

Investigate the Role of Rye Nutrition in the Weight Production of Turkish Sheep

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Abstract The main objectives of this study were to use rye grain in the diet of Turkish sheep as a substitute for barley grain and to understand the biological value of rye in feeding lambs and weight gain. Animals were divided into 3 experimental groups with 3 replicates in each group. Control group (T1) received standard diet with barely grain while groups T2 and T3 fed on diets with substitution of 20 and 30% barely grain by rye grain. The results of the study showed that lambs fed on 20% rye seeds have a significant higher weight gain as a results of better feed intake and feed conversion.

1 Introduction

Agriculture and animal husbandry are the occupations of the majority of Afghanistan's population. Among livestock, sheep rearing has the upper hand in Afghanistan due to the high domestic demand for mutton (Zahid et al 2021). However, due to nutritional constraints, livestock productivity is less than in other countries (Uzun et al 2006). Raising and fattening lambs is a very promising income-generating activity, so they need cereal supplements. Cereals Crops are expensive because they are needed for human consumption, so the partial replacement of cereals in the diet of fattened lambs is the main research area of need for Afghanistan (Zahid et al 2021). Comprehensive and extensive research in this area is essential for appropriate solutions (Sirin and Sen 2018). The replacement of barley with rye in lamb was tried, as rye is an additional crop in Afghanistan that usually grows unintentionally among cereals, especially wheat and barley, and most farmers throw

it away unused. Rye (*Scaevola taccada* L.) is very similar to cereals, especially barley, regarding family and nutrient composition (Gómez et al 2009). Rye is an annual plant and belonging to the cereal family, as well as the properties of the rye is very close to the wheat and barley crop which has a great nutritional value to animals (Gómez et al 2009). Rye is an annual plant from the cereal family that, like wheat and barley, has a high nutritional value for animal nutrition, as rye is available at a low price compared to wheat and barley. Rye is one of the most resistant types of cereal crops that can accordance in different climate, and cold or rainy weather up to 16 degrees, and sea level 3000 meters can be adapted and grown (Park et al 2014). Rye grains are rich in carbohydrates in which they have 69-76gr per 100 gr of dried biomass. It is also rich in calcium and selenium, which acts as an antioxidant, and is important regarding vitamins and carbohydrates which help absorb vitamins (Rey et al 2021). Rye is delicious food for sheep and other animals and has a higher energy value compared to other grains (Afzal et al 2013). Rye is a young crop that first

spread to Central and Northern Europe as a seed weed (Kosicki et al 2020). Rye is a usual cereal in central, Eastern, European, and all world where it is used for the production of bread for humans and fodder (Hansen et al 2003). Also, rye is a multi-purpose crop. Winter rye is one of the most important cereal crops because of its high adaptive capacity and stable seed yield. Winter rye has a beneficial agro technical effect (Shakirzyanov et al 2020). The basic chemical compounds of the rye grain are starch, fiber, protein, and ash. The starch content is exclusive mainly to the endosperm, and contents between 57.1 and 65.6 g/100 g of dry matter are reported in the rye (Hansen et al 2004). Rye contains enzymes that include all of its major constituents, and in particular, the starch-degrading amylases have a key role concerning the baking the quality of the rye flour (Bushuk 2001). Rye is a typical feed plant, which is given to animals as grain, forage, or rye bran. Rye grain is also used in the cereal and milling industry as a raw material for the production of flour, from which various types of bread are made (Jasińska et al 2006). Also, some source says, the rye is not generally used in animal nutrition, because of concerns about ergot alkaloid contamination (Rajtar et al 2021). Rye is more tolerant than drought and, it can grow in a wide range of deferent soil including, poor, sandy soils. In addition, rye has some nutritional benefits over wheat, since its content of minerals, lysine, and dietary fiber is very high (Thompson 1983). (Comino et al 2014) mentioned that 70% of the costs of a farm are related to animal feed and suggested that local foods and by-products is better used to reduce livestock consumption cost.

Accordingly, the aim of this study was to use local rye grain, as substitute to barely grain, in the ration for fattening lambs and examining its effect, in different ratios, on animal weight, food intake and feed conversion ratio (FCR).

2 Material and Methods

2.1 Research location

The present study was conducted between 15 October to 15 December 2018 in the central Baghlan district located in the northeast part of Afghanistan. This province is located at 29° and 31 minutes' north latitude and 58° and 48 minutes' south longitude. Baghlan province is 230 Km from Kabul and along the Kabul highway.

2.2 Experimental design and treatments

Turkish male lambs at the age of 5-6 months and weight 41.2 Kg were selected and randomly divided into 3 experimental groups with 3 replicates in each group. Lambs were guided to a period (10 days) for adaption, then fed on diet 4 times a day and had always access to drinking water. The weight gain of the lambs was measured and recorded weekly using a digital scale for nine weeks. Groups (T1, T2 and T3) received rations with compositions described in **Table 2**. Rations of groups T2 and T3 contains 20 and 30% respectively of rye grains at the expenses of barely grain. A common rye cultivar was used in the experiment which is called "Lashak" in the local name. The obtained rye grain from the market was prepared in a semi-milled form and mixed with other ration components.

2.3 Ration formulation

The experimental ration was formulated according to the requirement of medium-sized lambs with an average weight of 41.32 Kg, using the standard tables and guidelines of the National Research Council-NRC. The nutritional needs of lambs in the study were calculated based on guidelines standard tables of National Research Council, and feed is usually used as a natural dry weight for animals, it is $1600 \div 0.9 = 1777$ grams (National Research Council 2007). First, the requirements of dry matter, crude protein, calcium, phosphorus, and energy needs of lambs in Kg or mg from based on NRC standard table (National Research Council 2007) were determined, then rations such as Lucerne hay and Wheat straw as a main grass of diet, from Barley grain and Rye grain as an alternative food with 20 and 30%, from Cottonseed for energy supply and dietary protein were used, which their details are shown **Table 1**.

The experimental groups are as follows: the ration of feed compounds used in different treatments of the study is well described in **Table 2**.

2.4 Data Analysis

Data from the present study were collected weekly. Total feed intake for each treatment was determined by weighting the feed twice daily (morning and evening) by a digital scale. Before all, the amount of food leftover from the previous meal of lambs was discarded after weighing. Total dry weight in take and Feed conversion ratio were determined through the procedures of $T.D.W = \text{First taken weight} - \text{Last taken weight}$, and $F.C.R = \text{Feed given}/\text{Animal weight gain}$.

Table 1. Receiving the nutritional needs of lambs with 41 Kg weight

Animal weight (Kg)	Dry matter (90%) (Kg)	Dry matter (100%) (Kg)	Crude Protein (gr)	Metabolic energy (Mca)	Calcium (gr)	Phosphorus (gr)
41	1.77	1.6	190	4	5	4

Table 2. Composition of ration (in Kg; on dry matter basis)

Ration Quantity	Groups		
	T1 (Control)	T2 (20%)	T3 (30%)
Lucerne hay	0.6	0.6	0.6
Wheat straw	0.4	0.4	0.4
Cottonseed meal/cake	0.22	0.22	0.22
Rye grain	0	0.364	0.545
Barely grain	0.5	0.18	0.004
Dicalcium phosphate (DCP)	0.005	0.005	0.005
Total Ration Quantity	1.725	1.769	1.774

The collected data were analyzed by using statistical software Minitab17.0 (Minitab Inc. State College, PA, USA) and GraphPad Prism5 software (San Diego, CA, USA); One-Way Analysis of Variance (One-Way ANOVA) and Tukey test were run. Also, the data obtained in terms of weight gain and differences between treatments compared to the control in all weeks were analyzed statistically, and $P < 0.05$ is accepted as significant between groups/treatments.

3 Result and Discussion

Results of the present study show that weight gain of lambs during the study (9 week) depends on the ration composition. Weight gains of sheep with fed on rye grain in different percentages (20 and 30%) have different effects. The average weight of lambs in the control and fed on 20 and 30% rye grain at the beginning of the study were 41.2, 41.96 and 40.53 Kg, while at the end of the study the lamb weights increased to 48.6, 53.83 and 51.1 Kg, respectively as presented in **Table 4** and **Fig 1**. Lambs fed on 20% rye showed significant increase in weight gain compared to that of the control treatment from 5 to 6 weeks at the level of $P > 0.05$, while weeks of 6-9 were increased significantly at the value of $P > 0.01$ (**Fig 1**). Statistical analysis in **Table 3** showed that the sheep used 20% rye grain replaced barley grain has better and positive effect on the process of weight gain and food intake in sheep. The result of the present study is consistent with the finding of Hansen et al (2004), who reported that rye can be

used alone or mixed with other grasses in percentages of 25 to 40% with increasing weight gain. **Table 3** shows also the total feed intake, weight gain, and food effectiveness during the nine weeks of study while **Table 4** shows the average weekly weight gain and the total weight gains of experienced lambs.

According to **Table 3**, the reduction of daily food intake based on total dry matter intake was not observed in the present study and the amount of food consumption continued normally throughout the study period, which may be due to the pleasantness of rye. It was observed that lambs consumed rye with great interest, and this observation was quite similar to the opinion of Thompson (1983) who stated that oatmeal is a delicious feed for sheep and other animals and has a higher energy value, compared to other grains and suggested that rye could form 50-100% of grains in sheep diets. It was observed also that lambs eat milled rye grain better than its un-milled form; this observation is consistent with those of Sharma et al (1981) and Huuskonen and Pesonen (2018) who observed that rye is similar to corn, wheat and barley regarding its food composition; it is mostly used for animal nutrition and better used in large particles.

In addition, Sharma et al (1981) reported that feeding diets high in grain causes digestive disorders such as ruminal acidosis, reduced rumination, decreased glaze secretion, and low animal performance, but these problems can be easily alleviated by increasing the number of fibrous foods. However, in the present study, it was found that the used diet did not cause any of the mentioned digestive disorders in the lambs, but the sheep had the normal food intake and weight gain.

Table 3. Total feed intake, weight gain, and food effectiveness during nine weeks /group

No.	Groups	Total dry matter intake (Kg)	Total weight intake (Kg)	Feed conversion ratio (FCR)
1	T1 (Control)	88.23	7.4	11.922
2	T2 (20%)	95.57	11.87	8.051
3	T3 (30%)	92.4	10.57	8.741

Table 4. Weekly gain and total weight in experienced lambs

Specification	T1 (Control)	T2 (20%)	T3 (30%)
The first weight (Kg)	41.2±2.34 ^a	41.96±2.54 ^a	40.53±2.1 ^a
Weight gain during the research (kg)	7.4±0.6 ^a	11.87±1.1 ^b	10.57±0.1 ^b
Final weight (kg)	48.6±1.682 ^b	53.83±1.443 ^a	51.1±2.11 ^{ab}
Average weekly gain during the research (kg)	0.822±0.310 ^a	1.318±0.496 ^b	1.174±0.352 ^a
Average dally gain during the research (kg)	0.117±0.04 ^a	0.188±0.071 ^b	0.167±0.05 ^a
ANOVA			
Treatment	*		
Duration	*		

Means with similar letter in a row are not significantly different at 5% level. * indicates significant differences at the level of (P<0.05), and ± standard division.

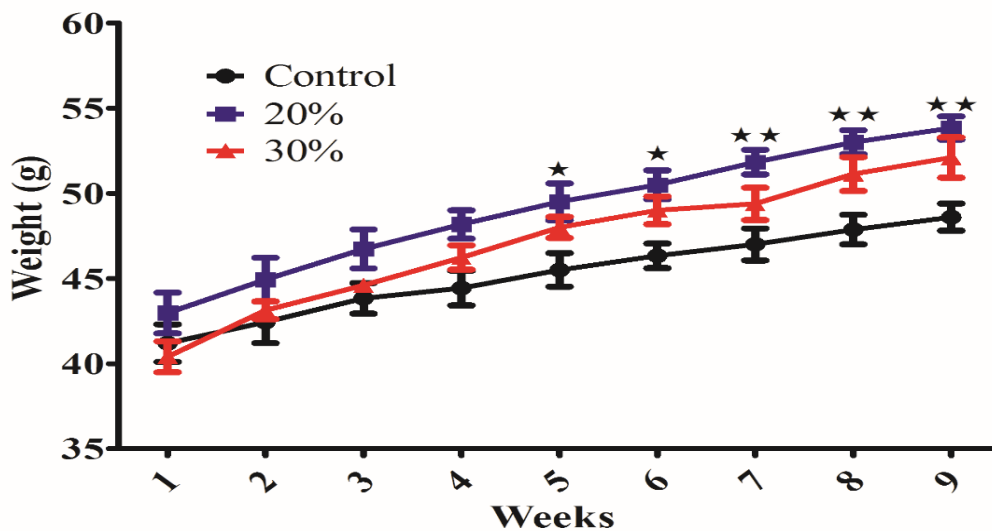


Fig 1. Weight gain of lambs during 9 weeks of experience. * = P >0.05 and ** = P >0.01.

4 Conclusion

The objective of this study was to promote the use of by-products for animal feed in Afghanistan. In this research, we tried to reduce production costs, accordingly, rye grain was used as the main source of dietary energy in the experimental groups. It was found that the price of rye grain is 50% cheaper and more cost-effective than other cereals, especially barley grain. Rye grain is an important diet for animals because of it contains crude fiber, protein, starch, fat, and minerals. Rye is also used to make flour, bread, and beer; besides, rye grain can be used as a food source to replace other cereals to accelerate the growth and weight gain of livestock and reduce the cost of rations.

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