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Effect of Hydroponic Barley Fodder on Awassi Lambs Performance

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Abstract

The objective of this research was to investigate the effect of feeding hydroponic barley (HB) on the performance of Awassi ram lambs. A total of 50 weaned lambs were used in a feeding trial by dividing it into two groups. The first was fed a total mixed ration diet (control) while lambs in the second group were fed similar ration except that barley grain was totally replaced by HB for 90 days feeding trial. Lambs were fed ad libitum twice per day and had a free access to fresh water. Feed offered and refusals were collected, body weight gain was measured weekly, and feed conversion ratio (FCR) was calculated. Results of the experiment showed that HB had a positive effect ($p<0.05$) on feed intake, final body weight, total gain, average daily gain, and FCR on lambs fed the HB diet when compared to lambs fed the control diet. In conclusion, HB can be used as feed for lambs in the fattening period to enhance their growth performance.

Keywords: Awassi ram lambs, Hydroponic barley, Growth performance.

1. Introduction

As livestock population increases, large gap exists in between requirements and availability of feed to maintain animal nutrients requirement. Sheep production in Jordan is focusing on lamb meat as a final product for consumers; therefore greater weight gain of lambs has a particular importance in animal industry in our area. The major limitations on livestock production in Jordan and many other countries in the Arabian region are the limited quantities and low quality of the produced green forage in addition to the high cost of imported feed. Studies have shown that production of forage crops in Jordan covers about 20-25% of its livestock feed requirements (Harb and Awawdeh, 2008). It is a fact that feeding animals is deficient without including green fodder (e.g. Green forage) in their diets (Shah et al., 2011). Green fodder is an essential component of the livestock ration to enhance their productive and reproductive performance. Consequently, for improving livestock products, quality green fodder should be fed more often to animals (Dung et al., 2010). However, the major constraints in production of green fodder are decreasing land size for fodder cultivation, scarcity of water, labor requirement, and high cost of fertilization (MOA, 2014). As a solution, growing hydroponics fodder may control some livestock feed diets and improve performance (Rodriguez et al., 2004).

Hydroponics is an advanced technology in agriculture. This techniques can meet the growing nutrients requirement for livestock feed with suitable prices, in addition to guarantee a constant production of high quantity of green forage throughout the year. Hydroponic fodder production is a technique of growing crops such as barley, in a hygienic environment free of chemicals, and artificial growth promoters (Jensen and Malter, 1995). Hydroponically fodder has a short growth period (around 7-10 days) and requires a small piece of land for production (Mooney, 2005). It has high feed quality that is rich with proteins, fibers, vitamins, and minerals (Bhise et al., 1988; Chung et al., 1989) with health beneficial effects on animals (Boue et al., 2003). As a reason, hydroponic culture is one of the most important agricultural techniques currently in use for green forage production in many countries.

As for sheep production, it is well documented that feed costs make more than 75% of total production costs of sheep projects (Abo-Omar et al., 2012). The majority of sheep raised locally are of the Awassi breed (DOS, 2014). Under the general and semi intensive sheep production system that is performed by farmers, feeding sheep in the off season results in great expenses on concentrated and roughage feeds. While as the productivity of the livestock in a farm is highly dependent on the nutritive value of dry and green fodder, the aim of this study was to evaluate the effect of hydroponically grown barley fodder on Awassi ram lambs growth performance.

2. Materials and Methods

2.1 Experimental animals and diets

The experiment was conducted in a population of Awassi sheep, including 50 weaned Awassi ram lambs. Lambs were purchased from a local farm and used in the experiment during the period of early October until late December of 2015 at the research station of the Faculty of Agriculture at Jerash University. Awassi ram lambs were weighed at the beginning of the study and then stratified by weight (average body weight = 19.0 ± 1.0 kg) and randomly assigned to one of two treatment diets. They were around three months old and were fattened during 90 days. Lambs were divided into two groups. Each group was consisted of 25 lambs. All lambs were handled at the same housing conditions and fed individually in pens (0.75 × 1.5 m). Lambs were fed ad libitum twice per day at 0800 and 1600 using plastic buckets with free access to fresh water. The green barley fodder was fed as part of total mixed ration (TMR) (Table 1). Two diets were formulated in this experiment as follows: Control diet with no hydroponic barley and HB diet with hydroponic barley (Table 1). Rations fed to lambs in control group were formulated to meet the recommended requirements by the (NRC, 1985). Daily feed intake was recorded by measuring feed offered and feed refusals, while the body weight gain was recorded weekly. Average daily gain and feed conversion ratio was calculated at the end of the experiment.

Table 1. Ingredient and chemical composition of the experimental diets.

	Diets[1]	
Item	Control	HB
Ingredient (% of the diet)		
Barley grain	62.0	0
Soybean meal	15.0	15.0
HB	0.0	62.0
Wheat hay	20.0	20.0
Salt	1.4	1.4
Limestone	1.5	1.5
Mineral and Vitamins[2]	0.1	0.1
Nutrients (%)		
DM	89.9	89.0
OM	89.5	89.6
CP	15.9	16.1
NDF	37.5	38.4
ADF	20.4	19.6
ME[3] (Mcal/kg)	2.7	2.5

[1]Diets were: Control (Cont; n=25) and hydroponic barley (HB; n=25).
[2]Composition per 1000 g contained (Dicalcium phosphate, 800 g; Sodium chloride, 60 g; Trace elements mixture, 20 g (Zn, Mn, Fe, Cu, Co, Se); Magnesium oxide, 20 g; Vit. A, 500,000 IU; Vit. D3, 85,000 IU, Vit. E, 200 IU).
ME[3]: Metabolizable energy; calculated using NRC (1985).

2.2. Hydroponic barley fodder.

A hydroponic system was designed and purchased from a local workshop was used in this study. It is composed of two cabinets (units) with metal frame each with dimensions (55 cm x 200 cm x 240 cm). Each unit consist of four shelves to carry 24 planting tray. Polystyrene trays with dimensions (25 cm x 45 cm x 8 cm) were used for growing seeds to produce green fodder. Hydroponic system was kept at control temperature inside a lab room near the animal farm after purchasing and the temperature was maintained at 24±2ºC. The relative humidity ranged between 45 and 70%. Barley cultivars were harvested to be used in the HB diet.

2.3. Chemical Analysis

Hydroponic samples as well as ration samples were collected and oven-dried at 70°C for 48 hours, weighed, and analyzed using the proximate analysis procedure (Table 1 and 2). Proximate analysis for collected samples was conducted and crude protein, crude fiber, crude fat, and dry matter contents were determined according to the procedures of AOAC (2000). Acid detergent fiber (ADF) and Neutral detergent fiber (NDF) was determined (Robertson and Van Soest, 1981; Van Soest et al., 1991).

Table 2. Chemical Composition of hydroponic barley (on dry weight basis)

Item %	Hydroponic barley
Dry matter	15.3
Crude protein	22.5
Crude fiber	11.4
Crude fat	3.2
ADF	13.1
NDF	32.5

2.4. Statistical Analysis

The experimental design used for this trial was complete randomized design. Analysis of variance was performed using the Statistical Analysis System (SAS, version 9.1, 2000, SAS Inst. Inc., Cary, NC). Differences among the means were determined by the Duncan's multiple range test with a significance defined at $P < 0.05$.

3. Results and Discussion

An experiment was conducted by feeding Awassi ram lambs diets containing barley grains (Control diet) and diets containing hydroponic barley (HB diet) to investigate its effect on lamb growth performance. Table 3 shows the parameters measured reflecting lamb's growth performance that was affected by the different diets. Initial body weight for lambs was not different ($p = 0.05$) at the beginning of the experiment. Final body weight was greater ($p < 0.05$) for lambs fed HB diet than lambs fed control diet with 39.04 kg vs. 36.36 kg for lambs fed HB and Control diet, respectively. Total gain (Final body weight – Initial body weight) was significantly higher ($p < 0.05$) for lambs fed HB diet with 20.52 kg, when compared to lambs fed Control diet with 17.21 kg.

Table 3**.** Growth performance of Awassi lambs fed concentrate diets containing hydroponic barley.

	Diets[1]			
Item	Control	HB	SD	P-value
Initial body weight (kg)	19.16	18.52	1.39	0.050
Final body weight (kg)	36.36	39.04	2.74	0.000
Total gain (kg)	17.21	20.52	1.37	0.000
Feed Intake (kg/day)	0.65	0.56	0.03	0.000
ADG (g)	191	226	0.01	0.000
FCR	3.39	2.44	0.21	0.000

[1]Diets were: Control (Cont; n=25) and hydroponic barley (HB; n=25).

Lambs feed intake found to be greater ($p < 0.05$) for lambs fed Control diet than lambs fed HB diet (0.65 kg/day vs. 0.56 kg/day). Average daily gain was higher ($p < 0.05$) by lambs fed HB diet with 266 g/gained/day, while

ADG was 191 g/gained/day for lambs fed Cont diet. Feed conversion ratio (FCR) was affected by the experimental diets and was lower ($p < 0.05$) for lambs fed HB diet when compared with the lambs fed the Control diet (2.44 vs. 3.39). As shown in table 3, final body weight and total gain was improved by lambs fed HB diet than Control diet. Most studies performed by feeding HB to animals showed similar results to our study. Gebremedhin (2015) reported that feeding hydroponically grown barley fodder for growing goats increased total DM intake, feed conversion efficiency, and body weight gain when compared to goats fed concentrate diets. Moreover, a study performed by Fayed (2011) to find the effect of feeding barley grains that sprouted on rice straw on performance of growing Barki lambs showed enhancement on those lambs growth performance.

The higher performance in the BW gain of lambs supplemented with hydroponic fodder in this experiment could be due to the ability of the HB to supply necessary nutrients. This was in line with the concept of Naik et al. (2014) who reported that hydroponic sprouts is a rich sources of bioactive enzymes and may contain ingredients that improves the performance of livestock. Tudor et al. (2003) found that the increase in weight gain of lambs offered barley sprouts may reflects the effect of microbial activity in the rumen and how enhanced nutrient digestibility. Similar researchers also noticed that using maize hydroponic fodder has been reported to improve the performance of birds and animals up to 8%. Moreover, feeding hydroponic barley mixed with poor quality hay to drought master steers gained more by 1.01 kg/head/day when compared to steers fed concentrate diets (Muhammad et al., 2013; Tudoe et al., 2003). On the contrary, a study performed by Saidi et al. (2015) showed that HB had no effect on ewes' average weight. They reported that the level of CP in the HB ration was lower than the level recommended by NRC, despite the fact that the ewes' performance was positive. This might be due to the effects of increased nutrients and the low anti-nutritional factors in HB used in feeding the ewes.

The feed intake in this study greater with lambs fed the control diet. Our results are mostly similar with what was reported by Saidi et al. (2015) who found that the feed intake of ewes fed HB and the concentrate diet was similar. Feed intake was not affected by feeding ewes different levels of HB as reported by Shtaya (2004). There are several factors described as influencing feed intake as production level, temperature, type and quality of forage, breed, and concentrate ration. In our study, feed intake was not affected by adding HB probably due to the lower palatability of lambs to HB diet than to the control diet. Average daily gain and FCR on the other hand were improved with lambs fed HB diet than lambs fed Control diet. These findings were in agreement with data showed by Fayed (2011) who used barley sprouts grown in rice straw to be fed to growing Barki lambs and reported an increase in feed intake and gain of those lambs. Intissar and Eshtayeh (2004) reported that using sprouted barley grains with olive cakes that was fed to ewes gave highest feed conversion efficiency results when compared to ewes fed the control diets and that might be due to the higher crude protein and energy contents of the HB diet which provided absorbable nutrients and also enhancing the treated straw nutrients utilization. Researchers used other type of animals for investigating the effect of HB on their performance. Cuddeford (1989) described some possible advantages of hydroponic sprouts fed to horses. Morgan et al. (1992), on the other hand, found that pigs fed 4-day-old sprouts gained significantly less weight than those fed barley grain. In our study, a positive effect of feeding HB to lambs was shown, which reflects that feeding this type of feed might be of great benefit to farmers for increasing profit from the lamb meat industry.

4. Conclusion

Due to lack of pastures and high cost of fodder, it is so important to utilize alternative fodders with low cost and with high nutritive value. Hydroponic is one of the greatest solutions of the shortage in the green fodder found in our area. In this experiment, growth performance was improved by feeding HB. Therefore, it is recommended for local farmers to use HB as an alternative fodder for sheep and other livestock. More researches to impact and support our findings are needed.

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