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EFFECT OF PARTIAL SUBSTITUTION OF CORN WITH WHOLE-GRAIN WHEAT IN FATTENING LAMB DIETS ON THEIR GROWTH PERFORMANCE

MIRKO IVKOVIĆ*, SAŠA KRSTOVIĆ, MIROSLAVA POLOVINSKI-HORVATOVIĆ, DEJAN BEUKOVIĆ, IVAN PIHLER, DRAGAN GLAMOČIĆ

Faculty of Agriculture, University of Novi Sad, Trg Dositeja Obradovića 8, 21 000 Novi Sad, Serbia

*Corresponding author: mirko.ivkovic@stocarstvo.edu.rs

SUMMARY

Wheat grain is commonly used for animal feeding in some regions while it is rarely used in others. Its nutrient composition is quite similar to more commonly used corn grain, but there are some concerns regarding its effect on animal performance and health. However, it appears that usage of wheat grain in animal feeding is dominantly affected by economic rather than nutritional reasons. When used with caution, wheat can be a good alternative to corn. In order to test this, 20 Wurttemberg lambs, three months old, were randomly separated in two groups and fed diets containing 600 g of corn grain, or 300 g of corn grain and 300 g of wheat grain, for a period of one month. The used grains were whole, non processed grains. Two diets contained the same commercial protein supplement and alfalfa hay was offered ad libitum. Both groups accepted their experimental diet well and readily consumed the amounts offered. No health problems were observed. Growth rate was higher in male than in female lambs, but was not affected by wheat inclusion.

Key words: corn, lambs, starch, wheat, daily gain

INTRODUCTION

During the past two decades, the interest of Serbian farmers and feed producers in using wheat has increased. This is probably the result of several factors. Namely, the presence of companies and advisors from EU countries, who are accustomed to wheat use in animal feeding, has increased in Serbian agriculture. Also, there has been increasing usage of exogenous enzymes, which are important in digesting non-starch polysaccharides and reducing digesta viscosity when wheat is fed to pigs and poultry (Dusel et al., 1998; Rosenfelder et al., 2013; Amerah, 2015). Finally, wheat price might have had the crucial effect on using wheat as animal feed. Corn is normally cheaper than wheat in Serbia, yet it is also common that wheat price is lower. During these periods, farmers and feed producing industry are tempted to use wheat in their feed formulations instead of corn.

Grain of soft wheat, commonly produced in Serbia, is mainly composed of starch. It contains on average approximately 70% of starch on a dry matter basis, which is comparable to 74% of starch in corn grain (Sauvant et al., 2004). Its crude protein and neutral detergent fiber contents are on average somewhat higher, while fat contents and energy value are somewhat lower. However, the main difference between these two grains is not in their nutrient contents. Instead, it is the viscous properties of wheat non-starch carbohydrates and fast fermentation rate of its starch that makes wheat feeding more challenging. While digesta viscosity is the primarily concern in wheat feeding to non-ruminants (Choct & Annison, 1992), fast fermentation rate is important for ruminant feeding (Huntington, 1997). Ruminal degradation rate of starch from corn grain is 5.5% per hour, resulting in effective degradability rate of 60% and ruminal degradation rate of starch from wheat grain is 39% per hour with effective degradability rate of

94% (Sauvant et al., 2004). For this reason, wheat is commonly used for inducing ruminal acidosis for experimental purposes (Keunen et al., 2002; Krause & Oetzel, 2005; Plaizier et al., 2017).

According to a large review of trials on feeding different grains to feedlot cattle, published by Owens et al. (1997), wheat-fed cattle tended to have lower daily gains, but this difference was not statistically significant. Ørskov et al. (1974) compared feeding four different cereals in whole and ground form to young lambs, without supplemental forage. Lambs fed wheat had similar or even better diet digestibility coefficients than lambs fed corn, but somewhat lower daily gains. Occurrence of rumenitis was not affected by the cereal grain used, but by its form. Lambs fed ground cereals frequently had rumen lesions. Tripathi et al. (2007) observed reduced feed intake when corn was substituted by wheat grain, but in this trial damaged wheat grain contaminated with aflatoxin was used. Popova et al. (2013) demonstrated that corn and wheat fed lambs have similar intakes and daily gains, but methane production was 36% lower when corn was used. Antibiotics can be used to reduce severity of ruminal acidosis when feeding high amounts of wheat grain to sheep (Godfrey, 1995), but their use for this purpose is prohibited in Serbia (Službeni glasnik, 2010).

In feeding trials where both male and female lambs are used, male lambs usually have a higher growth rate and better feed conversion. Body weight gain in male lambs was determined to be higher by 16% (Ørskov et al, 1974), 16% to 20% (Rodríguez et al., 2011) or even 40% (Facciolongo et al., 2018).

The aim of this study was to test the effect of partial substitution of corn grain with wheat grain on fattening lamb growth performance, as a strategy to reduce feed cost during periods when wheat price is lower than corn price.

MATERIAL AND METHODS

The trial was conducted during July-August 2018 at a privately-owned sheep farm in Banatski Dvor, Vojvodina, Serbia. Twenty Wurttemberg (Merinolandschaf) lambs, 13 females and 7 males, with body weight of 20 to 25 kg, were used in the feeding trial. All lambs were from the same farm where the trial was conducted, had parents of similar characteristics and were of similar age, approximately 3 months old. Lambs were randomly assigned to one of the two treatments. Each group was housed in one straw bedded pen with free access to water. Both groups were fed a fixed amount of concentrate feeds from feed trough and *ad libitum* alfalfa hay from hay rack placed above the trough. Concentrate feed was composed of 40% commercial pelleted mix with declared protein content of 18% (Tab. 1) and 60% of grains. In group C, corn was a sole grain used, while in group W, 30% of corn and 30% of wheat was used (Tab. 2). Corn and wheat used were of good sensory appearance without visible spoilage signs and were used without any processing, as whole grains. Daily allowance of concentrate mix was 1 kg per lamb (400 g of mix and 600 g of corn for group C; 400 g of mix, 300 g of corn and 300 g of wheat for group W). Salt block was available *ad libitum*.

Table 1. Declared chemical composition of pelleted concentrate mix* used in the trial

Parameter	Content
Dry matter	min 87%
Crude protein	min 18%
Crude fiber	max 6%
Ash	max 8%
Calcium	0.8-1.0%
Phosphorus	0.5-0.7%
Sodium	0.3-0.4%
Feed units	min 0,9
*Ingredient composition of the mix: corn, soybean meal, sunflower meal, full-fat soybean, wheat middlings, brewer's yeast, calcium carbonate, monocalcium phosphate, sodium chloride, trace mineral and vitamin premix.	

Body weight of lambs was individually measured at the beginning and at the end of the trial. The trial lasted for 31 days. Based on the body weights, individual body weight gains were calculated and used in statistical analysis. Data was analyzed using main-effects ANOVA with feed and sex as the factors. Results were considered statistically significant if p-value was less than 0.05.

Table 2. Chemical composition of concentrate feeds used in the trial expressed on a dry matter basis

Parameter	Diet C	Diet W
Crude protein	14.0%	14.7%
Crude fiber	4.3%	4.3%
Calcium	0.44%	0.45%
Phosphorus	0.46%	0.48%
Sodium	0.16%	0.17%

RESULTS AND DISCUSSION

Both groups accepted their experimental diet well and readily consumed the amounts offered. All twenty lambs finished the trial and no apparent health problems were observed. Results of body weight measurements are shown in Table 3. Most lambs had daily body weight gains between 250 and 350 grams, which can be considered normal, with some lambs from both groups underperforming, giving a left-skewed distribution of body weight gains that is quite usual. A correlation between initial body weight and observed weight gain cannot be seen.

Table 3. Initial body weights, final body weights and body weight gains of lambs in the trial

Group	Sex	Initial BW (kg)	Final BW (kg)	Daily gain (kg)
C	F	21.9	29.8	0.25
C	F	21.5	28.2	0.22
C	F	24.5	28.6	0.13
C	F	24.1	33.6	0.31
C	F	22.5	31.2	0.28
C	F	24.1	32.2	0.26
C	M	24.6	33.1	0.27
C	M	21.9	30.2	0.27
C	M	24.0	33.0	0.29
C	M	21.3	31.2	0.32
W	F	20.5	28.0	0.24
W	F	24.0	29.1	0.16
W	F	20.5	28.8	0.27
W	F	24.3	30.4	0.20
W	F	23.0	31.0	0.26
W	F	21.4	29.0	0.25
W	F	21.0	25.0	0.13
W	M	20.8	29.6	0.28
W	M	25.0	35.4	0.34
W	M	20.0	28.8	0.28

Analysis of variance showed a statistically significant effect of sex on daily weight gain, while feeding group did not have a statistically significant effect (Tab. 4). Male lambs performed better, although the difference was not numerically large. This small difference between daily gains of male and female lambs can, in part, be explained by feeding limited amount of concentrate feed to all lambs.

The results of this trial are in agreement with results of previous trials with lambs (Orskov et al., 1974; Berthelot et al., 2010; Popova et al., 2013) and other fattening ruminants (Owens et al., 1997), showing comparable or slightly lower growth rates when replacing corn with wheat grain. It can be assumed that good results obtained with wheat in this trial are the result of using grain of good quality, its moderate inclusion level, providing forage *ad libitum* and using whole grains. Using moldy, damaged wheat grains can reduce intake (Tripathi et al., 2007), ground wheat use can lead to rumen lesions (Orskov et al., 1974), while using large amounts of wheat grain without forage supplementation can result in ruminants completely refusing feed or having serious health problems (McGregor, 2006). Substituting corn with wheat might have negative effects on methane production (Popova et al., 2013) or carcass weight and dressing percentage (Berthelot et al., 2010). From the perspective of farmers who sell their animals based on live weight, these factors are not of primary importance.

Table 4. Initial body weights, final body weights and body weight gains of lambs in the trial as affected by treatment and sex (average $\pm$ standard deviation)

Group	Sex	Initial BW, kg	Final BW, kg	Daily gain, kg
C	F	23.1 $\pm$ 1.3	30.6 $\pm$ 2.1	0.24 $\pm$ 0.06
C	M	23.0 $\pm$ 1.6	31.9 $\pm$ 1.4	0.29 $\pm$ 0.02
W	F	22.1 $\pm$ 1.6	28.8 $\pm$ 1.9	0.22 $\pm$ 0.05
W	M	21.9 $\pm$ 2.7	31.3 $\pm$ 3.6	0.30 $\pm$ 0.03
Groups				
C		23.0 $\pm$ 1.3	31.1 $\pm$ 1.9	0.26 $\pm$ 0.05
W		22.1 $\pm$ 1.8	29.5 $\pm$ 2.6	0.24 $\pm$ 0.06
<i>p-value</i>				0.41
Sex				
	F	22.6 $\pm$ 1.5	29.6 $\pm$ 2.2	0.23 $\pm$ 0.06
	M	22.5 $\pm$ 2.0	31.6 $\pm$ 2.3	0.29 $\pm$ 0.02
<i>p-value</i>				0.02

CONCLUSION

According to the results of this trial, it can be concluded that substitution of corn grain with wheat grain did not have a negative effect on fattening lambs' growth rate. This conclusion is limited to the conditions where moderate wheat grain inclusion is used, where forage is provided *ad libitum* and wheat grain is not ground or processed in some other way. In periods when wheat prices are low, this feedstuff can be a good alternative to corn grain in fattening lamb diets. Male lambs had 24% higher weight gains than female lambs, and the difference was statistically significant.

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