Effect of substituting barley grain with wet sugar beet pulp silage on some blood metabolites in lambs

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Abstract

The objective of this experiment was to evaluate the effects of substituting grain barley with wet sugar beet pulp (WSBP) silage prepared with wheat bran (WSBPS) at different levels on some blood parameters of lambs. A barley grain based control diet was prepared. Then, three experimental diets were prepared by substituting 35, 70 and 100% of barley grain with WSBPS (35, 70 and 100% WSBPS diets). Moreover, negative control was also established. A total of sixty, 6-7 month old male Akkaraman lambs with 24.29±1.50 kg mean body weight were used in the study. These lambs were fed one of five diets for a period of 75 days. Blood samples were taken at the beginning and end of the experiment. Serum glucose, total protein, BUN, phosphorus, and calcium levels were determined. Serum BUN and phosphorus levels were similar at the beginning and end of the experiment (P>0,05). Serum glucose levels were significantly higher in control, 100% WSBPS and negative control whereas Ca level was higher in all groups, except negative control at the end of experiment (P<0,05). Total protein levels were significantly lower in 70 and 100% WSBPS (P<0,05). All of the parameters, except BUN level were statistically similar among groups at the end of the experiment. In conclusion, substituting barley with wet sugar beet pulp silage did not have significant effects on blood parameters, except BUN. Substituting barley with WSBPS could be an alternative feeding strategy for farmers without affecting animal health based on the results of this experiment.

Key words: Blood metabolites, Sheep, Sugar beet pulp silage.

Introduction

Even though sugar beet pulp has not been considered as concentrate feed, sugar beet pulp has very highly digestible cellulose content compared with grass hay and other forages (Toğrul and Arslan, 2003). Moreover, it has some advantages over cereal grains since it is cheap and rich in pectin and does not cause metabolic disorders such as acidosis like cereal grains in ruminant animals (Avec et al., 2005). Sugar beet pulp contains 54.0% NDF, 30.0% NSP, 0.6% EE, and 4.4% ash on dry matter basis (Sniffen et al., 1992). However, crude protein content of sugar beet pulp is low (Mariotti et al., 2001), ranged from 8 to 10 %, DM (Coşkun et al., 2000) and mainly consists of NPN (Ergun and Tuncer, 2004). Therefore, it has to be supplemented with high quality protein sources when it is fed to ruminant animals.

Wheat bran, another industrial by product is mainly fed to ruminant animals because it is both rich in cellulose and cheap. If sugar beet pulp is ensiled with wheat bran some of the negative features of sugar beet pulp can be eliminated, because wheat bran is high in phosphorus, has ideal crude protein suited for ruminants and also has laxative effect (Ergun and Tuncer, 2004).

MATERIALS AND METHODS

Animals: A total of sixty, 6 to 7 month old male Akkaraman lambs with average body weight of 24.29±1.50 kg were used in the study. These lambs were randomly divided into one of four experimental groups according to their initial body weights.

Feed and Feeding: Barley based control diet was prepared. Wet sugar beet pulp-wheat bran silage was also prepared wherein 8% wheat bran (w/w basis) was incorporated with wet sugar beet pulp to obtain 20% dry matter (DM) in silage. Three experimental diets were formulated and prepared by

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substituting 35% of barley grain with wet sugar beet pulp-wheat bran silage (35% WSBPS diet), 70% of barley grain with wet sugar beet pulp-wheat bran silage (70% WSBPS diet) and 100% of barley grain with wet sugar beet pulp-wheat bran silage (100% WSBPS diet). Moreover, another group was also fed with just WSBP silage without wheat bran and safflower as negative control. Table 1 gives details of the experimental diets. The experimental diets were adjusted to be iso-caloric and iso-nitrogenous as close as possible with approximately 14% crude protein (CP) and 2.60 Mcal/kg energy. Data of Ozurturk et al. (2011), Leventoglu (2006), and NRC were utilized for determination of diet’s CP and energy values.

Ingredient and nutrient composition of experimental diets are given in Table 1.

The calcium and phosphorus content of ingredients used in preparation of experimental diets are presented in Table 2.

The experimental lambs were fed respectively with one of the five diets for a period of 75 days. Lambs were housed in cages as a group of three animals per cage. The cages were placed in a barn. Animals had free access to clean water and mineral blocks throughout the experiment.

Biochemical analysis: Blood samples were taken from jugular vein of lambs at the beginning and at the end of the experiment (75th day of experiment). Serum of blood samples were separated after centrifugation at 3000 rpm for 10 minutes. Serum glucose, total protein, BUN, phosphorus, and calcium levels were determined using an auto-analyzer (Coasc311, JAPAN). Phosphorus and Ca levels of the respective feed were determined according to method described by Kacar and Inal (2008).

Statistical analysis: Data were analyzed as completely randomized design using GLM procedure of SAS. Means were separated using Duncan test (SAS, 1995).

RESULTS AND DISCUSSION

The main objective of this study was to evaluate the effect of replacing barley grain with wet sugar beet pulp silages prepared with wheat bran, in lamb diets on serum glucose, BUN, serum calcium, phosphorus and total proteins.

Serum glucose, total protein, BUN, phosphorus, and calcium levels of the lambs fed different experimental diets, prior to and at the end of the experiment is presented in Table 3.

Serum glucose concentrations for all groups, except 35 and 70 % WSBPS significantly increased at the end of the experiment (P<0.05). However, serum glucose levels were similar among groups, including lambs fed wet sugar beet pulp silage without wheat bran (negative control) (P>0.05). Because lambs used in the experiment were collected from markets and they were fed with diet very low in energy (mainly low quality forage) the increases in serum glucose levels after feeding these diets was an expected result. Similar serum glucose levels between control diet (40% barley containing diet) and wet sugar beet silage without wheat bran indicated that even wet sugar beet silage alone can be an alternative for cereal barley in terms of energy. These serum glucose levels were typical for high-energy diets. Significant quadratic effects have been observed for this metabolite at 4.5 and 6 h post-feeding. The greatest concentrations occurred on the diets containing 50 or 25% barley (Mandebvu and Galbraith, 1999).

Serum glucose concentration significantly increased in lambs fed 100%WSBPS at the end of experiment and was the highest among all groups. In contrast, Wang et al. (2011) reported that substituting ground corn with sugar beet pulp (SBP) as an energy source for Chinese Holstein lactating dairy cows decreased the concentrations of serum glucose (P<0.01). The differences between these two experiments could be due to production levels of animals and difference in cereals (barley and corn) used for substitution. Sugar beet fiber and molasses have been reported to be effective on

Table 1: Ingredient and nutrient composition of experimental diets.

<table>
<thead>
<tr>
<th>Ingredients (% diet)</th>
<th>Control</th>
<th>35% WSBP</th>
<th>70% WSBP</th>
<th>100% WSBP</th>
<th>Negative</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sainfoin</td>
<td>42</td>
<td>40</td>
<td>40</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Barley</td>
<td>40</td>
<td>28</td>
<td>14</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Sunflower meal</td>
<td>18</td>
<td>15</td>
<td>12</td>
<td>17</td>
<td>0</td>
</tr>
<tr>
<td>Sugar beet silage</td>
<td>0</td>
<td>17</td>
<td>34</td>
<td>55</td>
<td>100</td>
</tr>
</tbody>
</table>

Calculated Nutrient Content

- CP (% DM): 14.11, 14.24, 14.30, 14.05, 10.88
- ME (Mcal/kg): 2.62, 2.63, 2.58, 2.55, 2.76

Table 2: Calcium and phosphorus content of feed ingredients in experimental diets %.

<table>
<thead>
<tr>
<th></th>
<th>Sainfoin</th>
<th>Sunflower meal</th>
<th>Barley</th>
<th>WSBPS</th>
<th>WB+WSBPS</th>
<th>Wheat bran</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ca</td>
<td>1.76</td>
<td>0.44</td>
<td>0.13</td>
<td>0.67</td>
<td>0.44</td>
<td>0.28</td>
</tr>
<tr>
<td>P</td>
<td>0.09</td>
<td>0.28</td>
<td>0.12</td>
<td>0.03</td>
<td>0.13</td>
<td>0.35</td>
</tr>
</tbody>
</table>
Table 3: Serum glucose, total protein, BUN, phosphorus and calcium levels at beginning and end of the experiment.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Glucose Beginning</th>
<th>Glucose End</th>
<th>BUN Beginning</th>
<th>BUN End</th>
<th>Phosphorus Beginning</th>
<th>Phosphorus End</th>
<th>Calcium Beginning</th>
<th>Calcium End</th>
<th>Total Protein Beginning</th>
<th>Total Protein End</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>48.75</td>
<td>64.50</td>
<td>3.42</td>
<td>9.050</td>
<td>1.87</td>
<td>5.975</td>
<td>9.050</td>
<td>6.775</td>
<td>7.575</td>
<td>6.775</td>
</tr>
<tr>
<td>%35 WSBPS</td>
<td>63.00</td>
<td>69.25</td>
<td>2.58</td>
<td>9.450</td>
<td>2.81</td>
<td>6.100</td>
<td>9.450</td>
<td>6.525</td>
<td>7.250</td>
<td>6.525</td>
</tr>
<tr>
<td>%70 WSBPS</td>
<td>64.00</td>
<td>69.25</td>
<td>2.58</td>
<td>8.750</td>
<td>2.81</td>
<td>6.100</td>
<td>8.750</td>
<td>6.525</td>
<td>7.250</td>
<td>6.525</td>
</tr>
<tr>
<td>%100 WSBPS</td>
<td>58.00</td>
<td>77.25</td>
<td>3.11</td>
<td>9.325</td>
<td>2.81</td>
<td>6.100</td>
<td>9.325</td>
<td>6.525</td>
<td>7.250</td>
<td>6.525</td>
</tr>
<tr>
<td>Negative Control</td>
<td>57.25</td>
<td>65.00</td>
<td>2.58</td>
<td>7.575</td>
<td>2.81</td>
<td>6.100</td>
<td>7.575</td>
<td>6.525</td>
<td>7.250</td>
<td>6.525</td>
</tr>
</tbody>
</table>

Glucose levels in different animal species (Diez et al., 1997; Thorsdottir et al., 1998; Elgilani, 2000). It has been reported that sugar beet fiber could reduce hyperglycemia and be useful in therapeutic liquid and formula diets. However, ruminant animal have different digestive system compared with mono-gastric and thus, it could not have similar effects as it is in mono-gastric animals.

Serum total protein concentrations were statistically similar among all group (P>0.05), except 70 and 100% WSBPS. Serum total protein concentrations decreased at the end of experiment in lambs fed 70 and 100% WSBPS (P<0.05) in this experiment. Even lambs fed wet sugar beet pulp silage prepared without wheat bran used as negative control in the experiment had similar serum total protein concentration compared with those of control group, indicating that wet sugar beet pulp had enough CP to meet CP requirement of these lambs. Similarly, Wang et al. (2011) reported that substituting ground corn with sugar beet pulp had no significant effects on the performance, nutritional status and blood total protein concentration.

The concentrations of BUN did not significantly change after experimental diets were fed to animals (P>0.05). However, BUN concentrations were significantly lower in animals fed either %100 WSBP or negative control diets compared with the other groups (P<0.05). BUN usually indicates the short-term protein intake and low BUN concentrations mean lack of rumen degradable protein in the diet of sheep. BUN levels can be altered by type of carbohydrate and protein fed to lambs (Scott, 2015). As percentages of WSBPS increased in diets, the amounts and percentages of protein escaping duodenum numerically increased. It was assumed that addition of WSBPS into diet increased the rate of passage, amount of escape protein and digestion of cellulose (Aldemir and Karsli, 2012). Thus, these increases in by-pass protein and cellulose concentrations in %100 WSBP or negative control diets may have led to a lower BUN concentrations in animals fed these diets. The lambs fed diets containing corn steep liquor (CSL) had only higher urea-N concentration compared (p<0.05) with the lambs fed with diet without CSL (Azizi-Shotorkhoft et al., 2016). In the same study, it was observed that lower protein digestibility with post-prandial urea concentrations were significantly decreased. The results for a feedlot experiment suggested that barley grain was utilized more effectively than molasses sugar beet pulp MSBP for gain in digesta-free body weight, carcass weight, and carcass crude protein, that is to say effects which were associated with greater concentrations of plasma urea concentrations (Mandebvu and Galbraith, 1999). In another experiment, substituting corn with sugar beet pulp at Barki lambs resulted in an increase in blood urea and creatine levels, but all measured blood parameters were within normal ranges with a significant (P<0.05) effects of experimental rations on blood plasma parameters.
(Mahmoud and El-Bordeny, 2016). Substituting ground corn with sugar beet pulp in Chinese Holstein lactating dairy cows resulted in a decrease at blood urea nitrogen (Wang et al., 2011). The difference between lamb and dairy cow experiments could be explained by the differences of CP requirements.

Serum Ca and P levels were not affected by diets and in general, Ca levels increased at the end of the experiment. Addition of WSBPS into diet increased serum Ca levels. This increase seems to be a result of higher Ca content of sugar beet pulp (0.44%) compared with that of barley (0.13%). In a similar experiment, twenty male lambs were fed either a basal diet containing molasses sugar beet pulp or barley. It was shown that serum calcium and phosphorus levels were not significantly different between groups (Bilal, 2009), which supports the results of the current experiment.

CONCLUSION

In conclusion, substituting barley with wet sugar beet pulp silage did not have significant effect on blood parameters, except BUN. Moreover, lambs fed wet sugar beet pulp silage prepared without wheat bran (negative control) had lower BUN levels compared with lambs fed wet sugar beet pulp silage prepared with wheat bran. Addition of wheat bran into wet sugar beet pulp silage may have positive effect on diet protein level. Substituting barley with sugar beet pulp silage could be an alternative feeding strategy for farmers without affecting animal health based on the results of this experiment.

REFERENCES


A dissertation thesis of Master of Science in Poultry Production.


