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EFFECT OF SEASONAL CHANGES AND TYPE OF ROUGHAGE ON:
II- NUTRITIVE VALUES, RUMEN FERMENTATION AND BLOOD METABOLITES OF CROSSBRED LAMBS

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ABSTRACT

A study was conducted to determine nutrients digestibility, ruminal fermentation and blood constituents of growing lambs fed berseem silages. Eighteen growing crossbreed lambs (23.2±0.91 kg average live body weight; 5 months old) were randomly distributed to three experimental groups (six in each). First group was fed starter concentrate feed mixture (CFM) and berseem hay (R1; as a control). Whereas, other groups were fed CFM plus berseem silage supplemented with either 5% ground yellow corn (BSC; R2) or lactic acid bacteria and yeast mixture (BSB; R3) during ensiling process. Blood samples were collected monthly to determine different metabolites. Before finishing the experiment, three digestibility trials were conducted using three lambs for each ration at average body weight 39.0 kg ±0.72 and 9 months of age. Daily dry matter intake (DMI), digestibility and feeding values were calculated. Also, rumen liquor parameters were measured pre- and post-feeding. The results indicated that the DMI appeared to the highest($P<0.05$) significant with R2 followed by R3 due to DM% of silage. As well as, the CP intake was the greatest ($P<0.05$) in R2 than other groups. The digestion coefficient of all nutrients in R2 were significantly ($P<0.01$) greater in R2 than other rations, except for OM, CP, EE and CF which were slightly higher with no significant differences. Whereas, R3 was the greatest ($P<0.01$) hemicellulose digestibility and the lowest ($P<0.01$)of cellulose. The values of TDN, DCP,TDN:CP ratio, ME, NE and CPI:MEI ratio did not vary significantly among treatments. The intake of TDN and DCP were greater ($P<0.01$) in R2 than other groups, whereas R1 had the highest ($P<0.01$) value of NFCI and NFCI:DCPI ratio. The quality index of rations was higher ($P<0.01$) value in R2 compared with other rations. The ruminal pH and effective NDF values were affected ($P<0.01$) by dietary treatments and sampling time. The highest ($P<0.01$) value of ruminal ammonia-N recorded with R1 than the others. However, ruminal TVFA's and buffering capacity tended to the lowest ($P<0.05$) in R1. Blood metabolites did not differ significantly among groups except for blood protein, albumin and globulin which were higher in control than treated groups. It can be concluded that growing lambs fed ration containing CFM plus berseem silage supplemented with 5% yellow corn had higher nutrients intake, digestibility, quality index, ruminal TVFA's and buffering capacity and consequently had the best performance.
Keywords: Roughage type, nutritive value, blood metabolites, lambs

INTRODUCTION

Animal feed shortage is the main constraint to the development of animal production especially in the summer season in Egypt. In winter the production of animal feeds is mainly dependent on berseem fodder while there is a lack of feed resources in summer. Green fodder and crop residues are the main feedstuffs which play pivotal role to fulfill the nutrients requirements of ruminant animals in tropical and sub-tropical countries Shahzad *et al.* (2009). Therefore, silage making from berseem (*Trifolium alexandrinum L*.) is considered one of the most effective practical substitutes to ensure sustainable fodder supply during fodder capacity season. As well as, the use of legumes can provide ruminants not only essential nutrients but also contain many anti-nutritional factors which have to be eliminated (Tamminga *et al.,* 1999). Berseem is highly nutritious, high yielding and abundantly available multi-cut legumes and could be ensiled to regularize fodder availability. However, leguminous fodders have high buffering capacity (due to high protein and mineral content) and high moisture content that led to slow pH decline during ensiling and caused heavy nutrient losses (Bolsen, *et al.,* 1996). This fodder could be best ensiled after lowering their moisture content and by supplementing with a fermentable carbohydrate source and inoculum lactic acid bacteria (Woolford, 1984 and Sarwar, *et al.,* 2005).

Silage quality and its nutritional value are influenced by numerous biological and technological factors (Owens *et al.,* 2009). One of the most important factors is the production of lactic acid during ensiling process, which in turn is dependent upon the soluble sugars present in the crop or ensiled materials (Schaefer *et al.*, 1989). Other factors that affect the rate of pH decline and final pH of silage are buffering capacity (related to the amount of acid needed to change the pH), dry matter content and the type and amount of bacteria present on the forage (Bolsen *et al.,* 1996; Higginbotham *et al.,* 1998). Preservation of high moisture legumes is usually limited by shortage of water soluble carbohydrates, high buffering capacity and clostridia proliferation. Bad preservation of high moisture legume silages usually leads to spoilage of preserved material, low silage intake and poor utilization by the animals (Jaurena and Pichard, 2001). Several workers have reported that the addition of cereal grains to high moisture forage legumes before ensiling improved dry matter intake and animal performance (Nicholson and Maclead, 1966; Spörndly *et al.,* 1982) and dry matter digestibility (Harrison *et al.,* 1994). Consequently, it could be more efficient to mix grains with forages when ensiling, instead of feeding them as supplements (Jones, 1988). Improved preservation of forage with added grains is obtained through a better fermentation process (Woolford, 1984; Jones *et al.,* 1990) and also reduced effluent production (Jaurena and Pichard, 1999). However, cereal fodders particularly maize, sorghum and millet offer potential suitability for silage making and usually there is no need to add energy source during ensiling process (Wierenga, *et al.,* 2010). Other authors have found little effect of adding cereal grains (Moseley and Ramanathan, 1989; Jones *et al.,* 1990). Jaurena and Pichard (2001) showed that adding maize grains to ensiling lucerne (50 kg/t) did not affect fermentation characteristics. Voluntary intake and digestibility are two main factors which affect the feeding value of silages (Xu *et al.,* 2007).

However, the information regarding the nutritive value of berseem silage supplemented with grains or biological cultures (during ensiling process) and their impact on growth performance, carcass characteristics, nutrients digestibility, rumen fermentations, blood constituents, anatomy and histological measurement of digestive tract is limited. Therefore, the present study was planned to evaluate: nutritive value of berseem silages as a replacement of conventional fodder (berseem hay) and its effect on nutrients intake, digestibility, rumen fermentation and blood metabolites of growing lambs.

MATERIALS AND METHODS

The present study was carried out at Mahallet Mousa Research station, Kafr El-Sheikh Governorate belonging to Animal production research Institute, Ministry of Agriculture. The object of this study was to complete the evaluation of berseem silages replacement with hay under local environmental temperature (Abd El-Hady, 2012) by studying the effect on nutritive value, digestibility, rumen fermentation and blood metabolites of growing lambs. The previous study with the same experimental rations was focused on growth performance, feed efficiency, metabolic aspects and carcass characteristics of lambs as affected by type of roughage under different seasons.

Ensiling process:

As mentioned in the first part (Abd El-Hady, 2012), about 20 ton of fresh berseem (3^{rd} cut) was collected from the field and divided into 2 equal portions for making silage different treatments. Berseem (*Trifolium alexandrinum L*.) was mechanically chopped using Turkish harvester chopper machine to 2-3 cm of length. The chopped berseem was wilted for 24 h to reduce the moisture content to about 70% before ensiling. At that time, the air temperature was 29^{o}C and the relative humidity was 70.5%. Wilted berseem was well pressed in layers using wheel tractor to ensure air removal and it was supplemented with 5% ground yellow corn (BSC) or 2% bacteria-yeast mixture (BSB) solution (EM1; contains 2.2 x 10^{8} CFU /ml of lactic acid bacteria and 1.0 x 10^{3} CFU/ml of yeast) in two silo, respectively. After filling of each silo, it was covered by plastic sheet followed by thin layer of rice straw and layer of soil to maintain anaerobic condition of silo. The ensiled berseem was kept for 2 months before feeding animals.

Experimental Animals:

The same eighteen growing crossbreed lambs (Rahmany x Romanouf; 5 months old) of 23.2±0.91 kg average live body weight were also used in the present study and continued to reach about 7 months. The animals were randomly distributed to three experimental groups according to their live body weight. Lambs were housed in semi-open stall barn and fed the experimental rations as group feeding. Starter concentrate feed mixture (CFM) and berseem silage or hay were offered twice daily according to NRC (1985). The feed intake was increased gradually according to increase body weight. Drinking water was available during the day. Mineral blocks were available free of choice for all animals under the experiment. All lambs were injected subcutaneously with anti-parasites and cut their wool at the beginning of the experiment.

Blood samples from each experimental animal were collected every month via jugular vein using heparinized tubes. Blood plasma was separated by centrifugation at 3000 r.p.m for 10 minutes and stored at -20^{o}C until analyzed for the different blood parameters. Plasma glucose, total protein, albumin, createnine and aminotransferases (AST and ALT) were determined calorimetrically using commercial kits according to the procedures outlined by the manufacture.

Experimental rations:

The same three experimental rations tested in the first part of this series (Abd El-Hady, 2012) were used in this study. The ingredients of CFM were 36% yellow corn, 22% soybean meal (44% CP), 15% linseed cake, 22% wheat bran, 3% molasses, 1.5% calcium carbonate and 0.5% sodium chloride. The chemical composition of CFM, berseem hay and silages were shown in Table (1). The growing lambs were assigned randomly to three experimental groups (Table 2) to be fed on:

Ration 1 (R1): 52% CFM plus 48% berseem hay (BH; as a control ration).

Ration 2 (R2): 42% CFM plus 58% BSC.

Ration 3 (R3): 52% CFM plus 48% BSB.

Digestion trials:

Three digestibility trials were conducted using three lambs to determine nutrients digestibility coefficients and nutritive values of the experimental rations. Animals were fed to cover the requirements of growing lambs. The average of body weight of lambs was 39.0 ±0.72 kg at 9 months of age. Animals were fed their allowances according to the experimental to assignment of each group.

The daily feed allowances were weighed and offered twice daily (at 8.0 AM and 4.0 PM). Drinking water was available to each animal allover the time. Samples of feeds were taken in the first and last of experiment and kept for later analysis. Feces samples were taken during the collection period of each trial (5 days) and dried in forced air oven at 65^{o}C for 48 hrs. Dried samples were composed for each animal and representative samples were taken, ground and kept for chemical analysis.

Chemical analysis and rumen fermentation:

Proximate analysis (DM, CP, CF, EE and ash) of feedstuffs and feces were determined according to A.O.A.C. (1990). The samples of feedstuffs and feces also were analyzed for fiber fractions according to the procedures of Van Soest, *et al.* (1991) to determine neutral detergent fiber (NDF), acid detergent fiber (ADF) and acid detergent lignin (ADL). Cellulose was calculated as = ADF-ADL and hemicellulose as = NDF-ADF. Non-fibrous carbohydrates (NFC) were calculated as: NFC% = OM – (%NDF + %CP + %EE) (Calsamiglia *et al.,* 1995).

Rumen fluid samples were collected from all experimental lambs during the last day of the metabolism trial. The samples were taken by rubber stomach tube using gentle mouth suction. About 100 ml of rumen fluid was collected just before offering the morning feed (zero time) and at 2 and 4 hrs post feeding (at timed interval). The collected samples were filtered through 4 layers of surgical gauze and were immediately used to determine rumen pH using digital pH-meter with a combined electrode. Then samples were stored in dried bottles at -20^{o}C for measuring other parameters. Ammonia nitrogen (NH_3-N) concentration was measured according to Conway (1957) method. Total volatile fatty acids (TVFA's) in rumen liquor were measured according to stem distillation procedure as described by Warner (1964). Rumen buffering capacity (their ability to resist pH change) was also determined as milli-equivalents (mE) of hydrochloric acid required to change the pH of 100 ml of rumen liquor to 4.5 according to Jasaitis *et al.*(1987).

For judging the quality of berseem silage, color and odder of silages were examined and samples were taken for chemical analysis. Silage samples were extracted using 20 g homogenized wet materials with 100 ml distilled water in warm blender for 10 minutes (Waldo and Schultz, 1956). The homogenized samples were filtered through double layers of cheese cloth and filter paper until it becomes clear. Then the filtrate was used to determine silage pH directly by using digital pH meter. Lactic acid concentration was determined in silage juice colorimetric according to Barker and Summerson (1941).

Statistical analysis:

Data of the study were analyzed using the general linear model (GLM) of SAS (2003). Data of nutrients digestibility and feeding values were analyzed using one way classification model included treatment effect. Whereas, rumen parameters and blood constituents were subjected using two way analysis of variance model including treatment, time and interaction between them. Differences among the overall means were done using Duncan's multiple range test (Duncan, 1955).

Table 1. Chemical composition of the ingredients and experimental rations.

Items	DM	pH	Lact-ate	Chemical Composition (% as DM)											
				OM	CP	EE	CF	NFE	Ash	NDF	ADF	ADL	Hemi.	Cellu.	NFC
Ingredients															
CFM	86.16	-	-	93.11	17.63	3.53	11.26	60.69	6.89	31.12	14.56	5.54	16.56	9.02	40.84
BH	86.78	-	-	88.13	13.60	1.92	26.33	46.28	11.87	42.43	28.96	9.98	13.47	18.98	30.18
BSC	33.20	4.88	3.03	80.27	14.52	3.73	37.15	24.87	19.73	52.88	33.96	12.69	18.92	21.27	9.14
BSB	27.90	4.70	3.08	81.55	13.38	4.35	39.37	24.45	18.45	52.86	33.17	11.10	19.70	22.06	10.96
Experimental rations															
R1	84.01	-	-	90.73	15.70	2.76	18.47	53.80	9.27	36.53	21.44	7.66	15.67	13.78	35.74
R2	44.80	-	-	85.67	15.83	3.64	26.25	39.95	14.33	43.72	25.79	9.68	17.93	16.11	22.49
R3	42.98	-	-	87.47	15.58	3.92	24.85	43.12	12.53	41.63	23.55	8.23	18.08	15.32	26.39

RESULTS AND DISCUSSION

Chemical composition of the tested rations:

Chemical composition of CFM, BH, BSC, BSB and experimental rations are summarized in Table (1). The summative analysis of the ingredients used to formulate the experimental rations (R1, R2 and R3) was within the normal published ranges (Abou El-Enin, 2005; Sarwar *et al.,* 2005; Ead and Maklad 2006 and Touqir *et al.,* 2007). The fermentative traits of silage showed that the ensiled berseem showed good aroma with yellowish color and texture was soft. The pH values and lactic acid concentration of berseem silage supplemented with bacteria (BSB) were slightly better than those of supplemented with ground corn (BSC). The DM content of BSC and BSB were 33.2% and 27.9%, respectively and reached to 44.8 and 42.98% as a total mixed ration for R2 and R3. The lower dry matter was observed in BSB might be owing to the solubility of bacteria additive. A water soluble carbohydrate was needed to improve the efficiency of bacteria and yeasts to produce more concentration of lactic acid and consequently lower pH value. These data agree with Jaurena and Pichard (2001) with lucerne silage and with berseem silage supplemented with ground yellow corn. Similar results were published by Touqir *et al.* (2007) who found lower pH and higher lactate content when berseem and Lucerne fodders were ensiled at 30% DM level compared with control, 20% or 40% DM level. Nisa *et al.* (2005) showed that addition of corn starch or molasses to Mott grass at ensiling has improved the availability of fermentable sugars for anaerobic fermentation that lead to higher lactic acid production and consequently lower pH.

Crude protein of BSC was slightly higher than BSB or BH (14.52 *vs*. 13.38 and 13.6, respectively). It may be due to ground corn supplementation. However, CP was similar among experimental ration. As well as, ash% were slightly higher in BSC than BSB (19.73% *vs.* 18.45%, respectively). Similar results were obtained by Jaurena and Pichard (2001) and Abou El-Enin (2005). The BH and consequently R1 were the highest value of NFC%. The values of NFC% of rations were in the plateau range (22.5 to 35.7%). Wheeler (2003) reported that the NFC% in total ration (as DM basis) should neither fall below 20% nor above 45%. Weiss (2002) reported that NFC% is a primary energy source for ruminants because of its highly digestible. The ether extract, crude fiber and its fractions (NDF and ADF) were lower in BH than silages, as well as ADL, Hemicellulose and cellulose. Similar trend was observed in R1 vs. R2 and R3 as total mixed ration. The results were in agreement with those recorded by Gabra and Hafez (2000).

Feed intake:

The average daily DM intake of basal diets, supplements and the total rations are presented in Table (2). The concentrate: roughage (C:R) ratio was a bout 50:50 in R1 and R3, while the ratio in R2 was about 40:60. The average DMI of concentrate as % of LBW was similar among groups(ranged from 1.09 to 1.13%), While, DMI of BSC as % of BW was the highest value followed by BSB (1.511% vs. 1.079%). The difference between silage groups may be due to DM% of silage. Likewise, total DMI was the greatest ($P<0.05$) in R2 based on BSC followed by R3 (2.61% *vs.* 2.21% of BW). The CP intake was higher ($P< 0.05$) in R2 than other groups (0.162 kg/d vs. 0.130 and 0.131 kg/d R2 vs. R1 and R3, respectively). This increase of intake in R2 may be attributed to mutual associative effect between silage and ground yellow corn in addition to higher CP% of BSC. It could be concluded that R2 was more palatable based on its higher DMI. The results are in harmony with the findings of El-Shaer *et al*. (1991) and El-Shaer *et al*. (2001) who found that feeding sheep and goats on halophytic silage supplemented with broiler letter or barley grains led to higher intake than that of berseem hay.

Table 2. Average daily DMI of CFM, BH, BSC and BSB by lambs during the digestion trials.

Items	R1	R2	R3
Average BW, kg	39.7	39.3	38.0
C:R ratio	52.2 :47.8	42.1: 57.9	51.7: 48.3
Intake as DM:			
CFM, kg/h/d	0.431	0.431	0.431
As % BW	1.086	1.097	1.134
BH, kg/h/d	0.395	-	-
As % BW	0.995	-	-
BSC, kg/h/d	-	0.594	-
As % BW	-	1.511	-
BSB, kg/h/d	-	-	0.410
As % BW	-	-	1.079
TDMI, kg/h/d	0.826	1.025	0.841
As % BW	2.081	2.608	2.213

Digestibility and nutritive values:

As shown in Table (3) the digestibility coefficients of most nutrients significantly (P<0.01) increased in R2 based on BSC, except for OM, CP, EE and CF which were slightly higher in R2 than other groups but without significant differences. Whereas, R3 had the highest (P<0.01) digestibility of hemicellulose and the lowest (P<0.01) for cellulose. The R1 based on BH had greater (P<0.01) value of cellulose followed by R2. The results are in agreement with the findings of Abou El-Enin *et al*. (2005) who found that OM, CP, EE and CF digestibility did not differ significantly between BSC and BH rations. Mostafa *et al*. (1995) found that CF digestibility had higher values in treated berseem silages than alfalfa hay. They mentioned that this effect was probably due to the biological treatment of ensilage which has favorable effect on cell wall digestibility. The results are in contrary to that of Etman *et al*. (1998) who reported that berseem hay had significantly higher digestion coefficients for most nutrients than those of berseem silage. On the other hand, the results differed with El-Shaer *et al*. (2001) who showed that CF, NDF and ADF were higher in control ration based on BH plus CFM than silage plus CFM but without significant differences.

The values of TDN, DCP,TDN:CP ratio, ME, NE and CPI:MEI ratio did not vary significantly among treatments (Table 3). However, the intake of TDN, DCP, NFC and NFCI:DCPI ratio were differed significantly (P<0.01) among groups. Where, TDNI and DCPI were greater in R2 than other groups, whereas R1 had the highest (P<0.01) value of NFCI and NFCI:DCPI ratio. However, the difference between R1 and R3 was not significant in the ratio of NFCI:DCPI. The results are in agreement with the findings of EL-Shaer *et al*. (2001) who found that TDN and DCP did not differ significantly when Barki male lambs were fed berseem hay plus CFM or halophytic silage plus CFM. In addition, Abou El-Enin *et al*. (2005) found similar results when Ossimi rams were fed either BH + CFM or BSC + CFM. On the other side, Abdelhamid *et al*. (2009) presented that TDN intake and DCP intake were higher (P<0.05) in lambs fed BH plus CFM than those fed banana waste silage supplemented with EM1.

Table 3. Nutrients digestibility and feeding values of experimental rations.

Items	R1	R2	R3	±SE
TDMI, kg/d	0.826^{b}	1.025^{a}	0.841^{b}	0.037*
CPI, kg/d	0.130^{B}	0.162^{A}	0.131^{B}	0.005**
Nutrient digestibility, %:				
DM	57.10^{A}	60.97^{A}	47.83^{B}	1.83**
OM	59.52	62.87	56.75	1.66^{NS}
CP	42.10	43.75	37.57	2.80^{NS}
EE	20.10	27.70	23.87	1.70^{NS}
CF	46.65	52.68	46.16	1.83^{NS}
NFE	71.04^{b}	80.30^{a}	72.75^{b}	1.88*
NDF	46.77^{B}	59.44^{A}	55.31^{A}	1.64**
ADF	46.93^{A}	54.32^{A}	33.33^{B}	2.79**
ADL	20.05^{C}	56.92^{A}	38.79^{B}	2.31**
Hemicellulose	48.53^{C}	66.79^{B}	83.91^{A}	3.66**
Cellulose	61.87^{A}	52.76^{A}	30.41^{B}	3.65**
NFC	83.26^{ab}	88.71^{a}	75.38^{b}	2.33*
Feeding value:				
TDN%	54.70	55.12	50.85	1.56^{NS}
DCP%	6.61	6.92	5.86	0.456^{NS}
TDNI, kg/d	0.451^{B}	0.565^{A}	0.426^{B}	0.019**
DCPI, kg/d	0.055^{b}	0.071^{a}	0.049^{b}	0.004*
NFCI, kg/d	0.295^{A}	0.230^{B}	0.221^{B}	0.004**
NFCI : DCPI	5.42^{A}	3.28^{B}	4.57^{A}	0.257**
ME, Mcal/kg	1.947	1.962	1.810	0.056^{NS}
NE, Mcal/kg[1]	1.22	1.23	1.13	0.038^{NS}
TDN : CP	3.48	3.48	3.26	0.091^{NS}
DDM%[2]	72.2^{A}	68.8^{C}	70.6^{B}	0.295**
RFV[3]	46.2^{b}	54.6^{a}	45.9^{b}	1.790*
RFQ[4]	92.7^{B}	116.7^{A}	91.4^{B}	2.94**
QI[5]	1.25^{B}	1.56^{A}	1.24^{B}	0.037**
CPI:MEI	80.8	80.7	86.2	2.19^{NS}

[1]NE (Mcal/kg) = (TDN% x 0.0245) – 0.12 (NRC, 2001)
[2] DDM% (Digested dry matter) = 88.9 – 0.779 x (ADF% of DM) (Schroeder, 1996)
[3]RFV (Relative feeding value) = DMI x DDM / 1.29 (Schroeder, 1996)
[4]RFQ (relative feeding quality) = (DMI% of BW) x (TDN% of DM) / 1.23 (Moore, 1994)
[5]QI (Quality Index) = 0.0125 x RFQ + 0.097 (Moore, 1994)
^{A,B} and ^{C}: values in the same row with different superscripts differ significantly (P<0.01).
^{a,b} and ^{c}: values in the same row with different superscripts differ significantly (P<0.05).
***P< 0.05 ; **P< 0.01 ; ^{NS} Non Significant**

The lowest (P<0.01) value of digested dry matter (DDM%) was in R2 (68.8%) and the highest value was in R1 (72.2%). On contrary, the relative feeding value (RFV), relative feeding quality (RFQ) and the quality index (QI) were higher (P<0.01) for R2 compared with other rations. The CPI:MEI ratio tend to be higher in R3 than others (86.2 vs. 80.8 and 80.7 for R3, R1 and R2, respectively). Gabler (2002) reported that dry matter utilization improved quadratically with the 63.3 CP:ME ratio having the highest total tract apparent DM digestibility. The TDN:CP ratio tended to be the lowest in R3 (3.26 vs. 3.48 and 3.48 for R3, R1 and R2, respectively). The dietary ratio of TDN:CP is often used to evaluate the energy and protein balance of forage diets. Most researchers suggest that protein supplementation may be needed when the TDN:CP ratio is greater than 6:1 to 8:1 (Bohnert and Delcurto, 2003). So, it could be concluded from the results that feeding on R2 is the best ration in this respect compared with other rations.

The quality index (QI) measures the voluntary intake of TDN above maintenance. When forage are fed without supplemental energy or protein, QI is related to the gain of growing cattle (Moore and Kunkle, 1995). When QI equaled 1.0 the intake of TDN just meats the maintenance requirement and when QI equaled 1.8 average daily gains is 0.6 kg/d for steers.

Rumen liquor parameters:

As shown in Table (4) the ruminal pH values were affected by dietary treatments, sampling time (P<0.01) and the interaction between them (P= 0.077). The lowest ruminal pH was in control ration (R1). Based on the mean values, the maximum (P<0.01) pH values were observed at zero time whereas the minimum values were observed at 2 hrs post feeding. The optimum cellulolytic bacteria activity is within the range of pH value 6-7 (Prasad *et al*., 1972). Similar trend was observed with effective NDF (eNDF). The best (P<0.05) eNDF% was in R2 (31.9% vs. 26.3 and 30.2 for R2, R1 and R3, respectively). Pitt *et al*. (1996) reported that eNDF was adequate predictor of rumen pH. The rumen pH is directly related to microbial protein yield (Russell *et al.,* 1992). Microbial yield is reduced 2.5% for each percentage unite reduction in eNDF below 20%.

The ruminal ammonia-N was significantly (P<0.01) affected by experimental rations ($Fig1_a$). The highest concentration was in R1 (13.18 mg/dl) followed by R2 (9.51 mg/dl). As well as, the highest concentration was at zero time and decreased gradually to the lowest value at 4 hrs post-feeding. The ruminal concentration of ammonia-N at any given time is a function of its production, utilization by rumen microbes, absorption across the ruminal wall, passage to the lower gut and recycled through saliva and depends on C:R ratio as well (Mehrez,1992).

The highest concentration (P<0.05) of TVFA's was in rumen liquor (7.33 mleq/dl) of lambs fed R2 followed by R3 based on berseem silage (6.39 mleq/dl). The highest (P<0.01) values of VFA's were found at 4 hrs. post-feeding, especially in R1 and R2, while in R3 the maximum level of VFA's found to be at 2 hrs as shown in Table (4) and ($Fig1_b$). Topps (1964) found that both digestibility and protein content of the ration had significant effect on the concentration of TVFA's in the rumen liquor. In addition, Topps (1995) reported that forage legumes increase the TVFA's concentration without affecting the relative proportion and the rumen pH, indicating that forage legumes are likely to maintain a stable fermentation pattern. The results are in agreement with those findings by Hanafy (1985) and Abou El-Enin *et al.* (2005) who found that TVFA's reached the highest value from 2 to 4 hrs after feeding on berseem silage supplemented with different additives. Similar trend was found with buffering capacity which was affected by feeding on berseem silages. So that, the highest level of ruminal buffering capacity was in R3 (8.45 mg/dl) followed by R2 (7.95 mg/dl). The highest mean level (P<0.01) of buffering capacity was at zero time (pre-feeding) and decreased post-feeding, however the interaction between treatment and time of sampling did not affect significantly on buffering capacity. Similar trend was found by Moharrery (2005) who presented that buffering capacity of alfalfa hay was 5.32 and corn silage was 10.18 mleq/kg DM.

Table 4. Effect of feeding experimental rations on some rumen liquor parameters at different times after feeding.

Parameters	Hours	R1	R2	R3	Mean of Time
pH	**0**	6.97	7.31	7.08	7.12^{A}
	2	6.25	6.51	6.20	6.32^{C}
	4	6.39	6.52	6.82	6.58^{B}
±SE		0.103	0.104	0.103	0.059**
Mean of treatment		6.54^{b} ±0.059	6.77^{a}±0.064	6.70^{ab}±0.059*	
eNDF[1]	**0**	36.5	44.3	39.1	39.97^{A}
	2	19.6	25.7	18.4	21.22^{C}
	4	22.9	25.8	33.0	27.22^{B}
±SE		2.44	2.44	2.44	1.407**
Mean of treatment		26.3^{b} ±1.41	31.9a ±1.52	30.2^{ab}±1.41*	
Ammonia-N (mg/dl)	**0**	15.40	10.50	9.93	11.94^{a}
	2	12.83	10.27	8.05	10.38^{ab}
	4	11.29	7.77	5.95	8.34^{b}
±SE		1.53	1.53	1.53	0.881*
Mean of treatment		13.18^{A}±0.881	9.51B ±0.881	7.98^{B}±0.881**	
TVFA's (ml eq/dl)	**0**	4.00	4.17	5.33	4.50^{B}
	2	5.67	8.00	8.50	7.39^{A}
	4	6.83	9.83	5.33	7.33^{A}
±SE		0.714	0.714	0.714	0.412**
Mean of treatment		5.50^{b}±0.412	7.33a ±0.412	6.39^{ab} ±0.412*	
Buffering Capacity (mg/dl)	**0**	8.00	8.32	9.06	8.46^{A}
	2	5.63	7.37	7.22	6.74^{B}
	4	6.34	8.16	9.07	7.86^{A}
±SE		0.356	0.356	0.356	0.205**
Mean of treatment		6.65^{B}±0.205	7.95A ±0.205	8.45^{A}±0.205**	

[1]eNDF = (pH – 5.425)/0.04229. (Fox *et al.*, 2000)
***P< 0.05 ; **P< 0.01 ; [NS] Non Significant**
[A,B] and [C]: values in the same row with different superscripts differ significantly (P<0.01).
[a,b] and [c]: values in the same row with different superscripts differ significantly (P<0.05).

(a) **(b)**

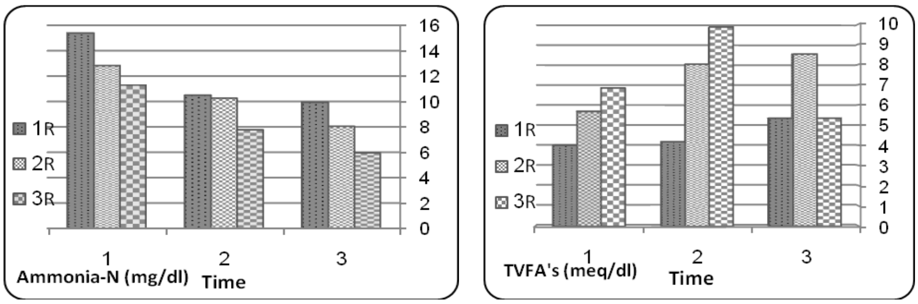

Fig. 1. Ammonia-N concentration (a) and TVFA's values (b) in rumen liquor of lambs before feeding and after 2 and 4 hrs post feeding.

Blood metabolites:

Concerning blood metabolites, data in Table (5) showed that plasma glucose of lambs did not differ significantly among experimental groups, however the level of glucose tended to be higher in R3 than others (48.4 vs. 47.12 and 47.5 mg/dl for R3, R1 and R2, respectively). Plasma total protein, albumin and globulin were significantly (P<0.05) affected by experimental rations. Lambs fed R1 had the greatest level of total protein (5.71 g/dl) while the lowest (P<0.05) level was in R3. The difference between R2 and either R1 or R3 was not significant. Similar trend was observed with plasma globulin. Whereas, the highest (P<0.05) value of albumin was in R2. The A/G ratio tends to be higher in silage groups than control. Plasma createnine levels were similar among groups. Liver enzymes activity as AST, ALT and the ratio between them appeared to the highest in control group with no significant differences among groups. The obtained results of blood metabolites were in the normal range as reported by Mohamed and Selim (1999) for sheep except for total protein which was higher than the recorded values. Similar trend was recorded by Abdelhamid *et al.* (2009) with most blood parameters except for plasma total protein of lambs which fed CFM plus berseem hay compared with CFM plus banana wastes silage supplemented with EM1.

Table 5. Effect of experimental rations on some blood parameters of growing lambs.

Items	R1	R2	R3	±SE
Glucose, mg/dl	47.12	47.50	48.40	2.35
T. protein, g/dl	5.71^{a}	5.53^{ab}	5.24^{b}	0.126^{*}
Albumin, g/dl	2.99^{b}	3.17^{a}	2.97^{b}	0.055^{*}
Globulin, g/dl	2.71^{a}	2.36^{ab}	2.27^{b}	0.127^{*}
A/G ratio	1.23	1.56	1.66	0.163
Createnine, mg/dl	0.835	0.856	0.834	0.022
AST, IU/l	35.8	31.9	29.1	2.25
ALT, IU/l	8.65	7.60	7.92	0.410
AST/ALT ratio	4.39	4.36	3.94	0.242

^{a} and ^{b}: values in the same row with different superscripts differ significantly (P<0.05)*

Conclusion:

It can be concluded that growing lambs fed berseem silage supplemented with ground yellow corn as a basal diet had higher nutrients intake, digestibility, quality index, ruminal TVFA's and buffering capacity and consequently had the best performance compared with feeding berseem hay, which supported the results in the first article that concluded berseem silage supplemented with 5% yellow corn showed the best growth performance, profit, and economic efficiency under the local thermal temperature compared with those fed berseem hay as a basal diet.

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تأثير التغيرات الموسمية ونوع مواد العلف الخشنة على:
٢- القيمة الغذائية وتخمرات الكرش وقياسات الدم للحملان

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أجريت هذه الدراسة لقياس معاملات الهضم وتخمرات الكرش وقياسات الدم للحملان النامية المغذاه على سيلاج البرسيم مقارنة بالدريس. تم اختيار ١٨ رأس من الحملان النامية الخليطة (عند متوسط وزن ٢٣.٢ ± ٠.٩١ كجم وعمر ٥ شهور) ووزعت الحيوانات على ثلاث مجموعات متساوية (٦ حملان فى كل مجموعة). المجموعة الأولى (م١) كانت تغذى على مخلوط علف مركز ودريس البرسيم (مقارنة)، اما المجموعة الثانية (م٢) غذيت على العلف المركز وسيلاج برسيم مضاف اليه ٥% مجروش ذرة صفراء اثناء السيلجة ، والمجموعة الثالثة (م٣) غذيت على العلف المركز وسيلاج البرسيم مضاف اليه ٢% مخلوط بكتيريا وخمائر أثناء السيلجة. وقد تم سحب عينات دم شهريا من كل الحملان منذ بداية التجربة وحتى نهايتها لتقدير بعض قياسات الدم مثل الجلوكوز ووظائف الكبد والكلى. وقبل نهاية التجربة تم عمل ثلاث تجارب هضم باستخدام ثلاث حملان من كل مجموعة بمتوسط وزن ٣٩.٠±٠.٧٢ كجم وعند عمر ٩ شهور. تم تسجيل المستهلك اليومى من المادة الجافة وتقدير معاملات الهضم والقيمة الغذائية لمواد العلف المستخدمة. أيضا تم سحب عينات من سائل الكرش قبل وبعد التغذية لتقدير بعض قياسات تخمرات الكرش. وقد أظهرت النتائج أن م٢ كانت أعلى استهلاكا من المادة الجافة ويليها م٣، وكذلك المستهلك من البروتين الخام كان أعلى معنويا ($P<0.05$) في م٢ عن بقية المعاملات. كما أن م٢ كانت الأعلى معنويا ($P<0.01$) فى معاملات هضم معظم مكونات مواد العلف فيما عدا المادة العضوية ، البروتين الخام ، المستخلص الأثير ، الألياف الخام حيث كانت الزيادة غير معنوية. فى حين أن م٣ كانت الأعلى فى معامل هضم الهيميسليولوز والأقل فى السليولوز. أما عن القيمة الغذائية فلم يكن هناك اختلاف معنوي بين المجاميع الثلاث فى كلا من مجموع المركبات الغذائية المهضومة ، البروتين المهضوم ، النسبة بين مجموع المركبات المهضومة والبروتين الخام ، الطاقة الممثلة ، الطاقة الصافية ، والنسبة بين المستهلك من كلا من البروتين الخام والطاقة الممثلة. وقد أظهرت م٢ زيادة معنويه ($P<0.01$) في المستهلك من مجموع المركبات المهضومة، البروتين المهضوم ، دليل جودة مخلوط العلف عن بقية المجاميع. وقد تأثرت درجة حموضة سائل الكرش وكذلك الألياف المتعادلة الفعالة بالمعاملات الغذائية ووقت سحب العينة. وقد تفوقت م١معنويا ($P<0.01$) فى مستوى الأمونيا فى حين انخفضت فيها ($P<0.05$) الأحماض الدهنية الطيارة وكذلك السعة التنظيمية للكرش عن بقية المجاميع. أما عن قياسات الدم فلم تتأثر معنويا بمواد العلف فيما عدا البروتين الكلى و الألبومين والجلوبيولين حيث كان التركيز الأعلى فى م١.

يمكن أن نستخلص من هذه الدراسة أن الحملان النامية المغذاة على سيلاج البرسيم المضاف اليه مجروش الذرة كانت الأعلى استهلاكا من المادة الجافه وكذلك الأعلى فى معاملات الهضم ودليل الجودة وكذلك الأحماض الدهنية الطيارة والسعة التنظيمية للكرش وبالتالي أظهرت أفضل آداء للحيوان بالمقارنه بالحيوانات المغذاه على دريس البرسيم، مما يدعم نتائج البحث الأول الذى أشار الى أن أفضل معدلات نمو وعائد وكفاءة اقتصادية للحملان النامية تحت ظروف التغيرات الموسمية المحلية في المجاميع المغذاه على سيلاج البرسيم وخاصة المعامل بالذرة المجروشة (م٢) بالمقارنة بتلك المغذاه على دريس البرسيم كمصدر أساسى للعلف الخشن.

قام بتحكيم البحث

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