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

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SUMMARY

A growth trial 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.,
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-opened pens, the offered and the refusals 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 paraffin oil were added to the strained ruminal fluid and stored in deep freeze at (-20ºC) 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 filtered 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:

\[ Y_{ij} = \mu + T_i + M_e + I_j + TM_{ie} + TI_{ij} + e_{ij} \]

Where: - \( Y_{ij} \) = experimental observation

\( \mu \) = 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:

| Item                  | Experimental treatments | 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≤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≤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≤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 final body weight was significantly differed (P≤0.01). It seems that T3 had the highest (P≤0.01) live body followed by T2 then T1, although the difference between T3 and T2 was not significant (P≥0.01), also the difference between T2 and T1 was not significant (P≥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             |                        | 91.89b | 92.69a | 90.66c | 0.002|
| Total TDN kg/h             |                        | 77.32b | 79.89a | 79.45a | 0.002|
| Total DCP kg/h             |                        | 4.82b  | 5.30a  | 5.70a  | 0.002|
| Body weight kg/h           |                        |        |        |        |      |
| Initial body weight kg/h   |                        | 7.40   | 7.49   | 7.85   | 0.608|
| Final body weight kg/h     |                        | 17.41b | 17.82bc | 18.32a | 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 14.31 mg %. 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               | 5.62c   | 5.82a    | 6.47c    | 6.74a    | 6.62a    | 0.014|
| TVFA’s mg %      | 6.89c   | 8.00a    | 8.20b    | 9.26b    | 9.62a    | 0.029|
| Ammonia-N mg %   | 8.69c   | 10.04d   | 11.44c   | 13.26b   | 14.31a   | 0.031|
| NPN mg %         | 16.26c  | 17.57d   | 19.68c   | 22.47b   | 23.90a   | 0.053|
| Total nitrogen mg % | 31.20b | 32.50d   | 36.42c   | 41.58b   | 44.22a   | 0.099|
| True protein mg % | 14.94c  | 14.93d   | 16.73c   | 19.10b   | 20.31a   | 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               | 5.92c     | 6.27b     | 6.57a     | 0.011|
| TVFA’s mg %      | 8.05c     | 8.37b     | 8.75a     | 0.023|
| Ammonia-N mg %   | 11.07c    | 11.51b    | 12.05a    | 0.024|
| NPN mg %         | 19.17c    | 19.92b    | 20.84a    | 0.041|
| Total nitrogen mg % | 35.69c | 37.08b    | 38.79a    | 0.076|
| True protein mg % | 16.52c    | 17.15b    | 17.94a    | 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\(^a\) | 5.71\(^b\) | 5.96\(^c\) | 6.76\(^c\) | 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 T3 had the highest (P≤0.01) values followed by T2 then T1 from 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 T3 had 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 T3 at age of 20 weeks (6.99) while the lowest (P≤0.01) value was for T1 at 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 T3 at 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 T1 at age of 8 weeks (6.60, 8.21, 15.43, 29.68 and 14.24 mg / 100 ml RL; respectively).

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.

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

Means with different litters with each row are significantly different (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.

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.

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   | 5.28    | 5.43    | 5.96    | 0.029|
|              | 12 wk| 6.01   | 5.48    | 5.63    | 6.16    | 0.029|
|              | 16 wk| 6.85   | 5.89    | 6.04    | 7.11    | 0.029|
|              | 20 wk| 7.16   | 6.05    | 6.46    | 7.31    | 0.029|
|              | 24 wk| 7.11   | 5.87    | 6.24    | 7.25    | 0.029|
| TVFA's mg %  | 8 wk| 5.99   | 8.10    | 9.31    | 7.98    | 0.059|
|              | 12 wk| 7.10   | 9.21    | 7.95    | 7.73    | 0.059|
|              | 16 wk| 7.45   | 9.59    | 8.05    | 7.72    | 0.059|
|              | 20 wk| 8.44   | 10.12   | 9.40    | 9.08    | 0.059|
| Ammonia-N mg % | 8 wk| 7.38   | 9.69    | 7.36    | 7.36    | 0.059|
|              | 12 wk| 8.73   | 11.04   | 10.38   | 9.99    | 0.062|
|              | 16 wk| 10.86  | 12.61   | 11.50   | 10.80   | 0.062|
|              | 20 wk| 12.76  | 14.08   | 13.32   | 12.86   | 0.062|
|              | 24 wk| 13.87  | 14.92   | 14.38   | 14.07   | 0.062|
| NPN mg %     | 8 wk| 13.97  | 18.02   | 16.86   | 16.18   | 0.107|
|              | 12 wk| 15.28  | 19.33   | 18.17   | 17.49   | 0.107|
|              | 16 wk| 16.86  | 21.69   | 19.78   | 18.58   | 0.107|
|              | 20 wk| 21.64  | 23.88   | 22.58   | 21.80   | 0.107|
|              | 24 wk| 23.16  | 24.91   | 24.02   | 23.50   | 0.107|
| Total nitrogen mg % | 8 wk| 26.97  | 34.46   | 32.32   | 31.07   | 0.198|
|              | 12 wk| 28.27  | 35.76   | 33.62   | 32.37   | 0.198|
|              | 16 wk| 34.56  | 40.13   | 36.59   | 34.38   | 0.198|
|              | 20 wk| 40.04  | 44.18   | 41.78   | 40.33   | 0.198|
|              | 24 wk| 42.85  | 46.09   | 44.45   | 43.48   | 0.198|
| True protein mg % | 8 wk| 12.99  | 16.44   | 15.46   | 14.88   | 0.091|
|              | 12 wk| 12.98  | 16.43   | 15.45   | 14.87   | 0.091|
|              | 16 wk| 15.88  | 18.44   | 16.81   | 15.79   | 0.091|
|              | 20 wk| 18.39  | 20.29   | 19.19   | 18.53   | 0.091|
|              | 24 wk| 19.69  | 21.18   | 20.42   | 19.98   | 0.091|

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

The values shown in Table (9) indicate 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 T1 at 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 T1 at 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  | 6.13c    | 6.30c    | 7.05a    | 0.023 |
|            | 3 h  | 5.52c    | 5.75b    | 5.88a    | 0.023 |
|            | 6 h  | 5.75c    | 5.97b    | 6.15a    | 0.023 |
|            | 8 h  | 6.30c    | 6.78b    | 7.19a    | 0.023 |
| TVFA’s mg %| 0 h  | 7.40c    | 7.55b    | 7.77a    | 0.046 |
|            | 3 h  | 8.95c    | 9.50b    | 10.09a   | 0.046 |
|            | 6 h  | 8.04c    | 8.36b    | 8.76a    | 0.046 |
|            | 8 h  | 7.81c    | 8.08b    | 8.38a    | 0.046 |
| Ammonia-N mg %| 0 h | 10.19c   | 10.71b   | 11.26a   | 0.048 |
|            | 3 h  | 11.87c   | 12.43b   | 13.11a   | 0.048 |
|            | 6 h  | 11.34c   | 11.65b   | 12.18a   | 0.048 |
|            | 8 h  | 10.90c   | 11.27b   | 11.65a   | 0.048 |
| NPN mg %   | 0 h  | 17.64c   | 18.52b   | 19.47a   | 0.082 |
|            | 3 h  | 20.53c   | 21.49b   | 22.67a   | 0.082 |
|            | 6 h  | 19.63c   | 20.15b   | 21.07a   | 0.082 |
|            | 8 h  | 18.87c   | 19.50b   | 20.16a   | 0.082 |
| Total nitrogen mg %| 0 h | 32.86c   | 34.50b   | 36.25a   | 0.153 |
|            | 3 h  | 38.21c   | 39.99b   | 42.17a   | 0.153 |
|            | 6 h  | 36.54c   | 37.51b   | 39.21a   | 0.153 |
|            | 8 h  | 35.14c   | 36.31b   | 37.53a   | 0.153 |
| True protein mg %| 0 h | 15.22c   | 15.97b   | 16.77a   | 0.070 |
|            | 3 h  | 17.68c   | 18.49b   | 19.49a   | 0.070 |
|            | 6 h  | 16.91c   | 17.35b   | 18.14a   | 0.070 |
|            | 8 h  | 16.26c   | 16.80b   | 17.36a   | 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 Entodinium spp., Epidinium spp., Diplodinium spp., Polyolastron spp., Ophryoscolox spp., Isotrichia 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 Entodinium 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 Epidinium spp was in the second category followed by Diplodinium 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 Entodinium spp. 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 Entodinium. Also, the proportion of Holotrichia 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 Holotrichia.

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 Entodinium spp ranged between 267and 703 x10^4 cell/ml RF, Epidinium spp ranged between 65and 252x10^4 cell/ml RF, Diplodinum spp ranged between 23and 124 x10^4 cell/ml RF, Polyolastron spp ranged between 19and 52 x10^5 cell/ml RF, Ophryoscolox spp ranged between 20and 94 x10^5 cell/ml RF, Isotrichia spp ranged between 11 and 53x10^5 cell/ml RF, Dasytrachia spp ranged between 9 and 68 x10^5 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 x10^5 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  |
|---------------|---------|----------|----------|----------|----------|------|
| Entodinium    | 267.09d | 317.09d  | 352.48c  | 505.27b  | 703.05c  | 6.064|
| Epidinium     | 65.41c  | 95.41d   | 145.93c  | 193.61b  | 252.19a  | 1.807|
| Diplodinum    | 0.000   | 23.13d   | 29.13c   | 83.56b   | 123.70a  | 0.554|
| Polyolastron  | 0.000   | 19.50d   | 24.50c   | 23.86b   | 51.97a   | 0.211|
| Ophryoscolox  | 20.52c  | 24.52d   | 51.34c   | 71.97b   | 93.77a   | 0.375|
| Isotrichia    | 10.73c  | 13.73d   | 34.73c   | 53.40b   | 73.73a   | 0.328|
| Dasytrachia   | 9.48c   | 12.48d   | 32.37c   | 54.79b   | 68.54a   | 0.388|
| Total count   | 373.26c | 463.26d  | 670.51c  | 986.48b  | 1366.98a | 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≤0.01) affected by experimental treatments. Comparison among the three experimental treatments showed that T3 had the highest (P≤0.01) ruminal ciliate protozoa count for all species frequency and total count followed by T2, while T1 had the lowest (P≤0.01) frequency of species and the lowest (P≤0.01) total count. The values of total count were 868.55, 758.53 and 689.21(x10^5 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.
The values before feeding and the highest (P≤0.01) at 8 hours post feeding. While the lowest (P≤0.01) values were found for T1 at 778.76 cell/ml RF as the lowest total count. It is interesting to note that the differential and total numbers were at 3 hours post feeding while the highest (P<0.01) values were at 8 hours post 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, Polyplastron spp., Ophryoscolox spp., Isotrichia 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 (x10⁴ 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       | 436.95b| 347.03c | 437.02b | 495.00a | 5.424|
| Epidinum        | 152.55c| 111.23d | 157.41b | 180.85a | 1.616|
| Diplodinum      | 51.07c | 33.30d  | 52.47b  | 70.78a  | 0.495|
| Polyplastron    | 24.13b | 13.05c  | 24.36b  | 34.31a  | 0.189|
| Ophryoscolox    | 52.64b | 35.28c  | 53.05b  | 68.73a  | 0.335|
| Isotrichia      | 34.62b | 24.25c  | 35.88b  | 54.31a  | 0.294|
| Dasytrachia     | 34.43b | 23.01c  | 35.63b  | 49.06a  | 0.347|
| Total count     | 778.76b| 584.60a | 787.61b | 937.43a | 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 T3 had the highest (P≤0.01) values followed by T2 then T1 from 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 x10⁴ cell/ml RF as the highest total count. While the lowest (P≤0.01) values were found for T1 at age of 8 weeks being 322.54 x10⁴ 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
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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.

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

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

Means with different litters with each row are significantly different (P<0.01).
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 | 198.66c | 272.88e | 328.16c | 12.12|
|            | 12 wk| 318.66 | 248.66d | 322.88b | 378.16c | 12.12|
|            | 16 wk| 362.61 | 281.22d | 347.94b | 418.16c | 12.12|
|            | 20 wk| 517.83 | 416.33d | 521.11b | 565.83c | 12.12|
|            | 24 wk| 717.00 | 590.27d | 720.27b | 784.66c | 12.12|
| Epidinum   | 8 wk| 65.27c | 35.38d  | 74.94c  | 86.05c  | 3.614|
|            | 12 wk| 95.27c | 65.38d  | 104.94c | 116.05c | 3.614|
|            | 16 wk| 142.94c| 115.66d | 150.11b | 175.00c | 3.614|
|            | 20 wk| 194.55c| 150.66d | 201.77c | 227.44c | 3.614|
|            | 24 wk| 264.72c| 189.05d | 255.27c | 299.72c | 3.614|
| Diplodinum | 8 wk| 0.000  | 0.000   | 0.000   | 0.000   | 1.108|
|            | 12 wk| 19.16c | 6.16d   | 21.27b  | 45.94c  | 1.108|
|            | 16 wk| 25.16c | 12.16d  | 27.27b  | 51.94c  | 1.108|
|            | 20 wk| 83.27c | 52.55d  | 85.33b  | 113.11c | 1.108|
|            | 24 wk| 127.77c| 95.61d  | 128.50b | 142.94c | 1.108|
| Polypastra | 8 wk| 0.000  | 0.000   | 0.000   | 0.000   | 0.423|
|            | 12 wk| 19.11c | 6.72d   | 19.94c  | 32.22c  | 0.423|
|            | 16 wk| 24.11c | 11.72d  | 24.94c  | 37.22c  | 0.423|
|            | 20 wk| 23.38c | 11.38d  | 24.38b  | 36.27c  | 0.423|
|            | 24 wk| 54.05c | 35.44d  | 52.55b  | 65.83c  | 0.423|
| Ophryoscolox| 8 wk| 20.00c | 7.94d   | 21.11b  | 33.05c  | 0.750|
|            | 12 wk| 24.00c | 11.94d  | 25.11b  | 37.05c  | 0.750|
|            | 16 wk| 52.88c | 36.33d  | 51.33b  | 64.83c  | 0.750|
|            | 20 wk| 72.11c | 51.16d  | 73.50b  | 91.11c  | 0.750|
|            | 24 wk| 94.22c | 69.05d  | 94.22b  | 117.61c | 0.750|
| Isotrichia  | 8 wk| 8.38c  | 4.27d   | 10.83b  | 19.44c  | 0.657|
|            | 12 wk| 11.38c | 7.27d   | 13.83c  | 22.44c  | 0.657|
|            | 16 wk| 34.05c | 20.16d  | 35.27b  | 49.44c  | 0.657|
|            | 20 wk| 50.94c | 37.83d  | 51.72b  | 73.11c  | 0.657|
|            | 24 wk| 68.33c | 51.72d  | 67.77b  | 107.11c | 0.657|
| Dasytrichia| 8 wk| 7.72c  | 3.55d   | 9.05b   | 17.61c  | 0.777|
|            | 12 wk| 10.72c | 6.55d   | 12.05b  | 20.61c  | 0.777|
|            | 16 wk| 31.44c | 19.22d  | 33.38b  | 45.44c  | 0.777|
|            | 20 wk| 53.66c | 38.22d  | 53.11b  | 74.16c  | 0.777|
|            | 24 wk| 68.61c | 47.50d  | 70.55b  | 87.50c  | 0.777|
| Total count| 8 wk| 370.05c| 249.83d | 388.83b | 484.33c | 13.269|
|            | 12 wk| 460.05c| 339.83d | 478.83b | 574.33c | 13.269|
|            | 16 wk| 673.22c| 496.50d | 670.27b | 842.05c | 13.269|
|            | 20 wk| 995.77c| 758.16d | 1010.94b| 1181.05c| 13.269|
|            | 24 wk| 1394.72c| 1078.66d| 1389.16b| 1605.38c| 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 Entodinimidormipha 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 recorded 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  | 450.60b     | 430.43c     | 486.16a     | 9.395 |
|                | 3 h  | 308.73c     | 342.36b     | 390.00a     | 9.395 |
|                | 6 h  | 392.16c     | 428.40b     | 490.50a     | 9.395 |
|                | 8 h  | 392.16c     | 485.60b     | 548.80a     | 9.395 |
| Epidinum       | 0 h  | 133.03c     | 152.46b     | 172.16a     | 2.800 |
|                | 3 h  | 95.26c      | 110.43b     | 128.00a     | 2.800 |
|                | 6 h  | 138.40c     | 153.83b     | 180.00a     | 2.800 |
|                | 8 h  | 157.43c     | 173.83b     | 211.30a     | 2.800 |
| Diplodinum     | 0 h  | 45.83c      | 50.66b      | 56.73a      | 0.858 |
|                | 3 h  | 28.53c      | 32.26b      | 39.10a      | 0.858 |
|                | 6 h  | 48.00c      | 51.60b      | 57.83a      | 0.858 |
|                | 8 h  | 64.20c      | 69.90b      | 78.26a      | 0.858 |
| Polyplastron   | 0 h  | 21.43c      | 24.60b      | 26.36a      | 0.328 |
|                | 3 h  | 10.76c      | 13.26b      | 15.13a      | 0.328 |
|                | 6 h  | 22.50c      | 23.83b      | 26.76a      | 0.328 |
|                | 8 h  | 30.86c      | 34.13b      | 37.93a      | 0.328 |
| Ophryoscolox   | 0 h  | 47.40c      | 52.66b      | 57.86a      | 0.581 |
|                | 3 h  | 31.46c      | 34.76b      | 39.63a      | 0.581 |
|                | 6 h  | 48.36c      | 51.70b      | 59.10a      | 0.581 |
|                | 8 h  | 63.70c      | 66.63b      | 75.86a      | 0.581 |
| Isotrachia     | 0 h  | 29.20c      | 33.93b      | 40.73a      | 0.509 |
|                | 3 h  | 21.30c      | 23.23b      | 28.23a      | 0.509 |
|                | 6 h  | 30.46c      | 35.70b      | 41.50a      | 0.509 |
|                | 8 h  | 46.03c      | 53.56b      | 63.33a      | 0.509 |
| Dasytrachia    | 0 h  | 29.93c      | 34.33b      | 39.03a      | 0.602 |
|                | 3 h  | 20.93c      | 22.83b      | 25.26a      | 0.602 |
|                | 6 h  | 31.96c      | 35.10b      | 39.83a      | 0.602 |
|                | 8 h  | 44.76c      | 46.26b      | 56.16a      | 0.602 |
| Total count    | 0 h  | 694.30c     | 771.33b     | 870.66a     | 10.278 |
|                | 3 h  | 515.20c     | 576.56b     | 662.03a     | 10.278 |
|                | 6 h  | 704.10c     | 771.93b     | 886.80a     | 10.278 |
|                | 8 h  | 843.26a     | 914.30b     | 1054.73a    | 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 Dasytachia 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.

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