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EFFECT OF FEEDING DIFFERENT SOURCES OF FORAGES AND CONCENTRATES ON SHEEP PERFORMANCE

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SUMMARY

Two feeding experiments were conducted using 36 crossbred lambs (Rahmany X Romanouf), allotted into two equal groups to compare the efficiency of growth during winter or summer seasons using different forages [berseem (B) or darawa (D)] with different concentrates [concentrate mixture (CM), ureated corn grains (UC) and ureated barley grains (UB)]. Winter experiment examined three rations based on berseem (*Trifolium alexandrinum*): B+CM (R1), B+UC (R2) and B+UB (R3). Summer experiment examined three rations based on Darawa (Zea maize): D+CM (R4), D+UC (R5) and D+UB (R6). Urea was added to the crushed grains to formulate iso-nitrogenous and iso-caloric rations for each season. Concentrate: forage ratio was 40: 60 % for all rations on energy basis. Digestibilities of DM, OM, NFE, and CP differed significantly ($P<0.05$) among treatments. Dry matter intake and feed conversion were better for lambs fed CM than those fed ureated grains with either B or D. Lambs daily weight gain (DWG) was higher for B rations than D rations, and with CM ration than other B rations in winter season and other D rations in summer season. Lambs DWG and feed conversion as DM and TDN were higher for lambs fed B rations than D rations. No significant differences were found among groups concerning carcass characteristics. Feed cost / kg live body weight gain (LBW) was lower for B rations than D rations. In both seasons, feed cost / kg LBW was the lowest for UC rations followed by CM rations. Growing lambs during winter could save about 20% of the cost of feeding / kg LBW than during summer.

Keywords: Sheep, forages, concentrate mixture, meat

INTRODUCTION

Economic production from livestock depends mainly on green forages which have generally low digestible energy. As cereal grains have relatively higher readily fermentable carbohydrates, grain supplement is required beside

green forages to obtain balanced rations. Most of the previous studies concentrated on comparing different rations based on different green forages of the same cultivation season. Therefore it was desirable to study the efficiency of growth during winter and summer seasons, using rations based on the available main fresh forage cultivated during each season. Adding high proportions of grains to green forage diets can drastically change ruminal conditions and often has deleterious effect on digestion process (Horn and McCollum, 1987). Kennedy and Milligan (1980) suggested that grains could be used to increase nitrogen utilization. Akin (1986) reported that grains and forages have different chemical and physical characteristics that affect ruminal microbial populations, conditions and digestion. Therefore, effects of various types of grains on digestive process in ruminants could be moderated by using different forage types.

This study was performed to: 1) compare the efficiency of growth during the two main cultivation seasons, winter and summer, 2) determine the effect of concentrate type on carcass characteristics and 3) determine how digestion characteristics and sheep performance are affected by rations based on berseem or Darawa as forages and concentrate mixture or corn grains or barley grains as concentrates.

MATERIALS AND METHODS

Feeding experiments

Winter exp. (I): 18 crossbred (0.75 Rahmany X 0.25 Romanouf) lambs were randomly chosen from the herd of Mehallet Moussa Experimental Station at Kafrel-Sheikh province. Lambs aged between 9-10 months and averaged 27.0 kg body weight. Lambs were allotted into three similar groups according to LBW. Lambs were fed the following dietary treatments: 1) berseem + concentrate mixture (B+CM), 2) berseem + ureated corn (B+UC) and 3) berseem + ureated barley (B+UB). Consumed berseem was from the *2nd - 4th* cuts. Lambs were adapted to the experimental rations within three weeks before starting the feeding trial, which lasted for 100 days. Concentrate mixture consisted of: 34% wheat bran, 34% undecorticated cottonseed cake, 16% sorghum grains, 9% rice bran, 3% molasses, 3% limestone and 1% sodium chloride. Daily feed allowances were offered in order to cover 40% of energy needs from concentrates (CM or UC or UB) and 60% of energy needs from the green forages (berseem or darawa) in group feeding during each season. Nutrients allowances were estimated according to N.R.C. requirements (1985). Barley and corn grains were crushed and ureated by 3% urea, w/w (46.0% nitrogen). The urea solution was sprayed on the crushed grains one hour, just before feeding. Grains were left to absorb completely the urea solution. Rations were offered twice daily. Drinking water and mineral blocks were available free-choice. Initial, final and biweekly body weights were

determined as the average of two consecutive weights measured prior to the morning diet.

Summer exp. (II) : Another eighteen lambs from the same herd and the same crossbred were chosen randomly and allotted into three groups. Lambs averaged 23.3 kg body weight and aged 8-9 months. Lambs were fed the following diets: 4) darawa + concentrate mixture (D+CM), 5) darawa + ureated corn (D+UC) and 6) darawa + ureated barley (D+UB). All other procedures of feeding were the same as those in exp. I but exp. II lasted for only 90 days.

Digestion experiments

At the end of each feeding experiment, three lambs were chosen randomly from each group to evaluate the experimental rations. Lambs were fed individually to conduct the digestibility experiments using metabolic cages. Rations were offered twice daily, at 8 a. m. and 4 p. m. Proximate analysis for composite samples of feedstuffs and feces was conducted according to A. O. A. C. (1980).

Ruminal and blood parameters

Rumen liquor samples were collected from three lambs for each group, at the end of each digestion experiment by a stomach tube, used initially to stir the rumen liquor and contents by a stream of air for 5 minutes just before collection,. Samples were collected twice during two consecutive days before offering the morning diet and at 2, 4 and 8 hours post the zero sample. Rumen liquor samples were strained just after collection to determine ammonia nitrogen (NH_3-N) according to Conway, (1962) and rumen liquor acidity (pH) using digital pH meter. Samples were kept in deep freezer to determine total volatile fatty acids (TVFA's) which was conducted according to Erwin et. al., (1961). Serum samples were prepared from the jugular vein blood, which was collected in test tubes containing heparin to stop blood clotting. Blood samples were collected at the end of each feeding trial at 4 hours post morning diet. Serum urea was determined according to Fawcett and Scott (1960). Serum total protein was determined according to Weichselbaum (1946).

Slaughter experiment

At the end of the feeding experiment No. II (summer experiment), another three lambs from each group were slaughtered to investigate the effect of different rations on carcass characteristics. Physical characteristics were obtained by examining the eye muscle. Tenderness and water holding capacity (WHC) of eye muscle meat were determined according to Grau and Hamm (1957). Color intensity was determined as described by Hussaini *et al.* (1950).

Statistical analysis

The data were statistically analyzed separately for each experiment using one way ANOVA procedure of S.A.S. (1982).

RESULTS AND DISCUSSION

Nutritional evaluation

Chemical composition of feedstuffs and rations is shown in Tables (1) and (2). Although CP content of D seems higher than the common value, but it was lower than values mentioned by Abou-Raya (1967) and Soliman et. al., (1986) being 12.61 and 13.58% respectively which might be due to variety of D and level of fertilization. Data show that adding urea (3 % of air dried weight of grains) crushed corn and barley increased their contents of CP from 9.43 and 8.15% to 18.73 and 17.34% respectively. Inclusion of corn or barley grains either with B or D increased NFE content of the rations on the expense of CP, EE, CF, and ash contents.

Table 1. Chemical composition of feed ingredients used to formulate the experimental rations (on DM basis)

Feedstuffs	DM	Composition (% on DM basis)				
	%	CP	EE	CF	NFE	Ash
Berseem (B)	16.91	15.16	2.61	23.90	47.11	11.22
Darawa (D)	15.72	11.89	3.21	26.72	45.78	12.40
Conc. Mixture (CM)	91.11	17.78	4.65	14.15	53.73	9.67
Corn grains (C)	90.03	9.43	4.17	2.92	80.91	2.57
Barley grains (B)	91.31	8.15	1.90	7.71	77.30	4.94
Ureated Corn grains(UC)	89.50	18.73	3.74	2.62	72.60	2.31
Ureated Barley grains (UB)	90.79	17.34	1.71	6.94	69.56	4.45

Digestion coefficients of all nutrients were higher for D rations than B rations. This might be attributed to: 1) the heat stress during summer season and the relatively higher CF content of Darawa than Berseem, might led to the lower feed intake of D than B rations, 2) the relatively higher CF content of D than B rations might slowed the rate of passage of the digesta and more exposure to the digestive guices, 3) the nature of CF and lignin contents of D as cereal forage compared with B as leguminous forage. These findings agree with Abou-Raya *et al.* (1987) who found that forage type has marked effects on the concentrates digestibility. On the other side, rations containing CM either with B or D showed lower digestion coefficients for all nutrients except EE than the rations containing UC or UB. This might be due to: 1) the variation in the consumed concentrate: forage ratio as shown in Tables 3 and 2 the availability of both energy and nitrogen with UB or UC rations compared with CM. No significant differences were found between UC or UB rations except with EE and CF digestibilies. Rations contained UC had higher digestibility coefficients for all nutrients except CP and EE than rations contained UB.

These results are in agreement with those reported by Singh (1984), who found that DM, CF, EE and NFE digestibilities were higher for corn than barley diets which might refer to a negative effect of the barley hulls nature and content from CF and lignin. However the higher digestibility of CP for corn or barley rations than CM rations may be due to the high apparent digestibility of urea included in the grains rations (Cecava and Hancock, 1994). Darawa rations showed higher TDN values compared with berseem rations, while the inverse trend was found with DCP values (Table 2). The low DCP value of D rations might be related to its low CP content compared with berseem (table 1). The difference between barley and corn grains either with darawa or berseem was significant ($P<0.05$) in TDN values while it was insignificant in DCP values which might refer to the higher digestibility of corn contents of CF, NFE and EE compared with barley (Singh, 1984). Moreover the low TDN or DCP of CM rations in each experiment were expected as a result of their higher content of consumed forage ratio compared with the other two rations (Table 3).

Table 2. Chemical composition, digestibility coefficients and nutritive value of the experimental rations (on DM basis)

Item	Winter experiment I			Summer experiment II		
	B+CM	B+UC	B+UB	D+CM	D+UC	D+UB
Average feed intake, g	1282	1121	1138	1084	933	956
Forage/ feed intake %	37	28	31	38	29	32
Chemical composition:						
CP	16.11	16.00	15.66	14.16	13.78	13.49
EE	3.35	3.02	2.37	3.76	3.46	2.76
CF	20.37	17.94	18.9	21.87	19.52	20.45
NFE	49.52	54.30	53.81	48.87	53.83	53.38
Ash	10.65	8.74	9.26	11.34	9.41	9.92
Digestibility coefficients:						
DM	63.04^{b}	71.07^{a}	69.99^{a}	68.38^{b}	74.80^{a}	73.68^{a}
OM	66.51^{b}	74.28^{a}	72.51^{a}	71.37^{b}	76.86^{a}	75.24^{a}
CP	68.34^{b}	71.83^{a}	72.16^{a}	69.49^{b}	75.06^{a}	75.97^{a}
EE	68.04^{a}	64.87^{b}	61.37^{b}	82.44^{a}	78.46^{a}	69.93^{b}
CF	55.53^{b}	58.31^{b}	57.33^{b}	58.39^{b}	63.82^{a}	62.55^{ab}
NFE	70.33^{b}	80.79^{a}	78.43^{a}	76.86^{b}	81.95^{a}	80.19^{ab}
Nutritive values:						
TDN	62.27^{c}	70.23^{a}	67.62^{b}	67.15^{c}	73.02^{a}	70.19^{b}
DCP	11.01^{b}	11.49^{a}	11.30^{a}	9.84^{b}	10.34^{a}	10.25^{a}

a, b and c means bearing different superscripts on the same line for each experiment are significantly ($P<0.05$) different.

Feed intake and lamb performance

Lambs fed B rations showed higher feed intake (g/kg $w^{0.75}$ /d) as DM and DCP than those fed D rations (Table 3). The higher feed intakes as DM and

DCP of lambs fed CM rations than those fed rations contained ureated crushed grains might be attributed to: 1) the variation in the consumed concentrate: forage ratio, 2) better palatability of ration free from urea than that containing urea and has bitter taste, 3) the nature and content of ration's CF, lignin, carbohydrates, EE and CP.

In this connection data indicated that the digestible EE, CF and NFE which are the main source of energy were higher in D rations than in B rations. It was also noticed that the energy content of rations contained ureated grains was higher than CM rations.

Table 3. Average feed intake, body weight gain, feed conversion and feed cost per kg live body weigh gain

Item	Winter experiment I			Summer experiment II		
	B+CM	B+UC	B+UB	D+CM	D+UC	D+UB
Feed intake, g DM/ h/ d:						
Berseem	805	804	788	--	--	--
Darawa	--	--	--	667	659	652
Conc. Mixture	477	--	--	417	--	--
Corn grain	--	317	--	--	274	--
Barley grain	--	--	350	--	--	304
Total	1282	1121	1138	1084	933	956
Concentrate : forage ratio	37:63	28:72	31:69	38:62	29:71	32:68
Nutrients intake, g/kg $w^{0.75}$/d:						
DM	88.05	77.20	79.14	85.15	74.28	77.47
TDN	54.83	54.22	53.51	54.18	54.24	54.38
DCP	9.69	8.87	8.94	8.40	7.70	7.9
Live body weight (LBW) :						
Initial weight, kg	26.58	27.08	27.29	23.29	23.38	23.29
Final weight, kg	44.54	43.79	42.67	36.17	35.00	33.75
Total gain, kg	17.96	16.71	15.38	12.88	11.63	10.46
Daily weight gain, g	180^{a}	167^{ab}	154^{b}	143^{a}	129^{ab}	116^{b}
Feed conversion (kg feed/ kg gain):						
DM	7.14	6.71	7.40	7.58	7.22	8.23
TDN	4.44	4.71	5.00	5.09	5.27	5.77
DCP	0.79	0.77	0.84	0.75	0.75	0.84
Feed cost LE/kg LBW	2.61	2.46	2.73	3.08	2.95	3.45

a and b means bearing different superscripts on the same line for each experiment are significantly ($P<0.05$) different.

Despite of the similarity of the digestible energy intake as TDN/kg $w^{0.75}$ for all the tested rations (Table 3), lambs fed B rations showed higher daily weight gain compared with lambs fed D rations. These results agree with Van Keuren (1985) who indicated that the higher percentage of daily weight gains are more common with legumes than with grasses. Results are also in compatibility with Tyrrell *et al.* (1992) who found that more energy was

retained by cattle from legumes than from grasses, even when the forages had equal values of feed intake and digestibility coefficients. In this connection, N.R.C. (1981) and Lamas and Combas (1990) reported that the efficiency of utilization of energy is reduced in hotter environment. This is due to a higher maintenance requirements of heat-stressed animals resulting from elevated metabolism and activity to alleviate excess heat load, and lower production caused partly by reduced intake of energy and required nutrients.

On the other hand, results showed higher daily weight gain for lambs fed CM rations compared with grain rations. Results might be related to: 1) the greater efficiency of utilizing the digested nitrogen by animals fed true protein than urea diets, and 2) the variation in CM ingredients might contributed in efficient utilization of ration ingredients in tissue deposition compared with ureated grain rations (Singh *et al.*, 1980). They also reported that the energy supplementation to forage diets ensured better retention of nitrogen and improved the efficiency of nitrogen utilization for tissue deposition. Feed conversion as kg DM or TDN / kg live body weight gain was better for B rations than D rations. Moreover , rations contained CM were more efficient than UC or UB rations either with berseem or darawa.

From the economic point of view, results showed that feed cost/kg live body weight gain was lower for lambs fed B than D rations. Growing lambs during winter season could about 20% of the cost of feeding/ kg live bodyweight than growing lambs during summer. The lowest feed cost of UC ration in each experiment might be related to the feed intake (g/kg $w^{0.75}$) and the lowest concentrate : forage ratio in UC ration compared with the other two rations. Meanwhile UB ration had the highest feed cost in both experiments.

Blood and rumen liquor parameters

Results in Table (4) indicated that rumen liquor pH and NH_3-N concentrations were significantly ($P<0.05$) higher for lambs fed UC or UB rations than CM rations in each experiment. This might refer to: 1) rapid hydrolysis of urea to ammonia, 2) rapid and efficient formation of microbial protein using true protein compared with urea, and 3) the difference in buffering action in the rumen among rations. A similar trend was reported by Ortigues *et al.* (1988) who observed that ruminal ammonia and pH were higher for lambs fed rations supplemented by urea than that contained true protein. The concentrations of TVFA's were significantly ($P<0.05$) lower for lambs fed CM rations either with darawa or berseem than those fed ureated grains. Lambs fed B rations detected more concentrations of NH_3 - N and TVFA's compared with those fed D ration. This might refer to incompatible production of amino acids, NH_3 - N and TVFA's from B rations than the needs and capacity of rumen microflora to form microbial protein compared with D rations.

Table 4. Effect of experimental rations on some rumen liquor and blood parameters

Item	Winter experiment (I)			Summer experiment (II)		
	B+CM	B+UC	B+UB	D+CM	D+UC	D+UB
Rumen liquor:*						
pH	6.12 [b]	6.36 [a]	6.31 [a]	6.21 [b]	6.43 [a]	6.38 [a]
NH_3-N, mg/ 100 ml.	22.99 [b]	27.74 [a]	26.84 [a]	19.78 [b]	24.63 [a]	23.28 [a]
TVFA's, meq./ 100 ml.	9.05 [b]	9.39 [a]	9.62 [a]	8.21 [b]	8.75 [a]	8.71 [a]
Blood serum:						
Urea-N, mg/100 ml.	26.67 [b]	27.22 [a]	27.50 [a]	24.39 [b]	25.70 [a]	25.98 [a]
Total protein, g/100 ml.	7.17	7.03	7.08	6.97	6.84	6.86

a, b Means on the same line for each experiment bearing different superscripts are significantly ($P<0.05$) different.
* Average of the different sampling times (0, 2, 4 and 8 hours).

Blood urea-N concentration tended to be higher with lambs fed B rations than those fed D rations. Values of lambs fed rations contained ureated grains were significantly higher than those fed CM rations in each experiment. These results are in accordance with Broderick *et al.* (1993) who found lower concentration of blood urea when rations contained true protein compared with rations supplemented with urea. These findings might be referred to: 1) the rapid hydrolysis of urea to NH_3 in the rumen and 2) active absorption of NH_3 through rumen wall to blood stream due to higher pH values. No significant differences were observed concerning plasma total proteins among lambs due to the difference of concentrates source. Difference of grain source didn't affect plasma total proteins or urea-N.

Carcass quality:

Carcass weight and dressing percentage for lambs fed CM rations were greater than those fed rations contained ureated grains (Table 5). Results also cleared that the eye muscle area was significantly ($P<0.05$) bigger for lambs fed CM ration than the other two rations. No significant differences were found with other physical characteristics (tenderness, water holding capacity, color intensity and pH value) among lambs fed the three rations based on darawa due to the difference of the source of concentrates. Protein percentage was similar for lambs fed corn or barley rations, but insignificantly lower than lambs fed CM ration. This might be due to lower utilization of urea-N by lambs fed rations containing high level of urea as mentioned by Saha and Gupta (1990). Meanwhile fat percentage was insignificantly higher for lambs fed rations contained ureated grains than lambs fed CM ration.

Table 5. Effect of Concentrate sources on carcass characteristics of lambs in Exp. II.

Carcass and dressing %	Rations		
	D+CM	D+UC	D+UB
Fasting weight, kg	37.67[a]	36.67[ab]	35.08[b]
Empty body weight, kg	31.80	31.50	30.38
Hot carcass weight, kg	18.30	17.13	16.57
Dressing %	57.55	54.72	54.50
Prime cut %*	75.84	72.84	75.07
Physical characteristics :			
Eye muscle area, cm2	19.02	17.87	16.59
Tenderness	3.47	3.55	3.59
Water holding capacity	6.41	6.95	6.16
Color intensity	0.374	0.390	0.359
pH value	5.69	5.70	5.74
Chemical analysis (%) :			
Moisture	72.73	74.11	74.29
CP % On DM basis	81.82	81.19	81.11
EE % On DM basis	13.79	14.43	14.73
Ash % On DM basis	4.39	4.38	4.16

* on empty weight basis.

a and b means bearing different superscripts on the same line are significantly ($P<0.05$) different.

Generally it could be concluded that growing lambs on rations based on berseem during winter was more economic than growing lambs on rations based on darawa during summer. Moreover, using ureated corn with either berseem or darawa was more economic than using either concentrate mixture or barley grains. Growing lambs during winter, could save about 20% of the cost of feeding/kg live body weight than during summer.

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تأثير تغذية مصادر مختلفة من الاعلاف الخضراء والمركزة على أداء الاغنام

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استخدم ستة وثلاثون حولى خليط (رحمانى x رومانوف) مقسمة الى ست مجموعات متشابهة لتنفيذ تجربتى تغذية . استخدم ١٨ حولى فى كل تجربة لمقارنة كفاءة التسمين خلال موسمى الشتاء والصيف بالترتيب باستخدام مصادر أعلاف خضراء مختلفة [برسيم أو دراوة] وذلك مع مركزات مختلفة [علف مركز (ع م) أ، حبوب الذرة معاملة باليوريا (ذ ى) أ، حبوب الشعير معاملة باليوريا (ش ى)] . خلال الشتاء ، تمت تغذية ثلاث مجموعات من الحملان على ثلاث علائق تعتمد على البرسيم الطازج (ب) مع العلف المركز (ع م) – عليقة ١ (ع ١) أ، حبوب الذرة (ذ) – (ع ٢) أ، حبوب الشعير (ش) – (ع٣). وفى خلال الصيف غذيت ثلاث مجموعات أخرى من الحملان على ثلاث علائق تعتمد على الدراوة الخضراء مع ع م – (ع٤) أ، ذ – (ع٥) أ، ش – (ع٦). وكانت نسبة الاعلاف المركزة : الاعلاف الخضراء والخشنة ٤٠: ٦٠٪ . وجرشت الحبوب قبل تغذيتها ، ثم اضيف اليها محلول اليوريا (ى) للحصول على الاحتياجات الازوتية وعلى علائق متشابهة فى الطاقة.

وقد أظهرت النتائج اختلافات معنوية بين المعاملات (إحتمال < ٠,٠٥) لمعاملات هضم المادة الجافة والمادة العضوية والمستخلص خالى الازوت والبروتين الخام. وكان المأكول من المادة الجافة أعلى للعلائق المحتوية على ع م عن العلائق الاخرى. وكانت زيادة الوزن اليومية أعلى معنوياً (إحتمال < ٠,٠٥) فى تجربتى التغذية للعلائق المحتوية على ع م عن تلك التى غذيت على شعير معامل باليوريا. وكان التحويل الغذائى أعلى للعلائق المحتوية على ع م عن الاخرى. وكانت زيادة الوزن اليومية والتحويل الغذائى على صورة مادة جافة ومركبات كلية مهضومة أفضل للعلائق المحتوية على البرسيم عن تلك المحتوية على الدراوة. وقد تمت دراسة مقاييس صفات سائل الكرش (درجة الحموضة – نيتروجين الامونيا – مجموع الاحماض الدهنية الطيارة) والبروتين الكلى لسيرم الدم. اما بالنسبة لصفات الذبيحة فلم توجد أى فروق معنوية بين المجموعات. وكانت تكاليف التغذية / كجم من وزن الجسم الحى (وج ح) أقل لعلائق البرسيم عن

علائق الدراوه. ولكلا التجربتين كانت تكاليف التغذية / كجم و ج ح أقل للعلائق المحتوية على الذرة المعاملة باليوريا (ى ذ) يتبعها العلائق المحتوية على العلف المركز . وقد وفر تسمين الحملان خلال الشتاء ٢٠ ٪ تقريبا من تكاليف تسمين الحملان خلال الصيف .