Better Tolerance against Dietary Mycotoxins in Fattening Bulls when Supplemented with Farmatan-D®

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Summary

Hydrolysable tannins are polyphenolic secondary metabolites of plants, with a high bioactive function. A twelve-month feeding trial was conducted to determine the effect of the feed additive Farmatan-D® on average daily gain (ADG) of Simmental bulls. The feed supplement Farmatan-D® mainly consists of highly concentrated hydrolysable tannins, organic acids, and lignocellulose. This study focused on two periods. First period from month 1 to 7, and from month 8 to 12 of study. The study reveals that ADG in the first 7 months of the feeding trial is numerically higher (P = 0.119) in the control group and lower in the group with added Farmatan-D®. The results after the 8th month of our investigation suggest that the group supplemented with Farmatan-D® showed (P = 0.003) higher ADG than the control group after the month when a drop in ADG was observed due to the incidence of mycotoxicosis. Feed supplement helps animals better tolerate nutritional and metabolic imbalances and results in smaller production losses for the farmers.

Key words

fattening bulls, hydrolysable tannins, mycotoxicosis, average daily gain

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Introduction

The literature about tannins, polyphenolic secondary metabolites of plants, with both beneficial and adverse functions according to their concentration and chemical structure, is vast and often contradictory (Piluzza et al., 2014). In the past, tannins were classified as "anti-nutrients" because they can cause a reduction of feed intake and nutrient utilization (Frutos et al., 2004). Recently, there is an increasing awareness of tannins' beneficial roles in animal nutrition and health. Several researchers have reported health improvements in ruminants in the case of diets containing tannins. Tannin feedstuffs resulted in efficient nutrient utilization in ruminants in the form of better growth rates, milk yields and milk composition, higher production and better fertility (Barry and Mcnabb 1999; Makkar, 2003; Waghorn and McNabb, 2003; Patra and Saxena, 2011). The antimicrobial properties of tannins have opened the possibility of using them to manipulate ruminal microbial activity in a favorable direction (Lamy et al., 2011). It has generally been advised that tannin concentrations greater than 50 g/kg dry matter (DM) diet may negatively affect feed intake whereas lower concentrations of tannins have no influence on intake by ruminants (Barry and Manley, 1984; Aerts et al., 1999; Waghorn and McNabb, 2003).

After the ban on nutritive antibiotics in 2006 in the European Union, the EU Directive EC 1831/2003 provided an opportunity to exploit plants, plant extracts and plant secondary metabolites as natural alternatives to improve livestock productivity (Makkar et al., 2009). In recent years, many plants extracts have been evaluated for their ability to modulate rumen microbiome, feed digestion, and rumen fermentation. Some plant compounds have been revealed to have an effect on activity of rumen archaea, protozoa, and specific bacteria populations (Cobellis et al. 2016).

Plants tend to produce complex mixtures of tannins and not all tannins have the same feeding effects. The study of tannins in animal production has been focused primarily on condensed tannins (CT), and little information is available on the effects of hydrolysable tannins (HT) in livestock production. The aim of the study is to present the growth response of Simental bulls in fattening period prior to and after the incidence of mycotoxins in the feed ration supplemented with or without HT (Farmatan-D®).

Animals, material and methods

Experimental design

A 12- month field feeding trial was conducted to determine the effect supplementing bulls' diet with wood extract Farmatan-D® containing hydrolysable tannins on growth performance of Simmental bulls. The experiment was conducted on a commercial farm in Slovenia. At the beginning of the experiment the animals were uniform in age and live weight and then divided into a control (n=8, one pen) and an experimental group (n=8, one pen). Both groups were offered the same total mixed ration (TMR) which met the needs of the bulls at their specific stages of development. Bulls from the experimental group were supplemented with Farmatan-D® feed additive which consists of tannin wood extract, organic acids and lignocellulose (produced by Tanin Sevnica d.d, Slovenia) in concentrations presented in Table 1. The animals were fed ad libitum once a day and were slaughtered at the age of 18 months in a commercial abattoir.

Table 1. Daily dosage of feed additive Farmatan-D®

Category of animals based on live weight (kg)	Dosage per animal (g/day)
150-250	8
250-400	13
400-550	18
550-till end	24

Data collection

Animals were weighed at the beginning of the experiment – when the experimental group started receiving tannins, i.e. at app. the age of 174 days and 200 kg of live weight. At the end of the feeding trial (after 12 month) animals were weighed on the day of slaughter. During the trial the animals were weighed 13 times. Around the 8th weighing, occurred unintended problems with feed component which resulted in the ADG alteration. At that months according to visually inspected the mold was detected in corn maize silage component of feed ration (Bittman 2004, Oetzel 2009, Whitlow 2010). For that reason, the silage was immediately replaced. No laboratory analysis of mycotoxins was done. Accordant to that incidence, the whole period was divided into two phases, first and second period (prior to and after the onset of problems, respectively). The first period was from 1st to 7th weighing and the second period from 9th to 13th weighing. Daily gains of animals for both phases were calculated and compared. The live weight of animals at the slaughter was standardized on an average age of all animals before slaughter in the trial 562 days of age. The standardization was done according to ICAR (2011) (Figure 3).

Statistical analysis

Statistical analysis was carried out by SAS 9.1 (SAS Inc., Carry, NC, USA). GLM procedure was used in order to evaluate the effect of tannin supplementation on growth performance. The model comprised fixed effect of treatment group (with and without tannin supplementation). Least squares means (LS means) were compared using the PDIFF option in SAS.

Results and discussion

Some studies have confirmed that adding tannins to the feed decreases voluntary intake in lambs (Frutos et al., 2004). Barry and Manley (1984) reported that consumption of plant species with high tannin contents significantly reduces voluntary feed intake, while medium or low consumption seems to not affect it.

In the present study, we mainly focused on two periods of growth. Because we have weighed all the animals during the whole study, we noticed an extraordinary decrease in feed intake and daily gain between 7th and 8th month of the study. Noted drop in ADG in that month was by test group 45% and in control group 50%, compare to 7th month. This was probably due to the feed component that has been infested by mold and contaminated with mycotoxins. The drop in ADG was detected in all animals on the farm. Feed was immediately changed and the situation started to improved.

Figures 1 and 2 shows the comparison of control and experimental groups for daily gain for period 1st–7th and 9th–12th month of the study. Significant differences in ADG were observed after month 8 of the study (Figures 1 and 2). In our study ADG was higher in the control group (no tannin wood extract added) as compared to the experimental group during the first 7 months (P = 0.119). After month 8 of the study ADG was significantly higher (P = 0.0027) in the group with tannin wood extract and lower in the control group. The results of our investigation suggest that the group supplemented with tannin wood extract showed higher ADG than the control group after the month when a drop in ADG was detected. The achieved average age at the slaughter was 562 days. In Figure 3 are presented standardized live weight before slaughter. Statistical analyses shoved no significant differences between compared groups (P = 0.899).

Since it is hard to accurately determine the bioactive efficacy of tannins and their impact on microbial function and transformation of nutrients in ruminant nutrition the real cause for the increase of ADG in the tannin supplemented group in the second period of the trial remains unclear. According to different authors, ruminants are more resistant to certain mycotoxins than are monogastric animals, suggesting that there are detoxification mechanisms in the rumen (Dawson et al., 1997). We must also bear in mind that the feed for fattening bulls fundamentally has been shifted to higher proportions of concentrates, which contributes to the development of a large number of microbial populations in the rumen. More abundant microbial population in rumen as higher concentration of microbes in rumen juice possess great conversion capacity for nutrients in feed ration into animal ideally available nutrients.

Paswan and Sahoo (2010) have studied the feeding of oak leaves to cattle bulls. Oak leaves (hydrolysable tannins) along with local grass hay showed an increase in feed and nutrient intake and a positive shift on rumen metabolic (propionate-type fermentation, microbial energetic efficiency) and enzymatic (fiber-degrading and proteolytic activity) profile of animals. Jolazadeh et al. (2015) reported that treatment of soybean meal with pistachio extract concentrate (containing tannins) did not affect final body weight or dry matter intake, but adding pistachio extract linearly increased ADG and feed efficiency. Tabacco et al. (2006) showed that low levels of chestnut HT, applied to lucerne, are useful for reducing proteolysis in silages and could improve protein utilization. Elizondo et al. (2010) studied the use of commercial tannins *in vitro* to determine the capacity of tannins to inhibit the development of intestinal diseases produced by *Clostridium perfringens*. In this study, tannins were able to reduce the alpha toxin lecithinase activity and epsilon toxin cytotoxicity in Madin–Darby canine kidney (MDCK) cells. These results suggest that tannin-supplemented diets could be useful to prevent some clostridial diseases.

In ruminants, a particularly important positive effect of tannins is dietary protein protection from ruminal microflora attack. Due to the binding of tannins to dietary protein, and to a reduction in the activity of a large proportion of microflora, there is an increased rate of amino acid absorption in the intestine, which improves the utilization of nitrogen by ruminants. As well as binding to protein, tannins can also bind to

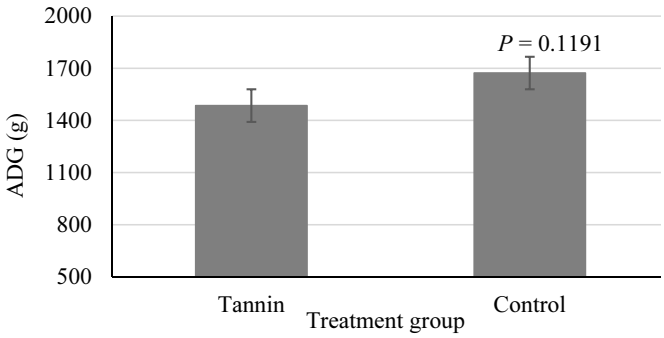

Figure 1. Average daily gain in the first period

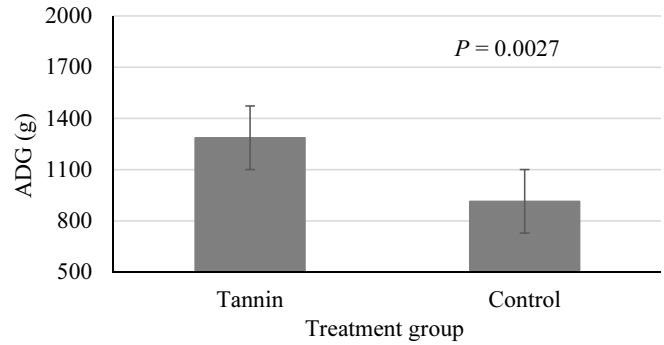

Figure 2. Average daily gain in the second period

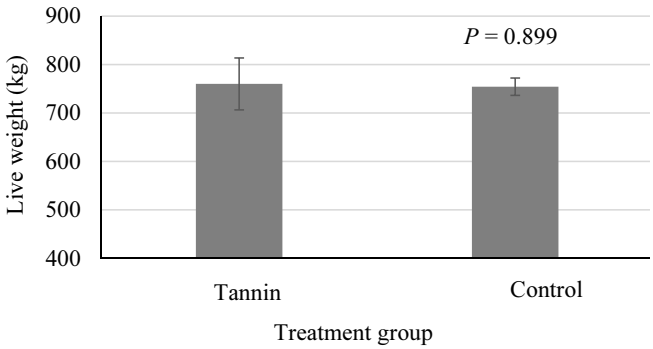

Figure 3. Standardized body weight before slaughter

carbohydrates, leading also to a reduction in ruminal gas production (Buzzini et al 2008; Lamy et al. 2011; Patra and Saxena, 2011). Tannins can also have post-ruminal benefits e.g. parasite control (Waghorn and McNabb, 2003).

Due to the activities mentioned above tannins can be associated with improvements in animal growth and productivity. Whether the higher ADG in our study can be ascribed to tannin attributions to protect feed protein from degradation, antimicrobial properties or just some positive health effect, still needs more research. Former studies of tannins have primarily focused on CT, and little information is available on the effects of HT in livestock production. In addition, many times studies

of tannins are concentrated on small ruminants like sheep and goats. Little attention is focused on fattening bulls. Also there has been no attention on mycotoxins exposure and adding tannins to animal feeds. The potential use of HT as a feed additive requires further investigation to provide a stronger basis for understanding the possible role of HT in animal feeding.

Conclusion

The obtained results of feeding trial on fattening Simmental bulls suggest that supplementing the diet with tannin wood extract (Farmatan-D®) led to significantly higher (P= 0.0027) ADG after the month where a drop in ADG was detected due to incidence of mycotoxins in feed ration component. The significant positive effect by using HT additives in mycotoxcosis occurrence can help animals better tolerate nutritional and metabolic imbalances.

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