RUMEN FERMENTATIONS AND RUMEN CILIATE PROTOZOA OF GOAT KIDS FED DIETS WITH DIFFERENT CONCENTRATE: ROUGHAGE RATIO

Hend A. Aziz, M.S. Nassar, H.S. Badway and M.H. Abd Elrahaman

Animal Nutrition Department, Desert Research Center, Cairo, Egypt.

(Received 10/10/2018, accepted 27/11/2018)

SUMMARY

A growth trail was carried out to determine the effect of feeding rations with different levels of concentrate: roughage ratio on rumen development through examining the rumen fermentation and the identification and density of rumen ciliate protozoa for sequence five months. Eighteen early weaned Balady male goats with an average live body weight about 7.58 kg at 60 days age were randomly allocated in three groups (6 lambs each) according to body weight. The three groups were fed starter pelleted consists of different concentrate: roughage ratios (T1; 90:10, T2; 80:20 and T3; 70:30). Results showed that rumen parameters concentration and ruminal ciliate protozoa count were significantly increased (P≤0.01) from the age of 8 weeks till the age of 24 weeks**.** Also, the data indicated that ruminal pH values and ruminal ciliate protozoa count were higher (P≤0.01) before feeding then it decreased at 3 hours post feeding followed by gradually increased, although total volatile fatty acids, ammonia nitrogen, non-protein nitrogen, total nitrogen and true protein nitrogen concentrations reached the highest (P≤0.01) value at 3hr post-feeding then decreased gradually. Seven species of ruminal protozoa were identified in this study, *Entodinum spp* was the most dominant specie. Comparison among the three experimental treatments showed that T3 had the highest (P≤0.01) concentrations of rumen parameters and ruminal ciliate protozoa count during the whole period followed by T2, while T1 had the lowest (P≤0.01) values. So we recommended involving high roughage ratio in goat kids feeding.

Keywords: *goat kids, rumen development, rumen parameters, protozoa.*

INTRODUCTION

Compared with other livestock species, relatively few studies have examined the use of high-concentrate diets for goat production. long-term feeding a high-concentrate diet causes a decreased ruminal pH value due to the accumulation of volatile fatty acids (VFA) and lactic acid, and a chronic digestive disorder known as subacute ruminal acidosis may occur (Chen et al., 2015). Therefore, determining the appropriate concentrate level is one of the most important factors to ensure the growth and health of house-fed yaks.

Examination of rumen parameters gives rapid diagnostic test for monitoring the function of the rumen as well as the nutritional health of the animals. Ruminal pH reflects the rumen acidosis condition, while, ruminal total volatile fatty acids as indicator of ruminal fermentation pattern and energy release in animal body.

Rumen ciliate protozoa play diverse and important roles in ruminal metabolism of nutrients (Williams and Coleman, 1991), they also showed that the many kinds of protozoa present in the rumen have different metabolic function and a different influence on ruminal fermentation, hence, some may be and some may not be beneficial to the ruminant host. Several factors seem to influence the concentration and composition of the protazoal fauna in the rumen; these include composition of diet, ruminal pH, ruminal temperature, turnover rate, frequency of feeding, feeding condition of the host and host species.

The microbiology of the rumen is an extremely complex subject due to the large number of organisms present with their diverse nature, and the shifting population that result from changes in the diet of the host animal. Despite differences observed among ruminants for protozoa numbers (Santra *et al*., 1998; Yanez-Ruiz *et al*., 2004) and the role of protozoa in fiber degradation and N turnover in the rumen (Eugene *et al*.,

2004), information about diurnal variation of rumen protozoa numbers in goats fed different diets is very scarce in the literature.

In view of the considerable differences in development of the ruminant stomach that given concentrate or roughage diets, an experiment was made, therefore, to examine the effect of diets containing different proportions of concentrates to roughages on rumen development through examining rumen parameters and the identification of ruminal protozoa species and their density in early weaned goat kids for sequence five months.

MATERIALS AND METHODS

The experiment was carried out in Ras Sudr experimental research station, desert research center, located in southern Sinai governorate, during the period from May to October, 2015. A growth trail was conducted to investigate the effect of diets containing different proportions of concentrates to roughages on rumen development through examining ruminal pH, total volatile fatty acids, ammonia nitrogen, non-protein nitrogen, total nitrogen and true protein nitrogen concentrations and the identification of ruminal protozoa species and their density (differential and total count) in the rumen liquor of early weaned goat kids for sequence five months.

Management and experimental rations: -

Eighteen early weaned Balady male goats, with an average live body weight 7.58 kg at 60 days age were used in this experiment. Animals were early weaned at 8 weeks age. Different experimental groups were supported by creep feeding ration from 3 weeks until 8 weeks age, besides dam's milk. After weaning lambs depends completely on the starter pelleted ration until 24 weeks age.

Animals were randomly allocated in three groups (6 animal each) according to body weight to use in growth trail lasted for five months from 8 weeks age to 24 weeks age. Animals in the first group (T1) were offered starter pelleted consists of 90 % concentrate and 10% roughage (T1, 90:10). The second group (T2) fed on starter pelleted consists of 80 % concentrate and 20% roughage (T2, 80:20). The third group (T3) was fed on starter pelleted consists of 70 % concentrate and 30% roughage (T3, 70:30). Berseem hay was the only roughage source.

Experimental rations were isonitrogenous and isocaloric and formulated to contain (14 %DP and 67 % TDN). Rations were offered to animals ad libtum in pelleted from 4mm screen with different ratios (Table 1). Animals were kept in semi-opend pens, the offered and the refusales were weighted daily, while water was freely available all the day time. This experiment lasted for five months.

Table (1): Composition of ingredient feed rations (%) used for lambs during the whole period:-

Ingredient	T1	T2	T3
Yellow corn	39	45	49
Soybean meal	12	14	15
Wheat bran	31	13	0
Berseem hay	10	20	30
Molasses	5	5	3
Limestone	1.5	1.5	1.5
Sodium chloride	1	1	1
Mineral mixture and vitamin	0.5	0.5	0.5
Total	100	100	100
CP	14.40	14.30	14.26
%TDN	67.23	66.99	66.47

(T1) starter pelleted consists of 90 % concentrate and 10% roughage (T1, 90:10).
(T2) starter pelleted consists of 80 % concentrate and 20% roughage (T2, 80:20).
(T3) starter pelleted consists of 70 % concentrate and 30% roughage (T3, 70:30

Chemical analysis:-

Chemical analysis of feed samples were carried out according to the A.O.A.C. (1990) in Animal Nutrition Laboratory of Desert Research Center. Neutral detergent fiber (NDF), acid detergent fiber (ADF) and acid detergent lignin (ADL) were determined according to the procedures of Goering and Van Soest (1982).

Rumen liquor analysis: -

Rumen liquor samples were obtained every 4 weeks from 6 animals from each group using stomach tube at zero time (before feeding), 3, 6 and 8 hours post feeding and filtered through two layers of gauze cloth to remove feed particles. pH was immediately measured with pH meter, then 1 ml toluene and 1ml paraphen oil were added to the strained ruminal fluid and stored in deep freeze at (-20^{o}C) until analysis. Value of pH in the rumen liquor was determined as described by the pH meter model the pHep. Ammonia nitrogen concentration (NH3-N) was determined according to A.O.A.C (1990), the total volatile fatty acids (TVFA's) was determined according to Warner (1964), total nitrogen (TN) and non-protein nitrogen (NPN) were determined by the modified semi-micro-kjeldahl digestion method according to A.O.A.C (1990). True protein nitrogen (TP) was calculated by subtracting the non-protein nitrogen content from total nitrogen content.

Ruminal ciliate protozoa count and classification: -

The number of rumen protozoa per 1 ml from rumen liquor and classification of the types of rumen protozoa were determined every 4 weeks in rumen liquor samples at zero time (before feeding), 3, 6 and 8 hours post feeding. The collected contents were immediately flittered through one layer of gauze, then fixed and stained with 4 times volume of methyl-green formalin saline solution as described by Ogimoto and Imai (1981) (100 ml formaldehyde 35 % ,900 ml distill water , methyl-green 0.6 g and sodium chloride 0.8 g), then stoked in dark place until examination.

After gentle mixing of fixed rumen liquor sample, one drop was poured on hemocytometer slide, covered with a cover slip and examined under a light microscope for identification of genera and species according to the description published by Dehority (1993).

The number of rumen protozoa per 1ml was calculated as follow:

Calculation: - number of protozoa /1 ml rumen liquor = N*5*10*4

Where:- N = count the number of protozoa in one large corner square of White Blood Cell.

Statistical analysis: -

General linear model procedure was used for statistical analysis through SAS software (SAS, 2002), the used design was two-way analysis, and the model was: -

$$Y_{iej} = \mu + T_i + M_e + I_j + TM_{ie} + TI_{ij} + e_{iej}$$

Where: - Y_{iej} = experimental observation

μ = general mean

T_i = effect of treatment (i = 1, 2, 3)

M_e = effect of age (e = 8, 12, 16, 20, 24 weeks)

I_j = effect of time of sampling (j=0, 3, 6, 8)

TM_{ie} =effect of interaction of treatment and age

TI_{ij}=effect of interaction of treatment and time of sampling

e_{ij} = experimental error

Duncan's multiple tests were applied for comparison of means (Duncan, 1955).

RESULTS AND DISCUSSION

Chemical composition:-

The data of chemical composition of the three experimental rations are insulated in Table (2), it was important to show that T3 had the lowest value of organic matter, although it had the highest value of crude fiber and its fraction.

Table (2): Chemical composition of experimental rations:

	Experimental treatments		
Items	T1	T2	T3
Chemical composition (%):			
DM	92.89	92.99	93.15
OM	90.02	90.49	89.54
Ash	9.97	9.51	10.45
EE	3.17	3.81	3.47
CP	13.75	13.04	12.63
CF	7.62	9.50	11.75
NFE	65.48	64.14	61.69
Cell wall constituents (%):			
NDF	33.88	37.2	39.56
ADF	11.24	13.45	15.12
ADL	2.41	3.3	4.5
Cellulose	8.83	10.15	10.62
Hemicellulose	22.64	23.75	24.44

(T1) starter pelleted consists of 90 % concentrate and 10% roughage (T1, 90:10).
(T2) starter pelleted consists of 80 % concentrate and 20% roughage (T2, 80:20).
(T3) starter pelleted consists of 70 % concentrate and 30% roughage (T3, 70:30).

Feed intake and body weight:

The data of Table (3) indicated that total feed intake (kg/h) as total dry matter or total TDN and total DCP intake were significantly ($P \leq 0.01$) affected by treatments during the whole period. Data of feed intake (kg/h) as dry matter intake indicated that T3 contained 70:30% concentrate to roughage ratio recorded the lowest ($P \leq 0.01$) intake of dry matter followed by T1 contained 90:10%, while T2 contained 80:20% concentrate to roughage ratio had the greatest ($P \leq 0.01$) values during the whole period. As for total feed intake as total TDN and total DCP (kg/h), it seems that T2 and T3 had higher values more than T1, although the difference between T2 and T3 was not significant.

These results can be supported by Papi *et al*. (2010) who stated that dry matter intake was decreased linearly ($P<0.001$) as concentrate level increased in the diet. However, Murphy *et al*., (2000) noted that cows fed 30:70 diets of F: C ratio had a significantly higher DMI than cows fed 50:50 diets.

The initial body weight was almost the same for all groups with no significant difference; however, the finial body weight was significantly differed ($P \leq 0.01$). It seems that T3 had the highest ($P \leq 0.01$) live body followed byT2 then T1, although the difference between T3 and T2 was not significant ($P \geq 0.01$), also the difference between T2 and T1 was not significant ($P \leq 0.01$).Similar results were found by Badway *et al*., (2013) who fed sheep lamps the same diets, they found a decrease in feed intake and an increase in live body weight with low concentrate: roughage ratio. Also, Chen et al., (2015) fed goats treatments contained four forage to concentrate ratios (on dry matter [DM] basis): A (70:30), B (60:40), C (50:50), D (40:60). They found that experimental treatments influenced final BW, DMI, ADG ($p<0.05$), the C and D group increased ($p<0.05$) DMI, ADG and feed efficiency compared with the treatments of A and B, respectively.

Table (3): Effect of experimental treatments on total feed intake and body weight:-

Item	Experimental treatment			
	T1	T2	T3	±SE
Number of animals	6	6	6	
Total Feed intake kg/h**:**				
Total DMI kg/h	91.89^{b}	92.69^{a}	90.66^{c}	0.002
Total TDN kg/h	77.32^{b}	79.89^{a}	79.45^{a}	0.002
Total DCP kg/h	4.82^{b}	5.30^{a}	5.70^{a}	0.002
Body weight kg/h**:**				
Initial body weight kg/h	7.40	7.49	7.85	0.608
final body weight kg/h	17.41^{b}	17.82^{ab}	18.32^{a}	0.799
Body weight gain Kg/h	10.01	10.33	10.46	0.645

Means with different litters with each row are significantly different (P<0.01).

Rumen liquors parameters: -

Data of ruminal parameters values of the different experimental treatments are illustrated in Tables (4, 5, 6, 7, 8 & 9). The data of overall means in Table (4) indicated that ruminal parameters concentration were significantly (P≤0.01) affected by age from 8 to 24 weeks of age. Comparison among the five months of age showed that ruminal pH, total volatile fatty acids, ammonia nitrogen, non-protein nitrogen, total nitrogen and true protein nitrogen concentrations were significantly increased (P≤0.01) from the first month till the fifth month, as that lower (P≤0.01) values were shown at 8 weeks age while higher values were found at 24 weeks age except for ruminal pH values that were higher at 20 weeks age more than at 24 weeks age. The values of ruminal pH ranged between 5.62 and 6.74. Total volatile fatty acids values ranged between 6.89 and 9.62 mg %. Ammonia nitrogen ranged between 8.69 and 14.31mg %. Non-protein nitrogen concentration ranged between 16.26 and 23.90 mg %. Total nitrogen concentration ranged between 31.20 and 44.22 mg %.and true protein nitrogen concentration ranged between 14.94 and 20.31 mg %.

Table (4): Over all mean of ruminal parameters of goat groups as affected by age for the whole period.

Item	8 weeks	12 weeks	16 weeks	20 weeks	24 weeks	±SE
PH	5.62^{e}	5.82^{d}	6.47^{c}	6.74^{a}	6.62^{b}	0.014
TVFA's mg %	6.89^{e}	8.00^{d}	8.20^{c}	9.26^{b}	9.62^{a}	0.029
Ammonia-N mg %	8.69^{e}	10.04^{d}	11.44^{c}	13.26^{b}	14.31^{a}	0.031
NPN mg %	16.26^{e}	17.57^{d}	19.68^{c}	22.47^{b}	23.90^{a}	0.053
Total nitrogen mg %	31.20^{e}	32.50^{d}	36.42^{c}	41.58^{b}	44.22^{a}	0.099
True protein mg %	14.94^{d}	14.93^{d}	16.73^{c}	19.10^{b}	20.31^{a}	0.045

Means with different litters with each row are significantly different (P<0.01).

The data of overall means in Table (5) indicated that ruminal parameters values were significantly (P≤0.01) affected by experimental treatments. Comparison among the three experimental treatments showed

Table (5): Overall mean of ruminal parameters of all treatments of goat groups for the whole period:-

Item	T1	T2	T3	±SE
PH	5.92^{c}	6.27^{b}	6.57^{a}	0.011
TVFA's mg %	8.05^{c}	8.37^{b}	8.75^{a}	0.023
Ammonia-N mg %	11.07^{c}	11.51^{b}	12.05^{a}	0.024
NPN mg %	19.17^{c}	19.92^{b}	20.84^{a}	0.041
Total nitrogen mg %	35.69^{c}	37.08^{b}	38.79^{a}	0.076
True protein mg %	16.52^{c}	17.15^{b}	17.94^{a}	0.035

Means with different litters with each row are significantly different (P<0.01).

that T3 had the highest (P≤0.01) ruminal pH, total volatile fatty acids, ammonia nitrogen, non-protein nitrogen, total nitrogen and true protein nitrogen concentrations followed by T2, while T1 had the lowest (P≤0.01) concentrations.

In accordance to previous researches present results are in agree with Manatbay *et al*. (2014) who reported that lower F:C ratios of substrates significantly increased NH3-N and total VFA concentration compared with the higher forage substrates. Inversion, Carro *et al*., (2000); Agle *et al*., (2010); Aguerre *et al*., (2011) and , Chen *et al*., (2015) showed that F:C ratios did not significantly affect NH3-N and total VFA concentrations in the rumen.

The data of overall means in Table (6) showed the values of ruminal parameters concentrations as affected by sampling time. The data of overall means of ruminal pH at the different sampling times clearly showed that the ruminal pH values were higher (P≤0.01) before feeding then it decreased at 3 hours post feeding then it gradually increased again. The highest value (P≤0.01) was at 8 hours post feeding (6.76) followed by zero time before feeding (6.59), whereas, the lowest one (P≤0.01)was recorded at 3hr post-feeding (5.71). This can be related to ruminal fermentation process by rumen microorganisms which took place on the soluble carbohydrates very soon producing more propionate, decreasing pH value. While fermentation of the structural carbohydrates needs more time producing more acetate delaying the decreased pH value. These results are in agreement with those obtained by El-Ashry *et al*., (1997) who reported that the minimum pH values were observed at 3hrs post feeding (ranged between 6.29 and 6.83) and tended to increase at 6 hrs post feeding. The reduction of rumen pH after feeding could be attributed to the major role of protozoa in slowing down the fermentation by ingesting starch grains and taking up soluble sugars and converting them to storage polysaccharides (Williams and Coleman, 1991).

The overall means of ruminal parameters concentrations at the different sampling times in Table (6) clearly showed an increase (P≤0.01) in total volatile fatty acids, ammonia nitrogen, non-proteins nitrogen, total nitrogen and true protein nitrogen concentrations, reached the highest (P≤0.01) value at 3hr post-feeding then decreased gradually at 6 hours post feeding and at 8 hours post feeding to reach the lowest values (P≤0.01) at zero time pre feeding. These results are in agreement with those obtained by El-Ashry *et al*., (1997) who reported that the maximum concentration of total VFA's were observed at 3hrs post feeding then decreased after 6 hrs. Elliott and Read (1968) showed that different roughage percents in the ration (5, 20, 25 or 50%) gave wide differences in molar proportions of VFA. Moreover, acetic acid percentage was increased from 38 to 60% when roughage increased from 5 to 50%.

The present results indicate that TVFA's showed a reverse trend of pH thus the rumen pH in general decreased with increasing the TVFA's concentration. Also, Fouad, (1991) concluded that the rumen pH in general was decreased with increasing the TVFA's concentration in lambs rumen. Variation in rumen pH might be responsible for the changes in other ruminal metabolites. He found that the changes in the rumen pH affected microorganisms activates and consequently the mutability concentrations.

Table (6): Overall mean of ruminal parameters as affected by time of sampling of goat groups for the whole period:-

Item	0 hour	3 hours	6 hours	8 hours	±SE
PH	6.59^{b}	5.71^{d}	5.96^{c}	6.76^{a}	0.013
TVFA's mg %	7.57^{d}	9.51^{a}	8.39^{b}	8.09^{c}	0.026
Ammonia-N mg %	10.72^{d}	12.47^{a}	11.72^{b}	11.27^{c}	0.027
NPN mg %	18.54^{d}	21.57^{a}	20.28^{b}	19.51^{c}	0.047
Total nitrogen mg %	34.54^{d}	40.12^{a}	37.75^{b}	36.33^{c}	0.088
True protein mg %	15.99^{d}	18.55^{a}	17.46^{b}	16.81^{c}	0.040

Means with different litters with each row are significantly different (P<0.01).

The data in Table (7) represented the values of ruminal parameters as affected by age of goats and treatments for the whole period. Comparison among the experimental treatments during the whole period indicated that there were a significant (P≤0.01) differences among T1, T2 and T3. As for ruminal pH, it was clear that T3had the highest (P≤0.01) values followed by T2 then T1from 8 weeks to 24 weeks of age, although the difference between T3 and T2 was not significant (P≤0.01) at the age of 12 weeks and 20 weeks. As for total volatile fatty acids, ammonia nitrogen, non-protein nitrogen, total nitrogen and true

protein nitrogen concentrations, showed that T3had the highest (P≤0.01) values followed by T2 then T1 which had the lowest values from 8 weeks to 24 weeks of age. The highest (P≤0.01) value of ruminal pH was for T3at age of 20 weeks (6.99) while the lowest (P≤0.01) value was for T1at age of 8 weeks (5.32). Also, the highest (P≤0.01) values of ruminal total volatile fatty acids, ammonia nitrogen, non-protein nitrogen, total nitrogen and true protein nitrogen concentrations were recorded for T3at age of 24 weeks (10.10, 14.89, 24.88, 46.02 and 21.14 mg / 100 ml RL; respectively), while the lowest (P≤0.01) value were recorded for T1at age of 8 weeks (6.60, 8.21, 15.43, 29.68 and 14.24 mg / 100 ml RL; respectively).

Table (7): Ruminal parameters as affected by age of goats and treatments for the whole period:-

Item	Age	T1	T2	T3	±SE
PH	8 wk	5.32^{c}	5.62^{b}	5.92^{a}	0.025
	12 wk	5.52^{b}	5.82^{a}	5.82^{a}	0.025
	16 wk	6.07^{c}	6.46^{b}	6.88^{a}	0.025
	20 wk	6.36^{b}	6.88^{a}	6.99^{a}	0.025
	24 wk	6.36^{c}	6.59^{b}	6.92^{a}	0.025
TVFA's mg %	8 wk	6.60^{c}	6.89^{b}	7.16^{a}	0.051
	12 wk	7.71^{c}	8.00^{b}	8.27^{a}	0.051
	16 wk	7.88^{c}	8.17^{b}	8.56^{a}	0.051
	20 wk	8.86^{c}	9.26^{b}	9.65^{a}	0.051
	24 wk	9.21^{c}	9.54^{b}	10.10^{a}	0.051
Ammonia-N mg %	8 wk	8.21^{c}	8.65^{b}	9.19^{a}	0.053
	12 wk	9.56^{c}	10.00^{b}	10.54^{a}	0.053
	16 wk	11.09^{c}	11.43^{b}	11.81^{a}	0.053
	20 wk	12.75^{c}	13.19^{b}	13.83^{a}	0.053
	24 wk	13.75^{c}	14.28^{b}	14.89^{a}	0.053
NPN mg %	8 wk	15.43^{c}	16.20^{b}	17.14^{a}	0.092
	12 wk	16.74^{c}	17.51^{b}	18.45^{a}	0.092
	16 wk	19.07^{c}	19.67^{b}	20.31^{a}	0.092
	20 wk	21.62^{c}	22.36^{b}	23.44^{a}	0.092
	24 wk	22.97^{c}	23.85^{b}	24.88^{a}	0.092
Total nitrogen mg %	8 wk	29.68^{c}	31.10^{b}	32.84^{a}	0.171
	12 wk	30.98^{c}	32.40^{b}	34.14^{a}	0.171
	16 wk	35.29^{c}	36.39^{b}	37.58^{a}	0.171
	20 wk	40.00^{c}	41.37^{b}	43.37^{a}	0.171
	24 wk	42.50^{c}	44.13^{b}	46.02^{a}	0.171
True protein mg %	8 wk	14.24^{c}	14.89^{b}	15.69^{a}	0.078
	12 wk	14.23^{c}	14.88^{b}	15.68^{a}	0.078
	16 wk	16.21^{c}	16.72^{b}	17.26^{a}	0.078
	20 wk	18.38^{c}	19.00^{b}	19.93^{a}	0.078
	24 wk	19.52^{c}	20.28^{b}	21.14^{a}	0.078

Means with different litters with each row are significantly different (P<0.01).

The effects of F: C ratios on rumen fermentations in ruminants have been investigated widely, but the results were inconsistent. Several possible explanations exist for this difference. Firstly, it might be due to the rumen ecosystem being able to adapt the appropriate changes of F: C ratios. In addition, feeding the lower F: C ratios (40:60 and 50:50) diets might have near a similar degradation rate between protein and carbohydrate, which then increased the growth yield of ruminal bacteria compared with the higher F: C ratios (60:40 and 70:30) diets as Russell *et al.*, (1992) demonstrated, and hence they had no difference of NH3-N and total VFA concentrations in the rumen.

The data in Table (8) represented the values of ruminal parameters as affected by age of goat groups and time of sampling for the whole period. The values of ruminal pH, total volatile fatty acids, ammonia nitrogen, non-protein nitrogen, total nitrogen and true protein nitrogen concentrations showed gradual increase from the age of 8 weeks till the age of 24 weeks, also, all parameters take the same trend at different sampling times from the age of 8 weeks till the age of 24 weeks. It is clear that ruminal pH values were high (P≤0.01) at zero time before feeding then it decreased (P≤0.01) at 3 hours post feeding then it increased

(P≤0.01) gradually to reach maximum value at 8 hours post feeding. The lowest (P≤0.01) value of ruminal pH was at age of 8 weeks at zero time before feeding, while the highest one was at age of 24 weeks at 8 hours post feeding. In respect of time of sampling, it seems that total volatile fatty acids, ammonia nitrogen, non-protein nitrogen, total nitrogen and true protein nitrogen concentrations were in contrary with pH values, as these parameters increased at 3 hours post feeding then it decreased (P≤0.01) gradually by progressed time of feeding, so the lowest values were recorded at zero time before feeding at the age of 8 weeks, while the highest values were shown at 3 hours post feeding at the age of 24 weeks.

Table (8): Ruminal parameters as affected by age of goat groups and time of sampling for the whole period:-

Item	Age	0 hour	3 hours	6 hours	8 hours	±SE
PH	8 wk	5.81^{b}	5.28^{d}	5.43^{c}	5.96^{a}	0.029
	12 wk	6.01^{b}	5.48^{d}	5.63^{c}	6.16^{a}	0.029
	16 wk	6.85^{b}	5.89^{d}	6.04^{c}	7.11^{a}	0.029
	20 wk	7.16^{b}	6.05^{d}	6.46^{c}	7.31^{a}	0.029
	24 wk	7.11^{b}	5.87^{d}	6.24^{c}	7.25^{a}	0.029
TVFA's mg %	8 wk	5.99^{d}	8.10^{a}	6.84^{b}	6.62^{c}	0.059
	12 wk	7.10^{d}	9.21^{a}	7.95^{b}	7.73^{c}	0.059
	16 wk	7.45^{d}	9.59^{a}	8.05^{b}	7.72^{c}	0.059
	20 wk	8.44^{d}	10.12^{a}	9.40^{b}	9.08^{c}	0.059
	24 wk	8.90^{d}	10.55^{a}	9.72^{b}	9.29^{c}	0.059
Ammonia-N mg %	8 wk	7.38^{d}	9.69^{a}	9.03^{b}	8.64^{c}	0.062
	12 wk	8.73^{d}	11.04^{a}	10.38^{b}	9.99^{c}	0.062
	16 wk	10.86^{d}	12.61^{a}	11.50^{b}	10.80^{c}	0.062
	20 wk	12.76^{d}	14.08^{a}	13.32^{b}	12.86^{c}	0.062
	24 wk	13.87^{d}	14.92^{a}	14.38^{b}	14.07^{c}	0.062
NPN mg %	8 wk	13.97^{d}	18.02^{a}	16.86^{b}	16.18^{c}	0.107
	12 wk	15.28^{d}	19.33^{a}	18.17^{b}	17.49^{c}	0.107
	16 wk	18.68^{d}	21.69^{a}	19.78^{b}	18.58^{c}	0.107
	20 wk	21.64^{d}	23.88^{a}	22.58^{b}	21.80^{c}	0.107
	24 wk	23.16^{d}	24.91^{a}	24.02^{b}	23.50^{c}	0.107
Total nitrogen mg %	8 wk	26.97^{d}	34.46^{a}	32.32^{b}	31.07^{c}	0.198
	12 wk	28.27^{d}	35.76^{a}	33.62^{b}	32.37^{c}	0.198
	16 wk	34.56^{d}	40.13^{a}	36.59^{b}	34.38^{c}	0.198
	20 wk	40.04^{d}	44.18^{a}	41.78^{b}	40.33^{c}	0.198
	24 wk	42.85^{d}	46.09^{a}	44.45^{b}	43.48^{c}	0.198
True protein mg %	8 wk	12.99^{d}	16.44^{a}	15.46^{b}	14.88^{c}	0.091
	12 wk	12.98^{d}	16.43^{a}	15.45^{b}	14.87^{c}	0.091
	16 wk	15.88^{d}	18.44^{a}	16.81^{b}	15.79^{c}	0.091
	20 wk	18.39^{d}	20.29^{a}	19.19^{b}	18.53^{c}	0.091
	24 wk	19.69^{d}	21.18^{a}	20.42^{b}	19.98^{c}	0.091

Means with different litters with each row are significantly different (P<0.01).

The current results of ruminal ammonia may be attributed to the presence of rumen protozoa as they play an important role in the digestion of protein (Euge'ne *et al*., 2004) and the formation of the end products of ruminal fermentation (Ushida and Jouany, 1996). Seng, *et al*., (2001) demonstrated a highly significant reduction of rumen ammonia nitrogen concentration when sheep were defaunated from protozoa. Moreover, Hristove, *et al*., (2001) showed that completely eliminated protozoa reduced ammonia concentration by 60% compared with untreated control in cattle fed medium-or high- concentrate barley based diets.

The values of ruminal parameters for the three goat treatments as affected by time of sampling for the whole period are found in Table (9). The data indicated that ruminal parameters values were significantly (P≤0.01) affected by experimental treatments at different time of sampling. The values showed that T3 had the highest (P≤0.01) ruminal pH, total volatile fatty acids, ammonia nitrogen, non-protein nitrogen, total nitrogen and true protein nitrogen concentrations followed by T2, while T1 had the lowest (P≤0.01) concentrations.

As for ruminal pH it seems that the lowest (P≤0.01) value was recoded for T1at 3 hours post feeding, while the highest (P≤0.01) value was recorded for T3 at 8 hours post feeding. Although, the lowest (P≤0.01) values for the other parameters were recoded for T1at zero time before feeding, while the highest (P≤0.01) value was recorded for T3 at 3 hours post feeding.

Similar results were found by Aziz *et al*., (2012) who fed lambs with the same ratios of concentrate: roughage. They found that the ratio of 30:70 and 20:80 were more efficient in improving ruminal parameters, also, they found that ruminal parameters were affected by time of sampling in the same trend.

Table (9): Ruminal parameters as affected by treatments and time of sampling of goat groups for the whole period:-

Item	Time	T1	T2	T3	±SE
PH	0 h	6.13^{c}	6.30^{b}	7.05^{a}	0.023
	3 h	5.52^{c}	5.75^{b}	5.88^{a}	0.023
	6 h	5.75^{c}	5.97^{b}	6.15^{a}	0.023
	8 h	6.30^{c}	6.78^{b}	7.19^{a}	0.023
TVFA's mg %	0 h	7.40^{c}	7.55^{b}	7.77^{a}	0.046
	3 h	8.95^{c}	9.50^{b}	10.09^{a}	0.046
	6 h	8.04^{c}	8.36^{b}	8.76^{a}	0.046
	8 h	7.81^{c}	8.08^{b}	8.38^{a}	0.046
Ammonia-N mg %	0 h	10.19^{c}	10.71^{b}	11.26^{a}	0.048
	3 h	11.87^{c}	12.43^{b}	13.11^{a}	0.048
	6 h	11.34^{c}	11.65^{b}	12.18^{a}	0.048
	8 h	10.90^{c}	11.27^{b}	11.65^{a}	0.048
NPN mg %	0 h	17.64^{c}	18.52^{b}	19.47^{a}	0.082
	3 h	20.53^{c}	21.49^{b}	22.67^{a}	0.082
	6 h	19.63^{c}	20.15^{b}	21.07^{a}	0.082
	8 h	18.87^{c}	19.50^{b}	20.16^{a}	0.082
Total nitrogen mg %	0 h	32.86^{c}	34.50^{b}	36.25^{a}	0.153
	3 h	38.21^{c}	39.99^{b}	42.17^{a}	0.153
	6 h	36.54^{c}	37.51^{b}	39.21^{a}	0.153
	8 h	35.14^{c}	36.31^{b}	37.53^{a}	0.153
True protein mg %	0 h	15.22^{c}	15.97^{b}	16.77^{a}	0.070
	3 h	17.68^{c}	18.49^{b}	19.49^{a}	0.070
	6 h	16.91^{c}	17.35^{b}	18.14^{a}	0.070
	8 h	16.26^{c}	16.80^{b}	17.36^{a}	0.070

Means with different litters with each row are significantly different (P<0.01).

Ruminal ciliate protozoa count:-

Tables (10, 11, 12, 13, 14 & 15) represented the identification of ruminal protozoa species and their density in the rumen liquor (x104 cell/ml rumen liquor) during all different samples time for the whole period for all treatments. Seven species of ruminal protozoa in goat kids were identified in this study; these species are *Entodinum spp*., *Epidinum spp*., *Diplodinum spp*., *Polyolastron spp*., *Ophryoscolox spp*., *Isotrchia spp.*, and *Dasytrachia spp*.

The data of overall means in Table (10) showed that ruminal ciliate protozoa count was significantly (P≤0.01) affected by age from 8 to 24 weeks of age. Comparison among the five months of age showed that ruminal ciliate protozoa count was significantly increased (P≤0.01) from the first month till the fifth month, as that lower (P≤0.01) values were at 8 weeks of age then increased gradually till reach to higher values at 24 weeks of age. The data clearly showed that *Entodinum spp* was the most dominant specie among all species in rumen fluid of kids at all weeks of age, whereas, *Polyolastron spp* was the rare specie among all species at all weeks of age. While *Epidinum spp* was in the second category followed by *Diplodinum spp* in the third category.

These results are in line with the findings of Franzolin and Dehority (1996) who reported that *Entodinium* constituted approximately 90% of the total protozoal numbers. Also, Ivan *et al*., (2000) reported that

Entodinium was the most detrimental of ciliate protozoa species. Hristove *et al*., (2001) showed that *Entodinum sp*p. made up 89 and 91% of the ciliate protozoal population in cattle fed medium- or high-concentrate barley –based diets. Moreover, Williams and Coleman, (1991) showed that high-concentrate diets may promote greater numbers of *Entodinia*. Also, the proportion of *Holotricha* was less ($P < 0.01$) for high- than low-concentrate diets, likely because the increase in the amount of starch (Dennis *et al*. 1983) and the lesser pH (Williams and Coleman, 1991) with high-concentrate diets may promote greater numbers of *Entodinia* compared with *Holotricha*.

No evidence was indicated the presence of *Diplodinum spp* and *Polyolastron spp* at the age of 8 weeks although other species were start appearance from the age of 8 weeks, as that the first appearance for the two species in rumen fluid of the kids was at 12 weeks of age. This is may be return to ruminal pH of kids at the age of 8 weeks which may be not suitable for the growth of *Diplodinum spp* and *Polyolastron spp* at this age. Similar results found by Aziz *et al*., (2012) who reported no evidence for the presence for *Diplodinum spp* and *Polyolastron spp* at the age of 8 weeks for sheep lambs fed on similar rations.

The values of *Entodinum spp* ranged between 267and 703 $x10^4$ cell/ml RF, *Epidinum spp* ranged between 65and 252$x10^4$ cell/ml RF, *Diplodinum spp* ranged between 23and 124 $x10^4$ cell/ml RF, *Polyolastron spp* ranged between 19and 52 $x10^4$ cell/ml RF, *Ophryoscolox spp* ranged between 20and 94 $x10^4$ cell/ml RF, *Isotrchia spp* ranged between 11 and 53$x10^4$ cell/ml RF, *Dasytrachia spp* ranged between 9 and 68 $x10^4$ cell/ml RF.

As for total ruminal ciliate protozoa count, it was the same trend of all species, as the minimum count was recorded at 8 weeks of age then increased gradually by progressed age till recorded the maximum count at 24 weeks of age, the total ruminal ciliate protozoa count ranged between 373 and 1367 $x10^4$ cell/ml RF.

Table (10): Over all mean of rumen ciliate protozoa count ($x10^4$ cell/ml RF) of goat groups as affected by age for the whole period.

Item	8 weeks	12 weeks	16 weeks	20 weeks	24 weeks	±SE
Entodinum	267.09^{e}	317.09^{d}	352.48^{c}	505.27^{b}	703.05^{a}	6.064
Epidinum	65.41^{e}	95.41^{d}	145.93^{c}	193.61^{b}	252.19^{a}	1.807
Diplodinum	0.000	23.13^{d}	29.13^{c}	83.56^{b}	123.70^{a}	0.554
Polyplastron	0.000	19.50^{d}	24.50^{c}	23.86^{b}	51.97^{a}	0.211
Ophryoscolox	20.52^{e}	24.52^{d}	51.34^{c}	71.97^{b}	93.77^{a}	0.375
Isotrachia	10.73^{e}	13.73^{d}	34.73^{c}	53.40^{b}	73.73^{a}	0.328
Dasytrachia	9.48^{e}	12.48^{d}	32.37^{c}	54.79^{b}	68.54^{a}	0.388
Total count	373.26^{e}	463.26^{d}	670.51^{c}	986.48^{b}	1366.98^{a}	6.634

Means with different litters with each row are significantly different (P<0.01).

The data of overall means in Table (11) represented the effect of treatments on ruminal ciliate protozoa count (cell/ml RF)for the whole period. Ruminal ciliate protozoa count was significantly ($P \leq 0.01$) affected by experimental treatments. Comparison among the three experimental treatments showed that T3 had the highest ($P \leq 0.01$) ruminal ciliate protozoa count for all species frequency and total count followed by T2, while T1 had the lowest ($P \leq 0.01$) frequency of species and the lowest ($P \leq 0.01$) total count. The values of total count were 868.55, 758.53 and 689.21($x10^4$ cell/ml RF) for T3, T2 and T1; respectively.

The present results indicate that diets with concentrate: roughage ratio 70:30% was the best in enhancing the total ruminal protozoa count ($x10^4$ cell/ml rumen liquor) followed by and 80:20% then 90:10% ratio. These results are supported by the results of Dehority and Orpin, (1988) who reported that the diets containing between 40 to 60% concentrate will support maximal protozoa numbers with a diverse fauna containing species in most of the genera. They added that when high or all concentrate diets are fed and ruminal pH decreased below 6.0, the numbers of protozoa decreased and primarily *Entodinium* species were absent.

Table (11): Overall mean of rumen ciliate protozoa count (x10^4 cell/ml RF) of all treatments for the whole period:-

Item	T1	T2	T3	±SE
Entodinum	386.44 ^{c}	421.70 ^{b}	478.86 ^{a}	4.697
Epidinum	131.03 ^{c}	147.64 ^{b}	172.86 ^{a}	1.400
Diplodinum	46.64 ^{c}	51.10 ^{b}	57.98 ^{a}	0.429
Polyplastron	21.39 ^{c}	23.95 ^{b}	26.55 ^{a}	0.164
Ophryoscolox	47.73 ^{c}	51.44 ^{b}	58.11 ^{a}	0.290
Isotrachia	31.75 ^{c}	36.60 ^{b}	43.45 ^{a}	0.254
Dasytrachia	31.90^c	34.63^b	40.07^a	0.301
Total count	689.21^c	758.53^b	868.55^a	5.139

Means with different litters with each row are significantly different (P<0.01).

The data of Table (12) represented the overall means of ruminal ciliate protozoa count at the different sampling times. Data clearly showed that the ruminal ciliate protozoa counts (differential and total) were higher (P≤0.01) before feeding then it decreased at 3 hours post feeding then it gradual increased again at 6 hours post feeding till reached the highest value (P≤0.01) at 8 hours post feeding. So the lowest (P≤0.01) differential and total numbers were at 3 hours post feeding while the highest (P≤0.01) values were at 8 hours post feeding, being 937.43, 787.61, 778.76 and 584.60 (x10^4 cell/ml RF) as total count at 8,6,0and 3 hours of feeding. The data showed non-significant (P≥0.01) difference between the values before feeding and the values at 6 hours post feeding for *Entodinum spp*, *Polyolastron spp*., *Ophryoscolox spp*., *Isotrchia spp.*, *Dasytrachia spp* and total ruminal ciliate protozoa counts.

The decrease of ruminal ciliate protozoa count after feeding can be related to ruminal pH values, as that ruminal pH values decreased directly after feeding according to the release of soluble carbohydrates quickly after feeding producing more propionate. While the gradual increase after 3 hours post feeding may also be related to ruminal pH values at this time, as ruminal pH values increased after 3 hours post feeding according to the release of acetate.

Similar results were found by Aziz *et al*., (2012) who showed that the lowest (P<0.01) differential and total numbers were at 3 hours post feeding while the highest (P<0.01) values were at 8 hours post feeding.

Table (12): Overall mean of rumen ciliate protozoa count (x10^4 cell/ml RF) as affected by time of sampling of goat groups for the whole period:-

Item	0 hour	3 hours	6 hours	8 hours	±SE
Entodinum	436.95^b	347.03^c	437.02^b	495.00^a	5.424
Epidinum	152.55^c	111.23^d	157.41^b	180.85^a	1.616
Diplodinum	51.07^c	33.30^d	52.47^b	70.78^a	0.495
Polyplastron	24.13^b	13.05^c	24.36^b	34.31^a	0.189
Ophryoscolox	52.64^b	35.28^c	53.05^b	68.73^a	0.335
Isotrachia	34.62^b	24.25^c	35.88^b	54.31^a	0.294
Dasytrachia	34.43^b	23.01^c	35.63^b	49.06^a	0.347
Total count	778.76^b	584.60^c	787.61^b	937.43^a	5.934

Means with different litters with each row are significantly different (P<0.01).

Ruminal ciliate protozoa counts as affected by age of goats and treatments for the whole period are shown in Table (13). Comparison among the experimental treatments during the whole period indicated that there was a significant (P≤0.01) difference among treatments.

It was clear that T3had the highest (P≤0.01) values followed by T2 then T1from 8 weeks till 24 weeks of age. The highest (P≤0.01) values of all species and total count were for T3 at age of 24 weeks, being 1513.04 x10^4 cell/ml RF as the highest total count. While the lowest (P≤0.01) values were found for T1at age of 8 weeks being 322.54 x10^4 cell/ml RF as the lowest total count. It is interesting to note that the highest numerically concentrations of TVFA's, were found at 24 weeks of age of kids, which coincided with the highest number of ruminal protozoa. These VFA and ammonia are used by ruminal protozoa to produce

microbial protein to build its bodies and increasing its numbers, this process stimulates the development of rumen of these lambs. Higher total nitrogen, true protein, NPN and ammonia concentrations in the rumen of lambs fed diets with concentrate: roughage ratio 80:20% and 70:30% may be attributed of higher rumen microbial population, mainly rumen ciliate protozoa, contributing to rumen microbial protein synthesis.

Table (13): Rumen ciliate protozoa count (x10^4 cell/ml RF) as affected by age of goats and treatments for the whole period:-

Item	Age	T1	T2	T3	±SE
Entodinum	8 wk	242.29^{c}	265.75^{b}	293.25^{a}	10.504
	12 wk	292.29^{c}	315.75^{b}	343.25^{a}	10.504
	16 wk	314.54^{c}	341.91^{b}	401.00^{a}	10.504
	20 wk	436.50^{c}	490.50^{b}	588.83^{a}	10.504
	24 wk	646.58^{c}	694.58^{b}	768.00^{a}	10.504
Epidinum	8 wk	48.20^{c}	66.08^{b}	81.95^{a}	3.130
	12 wk	78.20^{c}	96.08^{b}	111.95^{a}	3.130
	16 wk	124.95^{c}	146.58^{b}	166.25^{a}	3.130
	20 wk	178.25^{c}	190.70^{b}	211.87^{a}	3.130
	24 wk	225.54^{c}	238.75^{b}	292.29^{a}	3.130
Diplodinum	8 wk	0.00	0.00	0.00	0.960
	12 wk	21.45^{c}	23.08^{b}	24.87^{a}	0.960
	16 wk	27.45^{c}	29.08^{b}	30.87^{a}	0.960
	20 wk	71.83^{c}	80.95^{b}	97.91^{a}	0.960
	24 wk	112.45^{c}	122.41^{b}	136.25^{a}	0.960
Polyplastron	8 wk	0.000	0.000	0.000	0.367
	12 wk	16.91^{c}	19.70^{b}	21.87^{a}	0.367
	16 wk	21.91^{c}	24.70^{b}	26.87^{a}	0.367
	20 wk	20.87^{c}	23.29^{b}	27.41^{a}	0.367
	24 wk	47.25^{c}	52.08^{b}	56.58^{a}	0.367
Ophryoscolox	8 wk	17.45^{c}	19.91^{b}	24.20^{a}	0.650
	12 wk	21.45^{c}	23.91^{b}	28.20^{a}	0.650
	16 wk	46.91^{c}	51.58^{b}	55.54^{a}	0.650
	20 wk	66.37^{c}	70.16^{b}	79.37^{a}	0.650
	24 wk	86.45^{c}	91.62^{b}	103.25^{a}	0.650
Isotrachia	8 wk	7.66^{c}	10.41^{b}	14.12^{a}	0.569
	12 wk	10.66^{c}	13.41^{b}	17.12^{a}	0.569
	16 wk	26.04^{c}	34.79^{b}	43.37^{a}	0.569
	20 wk	49.79^{c}	52.37^{b}	58.04^{a}	0.569
	24 wk	64.58^{c}	72.04^{b}	84.58^{a}	0.569
Dasytrachia	8 wk	6.91^{c}	8.29^{b}	13.25^{a}	0.673
	12 wk	9.91^{c}	11.29^{b}	16.25^{a}	0.673
	16 wk	27.41^{c}	30.66^{b}	30.66^{a}	0.673
	20 wk	50.66^{c}	53.95^{b}	59.75^{a}	0.673
	24 wk	64.58^{c}	68.95^{b}	72.08^{a}	0.673
Total count	8 wk	322.54^{c}	370.45^{b}	426.79^{a}	11.491
	12 wk	412.54^{c}	460.45^{b}	516.79^{a}	11.491
	16 wk	589.25^{c}	659.33^{b}	762.95^{a}	11.491
	20 wk	874.29^{c}	961.95^{b}	1123.20^{a}	11.491
	24 wk	1247.45^{c}	1340.45^{b}	1513.04^{a}	11.491

Means with different litters with each row are significantly different (P<0.01).

Data of Table (14) represented the values of ruminal ciliate protozoa count as affected by age of goat groups and time of sampling for the whole period. The values of differential species and total count showed gradual increase from the age of 8 weeks till the age of 24 weeks. It seems that ruminal ciliate protozoa count take the same trend at different sampling times from the age of 8 weeks till the age of 24 weeks, as that all the differential species and total count were high (P≤0.01) at zero time before feeding then it

decreased (P≤0.01) at 3 hours post feeding then it increased (P≤0.01) gradually to reach maximum value at 8 hours post feeding. The lowest (P≤0.01) values of differential species and total count were recorded at age of 8 weeks at 3 hours post feeding, while the highest (P≤0.01) values were shown at age of 24 weeks at 8 hours post feeding.

Table (14): Rumen ciliate protozoa count (x10^4 cell/ml RF) as affected by age of goat treatments and time of sampling for the whole period:-

Item	Age	0 hour	3 hours	6 hours	8 hours	±SE
Entodinum	8 wk	268.66^{c}	198.66^{d}	272.88^{b}	328.16^{a}	12.12
	12 wk	318.66^{c}	248.66^{d}	322.88^{b}	378.16^{a}	12.12
	16 wk	362.61^{c}	281.22^{d}	347.94^{b}	418.16^{a}	12.12
	20 wk	517.83^{c}	416.33^{d}	521.11^{b}	565.83^{a}	12.12
	24 wk	717.00^{c}	590.27^{d}	720.27^{b}	784.66^{a}	12.12
Epidinum	8 wk	65.27^{c}	35.38^{d}	74.94^{b}	86.05^{a}	3.614
	12 wk	95.27^{c}	65.38^{d}	104.94^{b}	116.05^{a}	3.614
	16 wk	142.94^{c}	115.66^{d}	150.11^{b}	175.00^{a}	3.614
	20 wk	194.55^{c}	150.66^{d}	201.77^{b}	227.44^{a}	3.614
	24 wk	264.72^{c}	189.05^{d}	255.27^{b}	299.72^{a}	3.614
Diplodinum	8 wk	0.000	0.000	0.000	0.000	1.108
	12 wk	19.16^{c}	6.16^{d}	21.27^{b}	45.94^{a}	1.108
	16 wk	25.16^{c}	12.16^{d}	27.27^{b}	51.94^{a}	1.108
	20 wk	83.27^{c}	52.55^{d}	85.33^{b}	113.11^{a}	1.108
	24 wk	127.77^{c}	95.61^{d}	128.50^{b}	142.94^{a}	1.108
Polyplastron	8 wk	0.000	0.000	0.000	0.000	0.423
	12 wk	19.11^{c}	6.72^{d}	19.94^{b}	32.22^{a}	0.423
	16 wk	24.11^{c}	11.72^{d}	24.94^{b}	37.22^{a}	0.423
	20 wk	23.38^{c}	11.38^{d}	24.38^{b}	36.27^{a}	0.423
	24 wk	54.05^{c}	35.44^{d}	52.55^{b}	65.83^{a}	0.423
Ophryoscolox	8 wk	20.00^{c}	7.94^{d}	21.11^{b}	33.05^{a}	0.750
	12 wk	24.00^{c}	11.94^{d}	25.11^{b}	37.05^{a}	0.750
	16 wk	52.88^{c}	36.33^{d}	51.33^{b}	64.83^{a}	0.750
	20 wk	72.11^{c}	51.16^{d}	73.50^{b}	91.11^{a}	0.750
	24 wk	94.22^{c}	69.05^{d}	94.22^{b}	117.61^{a}	0.750
Isotrachia	8 wk	8.38^{c}	4.27^{d}	10.83^{b}	19.44^{a}	0.657
	12 wk	11.38^{c}	7.27^{d}	13.83^{b}	22.44^{a}	0.657
	16 wk	34.05^{c}	20.16^{d}	35.27^{b}	49.44^{a}	0.657
	20 wk	50.94^{c}	37.83^{d}	51.72^{b}	73.11^{a}	0.657
	24 wk	68.33^{c}	51.72^{d}	67.77^{b}	107.11^{a}	0.657
Dasytrachia	8 wk	7.72^{c}	3.55^{d}	9.05^{b}	17.61^{a}	0.777
	12 wk	10.72^{c}	6.55^{d}	12.05^{b}	20.61^{a}	0.777
	16 wk	31.44^{c}	19.22^{d}	33.38^{b}	45.44^{a}	0.777
	20 wk	53.66^{c}	38.22^{d}	53.11^{b}	74.16^{a}	0.777
	24 wk	68.61^{c}	47.50^{d}	70.55^{b}	87.50^{a}	0.777
Total count	8 wk	370.05^{c}	249.83^{d}	388.83^{b}	484.33^{a}	13.269
	12 wk	460.05^{c}	339.83^{d}	478.83^{b}	574.33^{a}	13.269
	16 wk	673.22^{c}	496.50^{d}	670.27^{b}	842.05^{a}	13.269
	20 wk	995.77^{c}	758.16^{d}	1010.94^{b}	1181.05^{a}	13.269
	24 wk	1394.72^{c}	1078.66^{d}	1389.16^{b}	1605.38^{a}	13.269

Means with different litters with each row are significantly different (P<0.01).

The progressive decrease of ciliate protozoa in the rumen after feeding has been widely described and ascribed to sequestration of *Entodiniomorphida* and also to the dilution effect of saliva influx and passage rate (Dehority, 2003). Also, Bhatia *et al*., (1992) indicated that total protozoa counts in rumen of camels were decreased 3 hrs after feeding and increased significantly 6 hrs post-feeding. Total protozoa numbers

were similar to values obtained by Yanez-Ruiz et al. (2004) in goats fed mixed diets with concentrate and roughage.

The values of ruminal ciliate protozoa counts for the three goat treatments as affected by time of sampling for the whole period are shown in Table (15). A significant (P≤0.01) difference was detected for different differential species and total count due to experimental treatments at different times of sampling.

The data showed that T3 had the highest (P≤0.01) values of differential species and total count at different sampling times (zero, 3, 6 and 8 hours of feeding) followed by T2, while T1 had the lowest (P≤0.01) values, except for *Entodinum spp* count before feeding. It seems that the lowest (P≤0.01) value was recoded for T2 while the highest (P≤0.01) value was recorded for T1, this may be related to the ability of *Entodinum spp* to tolerate lower ruminal pH.

Table (15): Rumen ciliate protozoa count (x10^4 cell/ml RF) as affected by treatments and time of sampling of goat groups for the whole period:-

Item	Time	T1	T2	T3	±SE
Entodinum	0 h	450.60^b	430.43^c	486.16^a	9.395
	3 h	308.73^c	342.36^b	390.00^a	9.395
	6 h	392.16^c	428.40^b	490.50^a	9.395
	8 h	392.16^c	485.60^b	548.80^a	9.395
Epidinum	0 h	133.03^c	152.46^b	172.16^a	2.800
	3 h	95.26^c	110.43^b	128.00^a	2.800
	6 h	138.40^c	153.83^b	180.00^a	2.800
	8 h	157.43^c	173.83^b	211.30^a	2.800
Diplodinum	0 h	45.83^c	50.66^b	56.73^a	0.858
	3 h	28.53^c	32.26^b	39.10^a	0.858
	6 h	48.00^c	51.60^b	57.83^a	0.858
	8 h	64.20^c	69.90^b	78.26^a	0.858
Polyplastron	0 h	21.43^c	24.60^b	26.36^a	0.328
	3 h	10.76^c	13.26^b	15.13^a	0.328
	6 h	22.50^c	23.83^b	26.76^a	0.328
	8 h	30.86^c	34.13^b	37.93^a	0.328
Ophryoscolox	0 h	47.40^c	52.66^b	57.86^a	0.581
	3 h	31.46^c	34.76^b	39.63^a	0.581
	6 h	48.36^c	51.70^b	59.10^a	0.581
	8 h	63.70^c	66.63^b	75.86^a	0.581
Isotrchia	0 h	29.20^c	33.93^b	40.73^a	0.509
	3 h	21.30^c	23.23^b	28.23^a	0.509
	6 h	30.46^c	35.70^b	41.50^a	0.509
	8 h	46.03^c	53.56^b	63.33^a	0.509
Dasytrachia	0 h	29.93^c	34.33^b	39.03^a	0.602
	3 h	20.93^c	22.83^b	25.26^a	0.602
	6 h	31.96^c	35.10^b	39.83^a	0.602
	8 h	44.76^c	46.26^b	56.16^a	0.602
Total count	0 h	694.30^c	771.33^b	870.66^a	10.278
	3 h	515.20^c	576.56^b	662.03^a	10.278
	6 h	704.10^c	771.93^b	886.80^a	10.278
	8 h	843.26^c	914.30^b	1054.73^a	10.278

Means with different litters with each row are significantly different (P<0.01).

Similar results were found by Cantalapiedra-Hijar *et al*., (2014) who stated that total protozoa numbers were affected (P <0.001) by roughage to concentrate ratio, and they also were different (P < 0.001) among diets across time.

The linear increase in rumen ciliate protozoa at 6 hrs post feeding could be ascribed to migration of rumen protozoa from the rumino-reticular fold to the rumen. It is established that the rumen protozoa

sequester to the rumen medium in response to chemical stimuli originating from the diet (Kamra *et al*., 1991).

It is interesting to note involving high roughage feeding for goat kids decreased total feed intake and developed normal rumen function characteristic. It was hypothesized that the early establishment of microorganisms would enhance rumen digestion and synthesis when high roughage rations were fed. Better fermentation of feed in the rumen of goat kids fed diets with concentrate: roughage ratio 80:20% and 70:30% could be ascribed to their higher rumen protozoa count as ciliate protozoa that play a significant role in degradation of nutrients in the rumen.

Also, it is interesting to note that concentrate: roughage ratio 70:30% improved ruminal fermentation more than other rations, which indicated that the ratio of 70:30% concentrate: roughage in the rations is the best ratio for goat kids from the age of two months till the age of six months.

The improvement in ruminal fermentation or the ratio of 70:30% concentrate: roughage may be due to the highest density of *Entodinum spp* (which is ferment cellulose and protein), *Diplodinum spp* and *Polyolastron spp* (which is ferment cellulose, especially that *Polyolastron spp* can digest 50% of cellulose in the rumen) and *Dasytrachia spp* (which is ferment volatile fatty acids) (Hungate, 1966), this improvement in rumen functions may lead to high live body weight.

CONCLUSION

Increasing roughage ratio in diets for goat kids, especially the ratio of 70:30% concentrate: roughage decreased total feed intake and increased live body weight, thus this ratio may use to reduce the cost of feeding. Also, this ratio enhances the fermentation of rumen parameters such that it had improved ruminal pH, increased ruminal total volatile fatty acids, ammonia nitrogen, non-protein nitrogen, total nitrogen and true protein nitrogen concentration. Also, it increased deferential and total count of rumen ciliate protozoa. These improvements in rumen fermentation may be expected to be reveres on rumen development in young kids. So we recommended involving high roughage ratio (70:30) in goat kids feeding.

REFERENCES

Agle M., A.N. Hristov, S. Zaman, C. Schneider, P. M. Ndegwa, Vaddella V.K. (2010). Effect of dietary concentrate on rumen fermentation, digestibility, and nitrogen losses in dairy cows. J Dairy Sci. 93:4211–4222.

Aguerre MJ., MA. Wattiaux, JM. Powell, GA. Broderick, C. Arndt (2011). Effect of forage-to-concentrate ratio in dairy cow diets on emission of methane, carbon dioxide, and ammonia, lactation performance, and manure excretion. J Dairy Sci. 94:3081–3093.

A.O.A.C. (1990). Official methods of analysis of the Association of Official Agricultural Chemists. Washington. D.C., USA.

Aziz, Hend A., H.S. Badway, M.S.Nassar and M.H. Abd Elrahaman (2012). Rumen fermentations, rumen ciliate protozoa and some blood parameters in early weaned lambs fed diets with different concentrate: roughage ratio. Egyptian J. Nutrition and Feeds, 15 (1): 31-48

Badway, H.S, M.S.Nassar, Hend A. Aziz and M.H. Abd Elrahaman (2013). Lambs performance, digestibility, nitrogen balance, water utilization and carcass characteristics in early weaned lambs fed diets with different concentrate: roughage ratio. Egyptian J. Nutrition and Feeds, 16 (1): 225-241.

Bhatia, J.S; A.K.Ghosal; W.R.Allen,; A. J.Higgins,; I.G. Mayhew,; D.H. Snow, and J.F. Wade, (1992). Studies on fermentation in the camel (camelus dromedaries). Proc. Of first inter. Camle conf., Dubai, 2-6 Th Feb., 1992, 271-274.

Cantalapiedra-Hijar G., D. R. Yanez-Ruiz, A. I. Martin-Garcia, and E. Molina-Alcaide (2014). Effects of forage:concentrate ratio and forage type on apparent digestibility, ruminal fermentation, and microbial growth in goats. J Anim Sci.87:622-631.

Carro, M. D., C. Valdes, M. J. Ranilla, and J. S. Gonzalez (2000). Effect of forage to concentrate ratio in the diet on ruminal fermentation and digesta flow kinetics in sheep. Anim. Sci.70:127–134.

Chen, G. J. , S. D. Song, B. X. Wang, Z. F. Zhang, Z. L. Peng, C. H. Guo*, J. C. Zhong, Y. Wang (2015). Effects of Forage:Concentrate Ratio on Growth Performance, Ruminal Fermentation and Blood Metabolites in Housing-feeding Yaks. Asian-Australasian J. of Anim. Sci. 28(12): 1736-1741.

Dennis, S. M., M. J. Arambel, E. E. Bartley, and A. D. Dayton.(1983). Effect of energy concentration and source of nitrogen on numbers and types of rumen protozoa. J. Dairy Sci. 66:1248–1254.

Duncan, D.B. (1955). Multiple range and multiple F-test. Biometrics. 11:1-42.

Dehority, B. A., (1993). Laboratory Manual for classification and Morphology of rumen ciliate protozoa. CRC. Press Inc., Florida.

Dehority, B. A. (2003). Rumen Microbiology. Nottingham Univ. Press, Nottingham, UK.

Dehority, B. A., and C. G. Orpin (1988). Development of natural fluctuations in, rumen microbial populations. In: P.N. Hoboson (Ed.) The Rumen Microbia Ecosystem. PP. 151- 183. Elsevier Science, London.

El-Ashry, M.A.; M.F. Ahmed; S.A. El-Saadany; M.E.S. Youssef; I.A. Gommaa and T.A.A. Deraz (1997). Effect of mechanical vs. mechano-chemical or mechano-biochemical treatments of crop residues on their use in ruminant rations: Digestibility, nitrogen balance and some blood and rumen liquor parameters of sheep. Egyptian J. Nutrition and feeds, 1: (Special Issue): 173-186.

Elliott, R.C. and W.D.C. Read (1968). Studies of high concentrate diets for cattle. 1. Growth and food intake of steers fed on diets containing different levels of low quality roughage. S. African J. Agr. Sci., 11: 713.

Euge'ne, M., H. Archimed and D. Sauvant, (2004). Quantitiative meta-analysis on effects of defaunation of the rumen on growth, intake and digestion in ruminants. Livestock Production Science, 85:81-97.

Fouad, R.T. (1991). Effect of some mechanical treatments and feed additives on the nutritional value of corn stalks. M.Sc. Thesis, Fac. Of Aric., Al-Azhar Univ.

Franzolin, R. and B. A. Dehority, (1996). Effect of Prolonged High-concentrate feeding on Ruminal protozoa concentration. J. Anim. Sci. 74: 2803-2809.

Hristove, A. N., M.Ivan, L.M. Rode, and T.A. McAllister, (2001). Fermentation characteristics and ruminal ciliate protozoal populations in cattle fed medium- or high- concentrate barley –based diets. J. Anim. Sci. 79:515-524.

Hungate,R.E. (1966). The Rumrn and its Microbes. Academic Press Inc., New York and London.

Ivan, M., L. Neill, R.Forster, R. Alimon, T.L.M. Rode, and T. Entz, (2000). Effects of Isotricha, Dasytricha, Entodinium, and total Fauna on Ruminal fermentation and duodenal flow in wethers fed different diets. J. Dairy Sci. 83: 776-787.

Kamra, D.N., Sawal, R.K., Pathak,N.N., Kewalramani, N. and Agarwal,N. (1991). Diurnal variation in ciliate protozoa in the rumen of black buck (Antilope cervicapra) fed green forage. Letters in Applied Microbiology 13:165-167.

Manatbay B., Y.Cheng, S.Mao, Z.Weiyun (2014). Effect of gynosaponin on rumen in vitro methanogenesis under different forage-concentrate ratios. Asian Australas J Anim Sci. 27:1088–1097.

Murphy, M., M. Akerlind, K. Holtenius (2000). Rumen fermentation in lactating cows selected for milk fat content fed two forage to concentrate ratios with hay or silage. J Dairy Sci. 83:756–764.

Ogimoto, K. and S. Imai (1981). Atals of Rumen Microbial-Ogy. Japan Scientific Societies Press, ToKyo.

Papia N., A. Mostafa-Tehrania, H. Amanloub, M. Memarian (2010). Effects of dietary forage-to-concentrate ratios on performance and carcass characteristics of growing fat-tailed lambs. Animal Feed Science and Technology 10:1016.

Russell J.B., J.D. O'Connor, D.G.Fox, P.J.Van Soest, C.J.Sniffen (1992). A net carbohydrate and protein system for evaluating cattle diets: I. Ruminal fermentation. J Anim Sci. 70:3551–3561.

Santra, A., S. A. Karim, A. S. Mishra, O. H. Chaturvedi, and R. Prasad. 1998. Rumen ciliate protozoa and fibre digestion in sheep and goats. Small Rumin. Res. 30:13–18.

SAS (2002). Statistical Analysis Systems Institute Inc., Release 8.1, Cary, NC., USA.

Seng, M., T.R.Preston, R.A. Leng and U.T. Meulen, (2001). Effect of singal drench of cooking oil on the rumen ecosystem and performance of young localyellow cattle fed rice straw and cassava foliage. Livestock Research for Rural Developmen, 13:4.

Ushida, K. and J.P. Jouany, (1996). Methane production associated with rumenciliate protozoa and its effect on protozoa activity. Letters in Applied Microbiol., 23:129-132.

Van Soest, P. J. (1982). Nutritional Ecology of the ruminant. Edt. O & B Books, Inc. Corvallis, O R., U.S.A.

Warner, A.C.J. (1964). Production of volatile fatty acids in the rumen methods of measurments. Nutr. Abst.&rev.34:339.

Williams, A. G.and G. S. Coleman (1991). The Rumen Protozoa. Springer-Verlag New York Inc., New York, NY.

Yanez-Ruiz, D. R., A. Moumen, A. I. Martin-Garcia, and E. Molina- Alcaide. (2004). Ruminal fermentation and degradation patterns, protozoa population, and urinary purine derivatives excretion in goats and wethers fed diets based on two-stage olive cake: Effect of PEG supply. J. Anim. Sci. 82:2023–2032.

تخمرات الكرش و بروتوزوا الكرش الهدبية لجداء الماعز المغذاه على علائق مختلفة فى نسبة الخشن الى المركز.

هند أحمد عزيز و محمود صابر نصار و حسانين سعد الدين بدوى و محمد حافظ عبد الرحمن

قسم تغذية الحيوان-مركز بحوث الصحراء-القاهرة- مصر

تم اجراء تجربة نمو لدراسة تأثير التغذية بعلائق ذات مستويات مختلفة فى نسبة المركز إلى الخشن على تطور الكرش من خلال دراسة تخمرات الكرش و دراسة تصنيف وكثافة بروتوزوا الكرش الهدبية لمدة خمس شهور متتالية. تم توزيع 18 ذكر من جداء الماعز البلدى المفطومة مبكراً بمتوسط وزن جسم حى 7.58 كجم على عمر 60 يوم عشوائياً فى ثلاث مجاميع (6 حمل فى كل مجموعة) حسب وزن الجسم. تم تغذية الحملان فى الثلاث مجاميع على مكعبات بادئ تتكون من نسب مختلفة من المركز و المالئ (معاملة (1) بنسبة 90 : 10 ، معاملة (2) بنسبة 80 : 20 و معاملة (3) بنسبة 70 : 30 %). وقد أظهرت النتائج الرئيسية أن تركيز قياسات سائل الكرش و أعداد بروتوزوا الكرش الهدبية سجلت زيادة معنوية بداية من عمر 8 أسابيع حتى عمر 24 أسبوع. وأيضاً أوضحت النتائج أن قيم الرقم الهيدروجينى و أعداد بروتوزوا الكرش الهدبية كانت عالية قبل التغذية ثم أنخفضت عند 3 ساعات من التغذية ثم تبع ذلك زيادة تدريجية بالرغم من أن تركيز الاحماض الدهنية الطيارة و نيتروجين الامونيا و النتروجين غير البروتينى و النتروجين الكلى و نتروجين البروتين الحقيقى وصل إلى أعلى قيمة عند 3 ساعات من التغذية ثم أنخفضت تدريجياً. كما تم التعرف على سبعة أجناس من بروتوزوا الكرش الهدبية و قد كان جنس انتودنيم هو الاكثر سيادة بين الاجناس الاخرى. و قد أظهرت المقارنة بين الثلاث مجاميع أن المجموعة الثالثة حصلت على أعلى تركيز لقياسات سائل الكرش وأعداد بروتوزوا الكرش الهدبية خلال الفترة الكلية يليها المجموعة الثانية بينما حصلت المجموعة الاولى على أقل قيم. و لهذا نوصى بتغذية جداء الماعزعلى علائق محتوية على نسب عالية (30%) من العلف الخشن.