 1982). However, improperly processed soyabean products may cause severe gastrointestinal disorders in calves and other animals. These may be related to soyabeans storing antinutritional factors (ANFs) including protease inhibitors (Lalles, 1995). Many ANFs are not completely inactivated by moderate heat-treatment. The extrusion process is, however, believed to destroy most of the ANFs present in feed. The purpose of the study was to determine

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the effects of raw or extruded feed containing soyabean meal on pancreatic juice secretion in the calf during the transition period from feeding milk to solid feed.

MATERIAL AND METHODS

The experiments were carried out on twelve calves, which were fitted with a pancreatic duct catheter and duodenal cannula at the age of 3 weeks after birth according to the method of Butler et al. (1960).

Calves were allotted randomly into one control group and two experimental groups. The animals from all groups were fed a milk diet and semiliquid feed consisting of a mixture of wheat chaff, barley (2% of BW), and milk (control group), raw mixture (wheat chaff, barley and 30.0% soyabean meal) experimental group I (raw soya group), and extruded mixture of the same composition (extruded soya group). The mixture was extruded at 180°C, and the total residence time of the meal in the barrel was 90 sec.

Experiments started after 1 week of recovery. Pancreatic juice (PJ) was collected in 15-min intervals during the preprandial period (30 min), prandial period (15 min) and postprandial period (3 h). During the prandial period, calves were fed either the control or experimental feed. Pancreatic juice volume was measured and 0.5 ml samples were taken for further analysis. The remaining amount of PJ was reintroduced into the duodenum.

The pancreatic juice was analysed for total protein content (Bradford, 1976) and trypsin activity (Erlanger et al., 1961). Proteolytic activity was determined using casein as the substrate. Statistical evaluation of the results was done by analysis of variance and Student's t-test.

RESULTS

Feeding increased pancreatic juice secretion in all three groups of calves. After feeding (postprandial period) pancreatic juice secretion decreased in both control and experimental calves, however, significantly higher values were found in the experimental groups (Figure 1). Feeding increased the protein output of all groups. In both the raw soya and extruded soya groups the values were significantly higher compared with the control. Protein output decreased after feeding in all groups, but was significantly higher in the extruded soya and raw soya groups. Patterns similar to protein output were found for proteolytic activity after feeding.

Trypsin activity increased in response to feed intake and remained at significantly higher levels during the postprandial period in the extruded and raw soya groups (Figure 2).

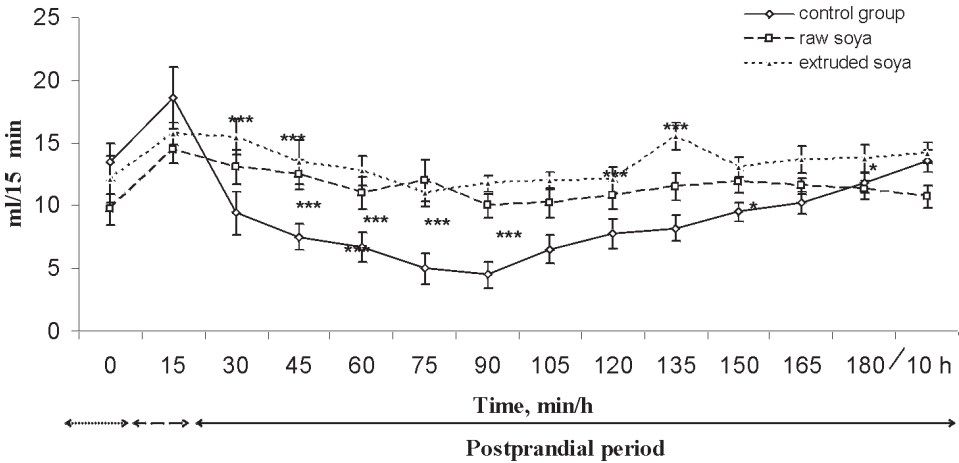


Figure 1. Volume of the pancreatic juice collected during the preprandial, prandial and postprandial period in preruminant calves, which were fed a semiliquid control diet or a diet with extruded or raw soyabean meal (n=12±SD, *P<0.05, **P<0.01, ***P<0.001 - significant differences between experimental and control group values at the same time of the experiment)

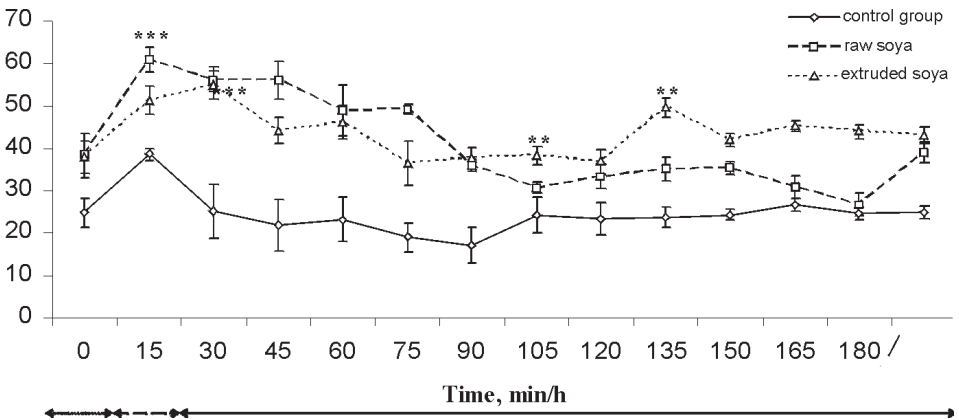


Figure 2. Trypsin activity of the pancreatic juice collected during the preprandial, prandial and postprandial period in preruminant calves, which were fed a semiliquid control diet or a diet with extruded or raw soyabean meal (n=12±SD, *P<0.05, **P<0.01, ***P<0.001- significant differences between experimental and control group values at the same time of the experiment)

DISCUSSION

Feeding raw soyabean to young animals greatly increases secretion of digestive enzymes by the pancreas. In the present study feeding a semiliquid diet containing

either extruded or raw soyabean meal stimulated pancreatic secretion over control values in the preruminant calf. Pancreatic proteases secreted into the upper small intestinal lumen suppress pancreatic exocrine secretion in the calf and several species (Zabielski et al., 1992). Soyabean meal is known to contain considerable amounts of ANFs such as trypsin inhibitors that block the active centre of the enzyme causing its deactivation. This leads to disruption of the feedback mechanism regulating the PJ secretion. This may be the reason for hyper-stimulation of the pancreatic exocrine function observed in calves fed a raw and extruded diet containing soyabean meal.

CONCLUSIONS

Feeding diets containing soyabean meal caused hyper-stimulation of exocrine pancreatic secretion in preruminant calves. This may be due to incomplete deactivation of soyabean ANFs in the extrusion process used in our experiments.

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STRESZCZENIE

Wpływ karmienia surową lub ekstrudowaną paszą zawierającą śrutę sojową na aktywność enzymów trawiennych soku trzustkowego u młodych cieląt

Celem badań było określenie wpływu surowej i ekstrudowanej paszy zawierającej śrutę sojową na aktywność enzymów soku trzustkowego u młodych cieląt. Doświadczenia przeprowadzono na 12 cielętach, którym założono kateter do przewodu trzustkowego w 3 tygodniu życia. Cielęta grupy kontrolnej żywiono dietą półpłynną (mleko i mieszanka zbóż), cielęta grup doświadczalnych półpłynną dietą zawierającą dodatkowo surową lub ekstrudowaną śrutę sojową. Stwierdzono istotnie większy wyrzut białka i trypsyny oraz większą aktywność proteolityczną w soku trzustkowym cieląt otrzymujących paszę z surową śrutą sojową.