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Effect of Voluntary Intake of Alfalfa or Rhodes Grass Hay Alone or Supplemented with Whole or Rolled Barley on Digestibility and Nitrogen Utilization in Sheep

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Key words: sheep, intake, digestibility, forage, barley.

Abstract. Two 3×3 latin square experimental design were used to evaluate the effect of voluntary intake of Alfalfa hay (A) or Rhodes grass hay (R) fed alone on ad libitum bases or supplemented at 1% body weight (BWt) with whole barley (WB) or rolled barley (RB), on digestibility and N utilization in 6 Najdi male lambs.

Total dry matter intake was 3.02, 3.22 and 3.07 %BWt for (A) and 2.17, 2.70 and 2.62 %BWt for (R) alone or with WB or RB supplements respectively. Intake was significantly affected by type of forage ($P<.01$) and barley supplementation ($P=.07$). Organic matter digestibility (OMD) was affected ($P<.05$) by type of forage and ($P<.01$) by supplementation. It was higher ($P<.05$) for (R) than (A) diets, and with supplements than without 71.1 vs 69.1, ($P<.01$) respectively. OMD was also higher with supplements of (RB) than (WB) 73.0 vs 69.1% ($P<.01$), respectively. Crude fiber (CFD) digestibility was affected by type of forage ($P<.01$) and barley supplementation ($P<.05$). It was higher for (R) than for (A) diets and declined with supplementation than without 59.9% vs 66.2% ($P<.01$), respectively. N balance was affected by type of forage ($P<.01$), respectively. N balance was affected by type of forage ($P<.01$) and not by supplementation with barley. Lambs retained more N, 15.5 vs 13.0 g/d with than without supplements and utilized N more efficiently 62.5 vs 48.9% ($P=.02$), respectivly.

Introduction

Sheep are the main indigenous livestock in Saudi Arabia, its population is in the range of six million head [1]. An attempt to improve its productivity, evaluating feedstuff available is the main aim in predicting nutrient requirements. Dry matter (DM) intake is an important consideration in formulating sheep rations. Livestock producers often supplement forage diet with cereal grains, in order to increase performance. Adding cereal grains to forage diet can drastically change ruminal conditions and often had deleterious effects on forage intake and digestion [2], Chemical and physical properties of grains affect the changes in ruminal conditions that take place when grain is fed [3], therefore, effects of various grains sources on intake and digestion in Ruminants may be modulated by forage type.

It is important to evaluate roughage as main feedstuffs for sheep. Hay is considered a highly preferred roughage, which has the same general nutritive properties as the forages they were made from. High quality legume hay will support moderate growth in ruminants. Alfalfa hay quality was highest when harvested at 10% bloom, while prennial grasses just prior to budding or at 0.9 to 1.3 m in height have lower quality [3].

One of the main problems in predicting the performance of growing lambs fed roughage diets is a lack of information on their limits on appetite. Early feeding standards made use of the approximation, that for roughage diets the intake of DM approached a maximum of 7% of BWt. Subsequent work has indicated that the voluntary intake of DM depends upon its apparent digestibility and composition of the diet [4]. Feeding 222g of barley DM caused some reduction in forage DM intake which was significant only for hay [5].

Apparent digestibility regards all nutrients in faeces as nondigestible, which is not necessary so, as some have been digested but not absorbed, or it came from intestinal mucosa and bacteria cells. TDN values is known to be affected by percentage of dry matter, the digestibility and the amount of mineral matter and fat in digestible dry matter [6].

Level of intake affects utilization of nutrients, as high intake may depress digestibility. Stage of maturity affects nutrient content of forage, as the plant matures the protein and NFE decrease. Digestibility is highly positively correlated with protein content. It is negatively correlated with fiber. The major factors influencing the fraction of dietary digestible energy (DE) appearing are: diet protein level, diet roughage level, and essential fatty acid content [3].

Intake of cereal grain depends on feed palatability and physical form, Andrews and Orskov [7] found that consumption of an oat diet was greater than that of rolled barley, but digestible dry matter intake of either was not different. Orskov [8] has outlined various advantages of feeding whole grains versus ground grains to ruminants. Whole grains reduce the rate of cellulose digestion to lower extent than rolled grains with a consequent decrease in roughage intake and digestibility. Rode and Satter [9] found that in dairy cow fed 25-75% lucerne hay and concentrates (maize or barley-based) apparent total digestion of OM increased ($P<0.01$) from 59.7 to 68.1% as forage in the diet decreased from 75 to 25%.

Mackay [10] studied the effect of varying hay to barley ratio on the digestibility and metabolizable energy value of the barley component of mixed rations for sheep. He found that feeding 4 Suffolk crossbred wethers 9 months old for 7 days to supply maintenance requirement of metabolizable energy on hay or barley alone or supplied with 75, 50 or 25% by hay. Ratio of barley to hay did not significantly affect digestibility of DM, OM, N or energy, or ME of the barley in the mixed feeds.

Afalfa and Rhodes grass hay are widely produced in Saudi Arabia, estimated availability in the range of 2.5 million tons per year, equal to 58% of forage requirements by livestock [11].

The objective of this experiment was to study intake and digestibility by sheep fed alfalfa or rhodes grass hay ad libitum with or without whole or rolled barley.

Materials and Methods

Digestibility, voluntary intake and N utilization were studied using six nagdi male lambs {average initial body weight (BWt) 47.6 kg} and approximately 8 month old, the lambs were divided into two groups of three lambs each. A latin square designed experiment was used for each group, the lambs were fed for three consecutive periods, of 21 days each.

Lambs in the first group were given a diet based on Alfalfa (A) hay (8*th* cut 30 days old) ad libitum and those in the second group were given a diet based on chopped Rhodes grass (R) hay (1*st* cut 60 days old) ad libitum. Lambs in each group received three types of supplementation, (0) no supplemental feed (basal only); basal (A) or (R) + whole (WB) or rolled (RB) barley dry matter at 1.0% of the body weight as a supplemental feed respectively. This was based on body weight at the end of the previous period and readjusted at 7 days before collection.

Animals were placed in a slatted floor pen during the first part of the preliminary periods then transferred to individual steelmetabolic crates equipped to collect faeces and urine separately 6 or 7 days before the collection starts to the end of the collection period. They were housed under fluorescent light at night.

Animals were allowed a one week changeover period from the diet which was received before the experiment. Additional two weeks were allowed for rumen adaptation followed by 7 day collection period during which the voluntary intake by each animal was measured. Faeces and urine were quantitatively collected.

Lambs on diets WB, RB were first given the supplement once daily at 8:00 am to ensure complete consumption (within max. 15 min.). The hays were administered as for control lambs on diet (0) at 8:15, 12:15, and 17:15 h. During collection period, animals received 110-115% of the ad libitum intake consumed during the adaptation period. Hay residues were removed at 8:00 am. before feeding weighted and used to adjust the amount of hay to be offered. Approximately 110-115% of consumption of the previous day were estimated. Animals had free access to water and trace mineralized salt at all times. The water intake was recorded.

Lambs were weighed three times at the beginning of each period, on the 7th day before collection and on the last day of the collection period. Dry matter intake in kilogram was divided by average lamb BWt within 7 days before collection and at the end of collection and multiplied by 100 to express intake as a percentage of BWt.

Faeces were quantitatively collected each day from each animal, weighed, and composited. A 20% aliquot was taken and frozen for analysis. Urine was collected each day in a plastic bucket containing 200ml 2N HCl, weighed, a 20% aliquot was taken, composited and frozen for nitrogen determination.

Feeds were sampled daily through 7 days collection and composited for each day, refusals were collected daily, weighed and a 20% aliquot was composited for 7 days collection.

After the end of each experimental period, faecal samples were thawed, dried in a forced air oven at 55°C for 24 hr, allowed to equilibrate at room temperature and weighed. Composite samples of faeces, feeds and refusals were ground through a 1 mm screen and were analyzed for dry matter, ash, ether extract and crude fiber according to AOAC [12]. Organic matter was determined by subtracting total ash from dry matter. Kjeldahl N content in feeds, refusals, faeces and urine were determined according to Haris [13]. Energy content of samples was determined with a Parr Adiabatic Calorimeter. Intake of the last 7 days of each period was not affected by daily intake ($P<.2$). Averages of values were used for expression of DM intake and digestibilities.

Data were subjected to analysis of variance using the general linear models (GLM) procedure of the statistical analysis system (SAS) [4], was used to analyze the following model of the main effects as described by John [15]:

$$Y_{ijkl} = u + P_i + F_j A_{k(j)} + S_l + E_{ijkl}$$

Y_{ijkl} = is the dependent variables (voluntary intake, digestibility and N-utilization), where *ith* period, *jth* forage type, *kth* animal, and *1th* supplementation.

P_i = period (i = 1,2,3 and each period 21 days).

F_j = forage type (j = 1,2 Alfafa and Rhodes grass hay).

$A_{k(j)}$ = animal received the *jth* forage type (k = 1,2 and 3).

S_l = supplementation (1 = 1,2,3 such that 0 = forage (no supplement), BW = (forage + whole barley), RB = (forage + rolled barley).

E_{ijkl} = residual error.

Orthogonal contrasts were used to compare:

1- Supplementation (WB + RB/2) vs none supplementation (0).

2- Whole barley supplementation (WB) vs rolled barley supplementation (RB).

Results and Discussion

Feedstuff chemical composition; are shown in (Table 1). The level of CP and GE content were higher for (A) than for (R), while (RB) and (WB) were almost similar. Crude fiber content (CF) and NFE were higher for (R) than (A). CF in (WB) was slightly higher than (RB).

Intake and digestibility; the effects of individual dietary treatments on intake (%BWt), DM, OM, CP, EF, CF, NFE, and energy digestibilities (DMD, OMD, CPD, EED, CFD, NFED, ED), TDN and digestible energy content (DE) are outlined in (Table 2) and the effect of barley supplementation are shown in (Table 3).

Barley grain made up 30.2, 31.8, 36.2 and 36.9% of total DM intake for Alfalfa : whole barley (A:WB), Alfalfa : rolled barley (A:RB), Rhodes grass : whole barley (R:WB), Rhodes grass : rolled barley (R:RB) diets respectively.

DM intake (%BWt) of hay and of the whole ration were affected ($P<.01$) by type of forage, by supplementation of hay and by total DM intake of %BWt ($P<.01$ and $P=.07$) respectively.

Table 1. Proximate analysis of the experimental feeds (g/Kg DM.)

Component (g/kg)	Hay[a] Alfalfa (A)	Rhodes grass (R)	Barley[b] Whole (WB)	Rolled (RB)
Dry matter (DM)	929.6	942.5	907.2	916.3
Organic matter (OM)	880.0	878.2	976.1	975.4
Crude protein (CP)[c]	177.0	98.2	117.8	119.1
Ether extract (EE)	18.7	16.3	21.6	21.0
Crude fiber (CF)	295.0	326.4	61.4	58.8
NFE[e]	389.3	437.3	775.3	776.5
Gross energy[f] (GE)	4.30	4.16	4.47	4.48

a Alfafa and Rhodes grass hay = basal feed.
b Whole and rolled barley = supplemental feed.
c CP = Nitrogen x 6.25
e NFE = Nitrogen free-extract.
f GE = Mcal/kg DM.

DM intake (%BWt) of hay and of the whole ration were affected (P<.01) by type of forage, by supplementation of hay and by total DM intake of %BWt (P<.01 and P=.07) respectively.

DM intake (%DMt) was greater (P<.01) for Alfalfa than for Rhodes in the whole diets, or when fed alone, supplemented or not supplemented with barley (2.91 vs 2.60, respectively). It was generally greater for (WB) than (RB). Lower concentration of CF and higher content of CP in (A) than in (R) may have been responsible for the forage effect. Similarly total DM intake of Bermuda Grass (14.3% CP and 71.4% NDF) and Orchard Grass (15.8% CP and 64.3% NDF) when fed alone to steers were 2.43% and 2.98% BWt, respectively [16]; thus an increase of total DM intake (hay and total) with Alfalfa than Rhodes diets would be expected because of increased absorption of usable nitrogeous compounds, Rhodes should not have affected N uptake as greatly as Alfalfa because of its lower CP level, therefore total DM intake was increased more with added grain with Rhodes than with Alfalfa (22.6 vs 4.1% of hay alone) for (R) and (A) diets, respectively.

Hay DM intake as %BWt declined (P<.01) with supplementation (2.60 vs 1.94), respectively, in agreement with other reports [17,18]. The decline was greater

Table 2. Voluntary intake and apparent digestibility coefficients by Najdi lambs fed Alfalfa (A) or Rhodes grass (R) hay along or with whole (WB) or rolled (RB) barley at 1% weight DM

Items	diet							
	A	A:WB	A:RB	R	R:WB	R:RB	SE#	Effect@
Barley intake								
%DMI	0	30.2	31.8	0	36.2	36.9		
DM intake %BWt								
supp.	0	0.97	0.97	0	0.97	0.97		
Hay	3.02	2.24	2.10	2.17	1.73	1.65	0.10	F,S
total	3.02	3.22	3.07	2.17	2.70	2.62	0.10	F
Water intake								
L/kg DM intake	4.12	3.48	3.51	3.42	3.11	3.30	0.55	
DE (Mcal/Kg DM)	2.89	2.94	3.07	2.73	2.87	3.02	0.05	f,S
Digestibility %								
Dry matter (DMD)	66.9	66.6	70.3	68.0	68.2	71.8	0.91	f,S
Organic matter (OMD)	68.5	68.5	72.1	69.7	69.8	73.8	0.76	f,S
Crude protein (CPD)	76.7	72.2	73.4	63.9	62.4	64.5	1.82	F
Ether extract (EED)	33.3	43.3	53.3	29.3	45.5	48.0	2.72	S
Crude fiber (CFD)	56.7	53.6	48.3	75.7	68.3	69.3	2.04	F,s
NFE (NFED)	75. 3	74.7	82.8	68.1	72.5	78.1	0.86	F,S
DE (ED)	66. 4	66.5	69.8	65.6	66.8	70.5	1.26	S
TDN	61. 0	63. 5	67.0	61.8	64.8	68.5	0.64	f,S

* Least squares means; n = 18; averaged across intake.

\# SE = standard error.

@ Effect: F and f = Forage type (P<.01 and P<.5);
S and s = Barley supplementation (P<.01 and P<.05).

NFE = Nitrogen free extract.

TDN = Total digestible nutrients.

Table 3. Effects of barley supplements on intake and digestibility (irrespective of basal diet*)

Items	diet			Contrast and significance			
	O	WB	RB	supp@	SE#	supp. vs none	RB vs WB
DM intake % BWt							
supp.	0	0.97	0.97	0.97			
Hay	2.60	1.99	1.88	1.94	0.07	<.01	
total	2.60	2.96	2.85	2.91	0.07	=.03	
Water intake							
L/kg DM intake	3.77	3.30	3.40	3.35	0.39		
DE Mcal/Kg DM	2.81	2.90	3.04	2.97	0.04	<.01	=.02
Digestibility %							
Dry matter (DMD)	67.4	67.4	71.1	69.25	0.65	<.02	<.01
Organic matter (OMD)	69.1	69.1	73.0	71.05	0.53	<.01	<.01
Crude protein (CPD)	70.3	67.3	69.0	68.15	1.29		
Ether extract (EED)	31.3	44.4	50.6	47.50	1.92	<.01	=.04
Crude fiber (CFD)	66.2	60.9	58.8	59.85	1.44	<.01	
NFED	71.7	74.6	80.4	77.50	0.61	<.01	<.01
DE	66.0	66.6	70.2	68.40	0.89	=.03	<.01
TDN	61.4	64.2	67.8	66.00	0.45	<.01	<.01

* Least squares means; n = 18; averaged across intake.

\# SE = standard error.

O = Basal diet (No supplemention).

WB = Basal + whole barley.

WR = Basal + rolled barley.

@ supp. = Barley supplementation (WB+RB/2).

NFED = Nitogen free extract digestibility.

with rolled barley (RB) than with whole barley (WB) and the depression as a percentage of barley intake was 80.4, 94.8, 45.4 and 53.6% for (A:WB), (A:RB), (R:WB) and (R:RB) diets, respectively. Jarrige *et al.*, [19] reported that the degree to which forage intake declines when concentrate is supplemented rises with increasing intake of forage. The ratio of water consumed to DM intake was similar among treatments.

Nutrient digestibility is used to evaluate feedstuffs and to express nutrient requirements. Measuring only faecal energy losses does not accurately reflect the energy available to ruminants for use in productive processes. As feedstuffs are exposed to microorganisms in the rumen. Loss of gross energy in the form of methane varies with the type of diet and the level of feeding. It ranges from 3 to 10%. The energy lost in urine is also not accounted for if only faecal energy is measured. It is rather constant and represent 3 to 5% of the energy value of a diet [20].

Digestibility was affected by forage type highly significantly (P<.01) for CPD, CFD and NFED, but only significantly (P<.05) for DMD, OMD, TDN and DE. DMD, OMD, EED, NFED, ED, TDN and DE were highly significantly affected (P<.01) while CFD was only significantly (P<.05) affected by supplementation.

DMD, OMD and TDN were numerically (P<.07) while CFD was highly significantly higher (P<.01) for Rhodes than Alfalfa diets. However, they were higher for Rhodes than Alfalfa when fed alone, but the difference was not significant. It was highly significant for CFD (P<.01). DMD was greater with than without supplementation 69.3 vs 67.4% (P<.02), also was OMD 71.1 vs 69.1% (P<.01). On the other hand Orskov and Fraser [18] discussed the effect of processing of barley-based supplements on rumen pH, rate of digestion and voluntary intake of dried grass in sheep. Their results showed that both forms of barley (whole & pelleted) reduced the intake of dried grass (P <.001), total intake of DM and digestible OM. The N intake and N retention were consistent with differences in DM intake, barley in both forms increased (P<.01) apparent digestiblity of OM. TDN was 66.0 vs 61.4% (P<.01) and ED 68.4 vs 66.0% (P<.03), respectively and increased (P<.01) with (RB) than (WB) for DMD, OMD, ED and TDN. In contrast; CFD declined with than without supplementation 59.9 vs 66.2% (P<.01), respectviely and the extent of depression was more with (RB) than (WB).

CPD, NFED (P<.01) and DE content (P=.06) were higher for Alfalfa than Rhodes in the whole diets, or when fed alone. Supplementation with barley improved NFED, 77.5 vs 71.7% (P<.01), as well as DE, 2.97 vs 2.81 Mcal/kg (P<.01) and EED 47.5 vs 31.3% (P<.01), respectively. (RB) showed better improvement of NFED (P<.01), DE (P=.02) and EED (P=.04) than (WB). In contrast, CPD has declined with supplementation with barley than without 68.2 vs 70.3%, respectively. The depression was more with (WB) than (RB). However, the difference was not significant. *Nitrogen utilization* : Growth is an increase in liveweight per unit of time, it is a very complex process, utilization and digestibility of feeds play the major part in this process. The energy and protein concentration needed for maximum gain, depend on the type of feed preparation. Improved feed conversion is usually achieved by increasing the amount of readily digestible materials such as the cereal grains.

Results (Table 4) showed the effects of dietary treatments on N intake (NI), fecal N (FN), Urinary N (UN), N Absorbed (NA), N retention (NR) and N utilization efficiency (NR/NI and NR/NA) and the effect of supplementation are shown in (Table 5).

NI, FN, UN, NA and NR were affected ($P<.01$), while NR/NI, NR/NA were affected ($P<.05$) by forage type. Whereas FN and NR/NA were affected ($P<.05$), NR/NI ($P=.1$) by supplementation.

NI, FN, UN, AN and NR were higher ($P<.01$) for (A) than (R) in whole diets, or if fed alone. FN was also higher in case of supplementation than for unsupplemented forage (10.8 vs 9.2g) ($P=.02$). FN was also greater with (WB) than (RB). In contrast, UN was lower in case of supplementation with barley than without 9.3 vs 12.2g ($P=.07$), respectively. (RB) was depressed to a greater extent than (WB).

NR/NI was higher ($P=.07$) for (A) than (R) in complete diets or if fed alone respectively. It was also higher for supplemented than for unsupplemented forage 42.6 vs 34.7% ($P=.04$), respectively. However, NR/NA behaved similarly to NR/NI 62.5 vs 48.9% ($P=.02$). Type of barley did not differ in N fractions.

Results in general showed the importance of using barley supplementation to sheep fed forage, especially where poor forage is used. Digestibility and nitrogen retention were improved further by rolled barley supplementation.

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Table 4. Daily nitrogen retention of sheep fed 110-115% of ad libitum intake from either Alfalfa or Rhodes grass hay with or without supplements of whole or rolled barly at 1.0% BWt DM*

Items	diet							
	A	A:WB	A:RB	R	R:WB	R:RB	SE#	Effect@
N balance								
intake, g/d (NI)	50.0	48.7	45.5	18.8	24.1	24.1	2.73	F
Feces, g/d (FN)	11.7	13.5	12.1	6.7	9.0	8.6	0.74	F,S
Absorbed, g/d (NA)	38.4	35.3	33.4	12.1	15.1	15.6	2.37	F
Urine, g/d (UN)	17.9	13.3	12.4	6.5	5.6	5.9	0.86	F
Retained, g/d (NR)	20.4	21.9	21.0	5.5	9.4	9.7	1.91	F
% of intake (NR/NI)	40.2	44.8	46.1	29.2	39.4	40.1	3.42	f
% of absorbed	52.4	61.9	62.9	45.4	63.1	62.0	4.29	S

* Least squares means; n = 18; averaged across intake.

\# SE = standard error.

@ Effect: F and f = Forage type (P<.01 and P<.5);
S = Barley supplementation (P<.05).

Table 5. Effects of barley supplements on N-utilization irrespective of basal diet.*

Items	diet					Contrast and significance	
	O@	WB	RB	supp	SE#	supp. vs none	RB vs WB
N balance							
intake, g/d (NI)	34.4	36.4	34.8	35.6	1.93		
Feces, g/d (FN)	9.2	11.3	10.3	10.8	0.52	=.02	
Absorbed, g/d (NA)	25.2	25.2	24.5	24.9	1.67		
Urine, g/d (UN)	12.2	9.5	9.1	9.3	0.61	=.07	
Retained, g/d (NR)	13.0	15.7	15.3	15.5	1.35		
% of intake (NR/NI)	34.7	42.1	43.1	42.6	2.42	=.04	
% of absorbed	48.9	62.5	62.4	62.5	3.04	=.02	

* Least squares means; n = 18; averaged across supplement and intake.
\# SE = standard error.
@ O = Basal diet (No supplementation).
WB = Basal + whole barley.
WR = Basal + rolled barley.
supp. = Barley supplementation (WB + RB/2).

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تأثر التغذية الحرة للأغنام على دريس البرسيم أو حشيشة رودس، منفردًا أو مع إضافة الشعير الكامل أو المفرود، على النسب الهضمية والاستفادة من النتروجين

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ملخص البحث. استخدمت في تجربتي هضم (٣×٣ مربع لاتيني) ٦ أغنام نجدي (٨ شهور، ٤٨ كجم) لدراسة تأثير اختلاف الأغذية على الكمية المأكولة، النسبة الهضمية والاستفادة من النتروجين. وقدم كل من دريس البرسيم (A) أو حشيشة رودس (R) أمام الحيوانات بشكل حر لوحده أو مع إضافة الشعير الكامل (WB) أو المفرود (RB) إليه بكمية تعادل ١٪ من وزن الحيوان. أظهرت النتائج أن الكمية المأكولة كنسبة مئوية من الوزن كانت ٣,٠٢، ٣,٢٢، ٣,٠٧٪ لمعاملة البرسيم و ٢,١٧، ٢,٧٠، ٢,٦٠٪ لحشيشة رودس في حالة التغذية على الدريس لوحده أو بإضافة الشعير الكامل أو المفرود إليه على التوالي. وكان تأثير الدريس معنويًا (P <.01). تأثر معامل الهضم للمادة العضوية معنويًا (P < .05) بنوع الدريس، وبالإضافة بدرجة معنوية جدًا (P < .01)، فقد زاد معامل الهضم الظاهري للرودس مقارنة بالبرسيم. حيث كان ٧١,١٪ في حالة إضافة الشعير، و ٦٩,١٪ بدون الإضافة، ومع الشعير المفرود ٧٣,٠٪ مقارنة بـ ٦٩,١٪ للشعير الكامل. كذلك تأثرت نسبة هضم الألياف بنوع الدريس، والإضافة، وزادت بدرجة أكبر مع الرودس عنه مع البرسيم، وكانت ٦٦,٢٪ مع الإضافة مقارنة ٥٩,٩٪ بدونها بدرجة معنوية (P<.01). أما ميزان النتروجين فقد تأثر بنوع الدريس (P<.01) وليس بالإضافة، حيث وجد أن الحملان قد خزنت ١٥,٥ جم/ اليوم في حالة الإضافة مقارنة ١٣,٠ جم/ اليوم بدون إضافة، كما كانت نسبة الاستفادة من النتروجين ٦٢,٥٪ و ٤٨,٩٪ بمعنوية (P=.02) على التوالي.