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GROWTH PERFORMANCE OF MALE KIDS ACCORDING TO DIFFERENT FEEDING SYSTEMS, CONCENTRATE TO ROUGHAGE RATIO AND DIETARY INCLUSION OF BENTONITE

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SUMMARY

This study was carried out on male Zaraibi kids which sucked dams received different feeding regimes, being:

A- 100% NRC (1981) allowances either as:
- 80% feed mixture (FM) + 20% Berseem hay (BH) + 3% Bentonite (BT) (high concentrate - BT, group 1),
- 80% FM + 20% BH (high concentrate, group 2),
- 60% FM + 40% BH + 3% BT (low concentrate - BT, group 3) or
- 60% FM + 40% BH (low concentrate, group 4).

B- *Ad lib.* feeding:
- of both FM and BH + 3% BT, (group 5) or
- of both FM and BH, (group 6).

Each of groups 1, 3 and 5, which received Bentonite in their dams' ration, was divided randomly into 2 subgroups. The first subgroup continued receiving Bentonite after weaning, while Bentonite stopped by weaning for the second subgroup. Accordingly, the experiment consisted of 9 treatments, each of 7 Zaraibi kids and lasted for three months post-weaning. Feeding allowances were calculated as total digestible nutrients (TDN) and digested crude protein (DCP). The resultant R/C ratio recorded for treatments received high and low concentrate rations were 28:72 vs 50:50, respectively. Kids on *ad lib.* feeding consumed 31:69 vs. 33:67 R/C ratios for with and without Bentonite groups, respectively. The group fed *ad lib.* plus Bentonite had increased feed intake and lowered water consumption. Meanwhile, feeding high roughage rations increased water consumption. The main result obtained is the significant increase in daily body gain (DBG) which due to the high level of feeding (*ad lib.*) and Bentonite inclusion. The highest daily gain in Zaraibi kids was shown with *ad lib.* + continuous Bentonite supply (115.2 g), followed by *ad lib.* + Bentonite supply to dams only (100.6 g), *ad lib.* without clay (92.54 g) and the high concentrate + continuous Bentonite treatment (86.98 g). The lowest daily gain was observed with low concentrate without Bentonite (69.68 g). The feed conversion was markedly improved by using Bentonite in all diets, which reflected in an economical increased growth. Both nutritional level and R/C ratio affected the rumen parameters measured. Addition of Bentonite lowered NH3-N concentration and enhanced total volatile fatty acids (VFA's) level in the rumen. Feeding level positively influenced rumen total VFA's and microbial population. It was concluded also that both the tested feeding schemes and using of Bentonite in growing male kids rations had influenced the tested hemato-biochemical parameters. Conclusively, the addition of Bentonite to goats ration improved growth performance of kids besides being of economic impact.

***Keywords:** Kids, Bentonite, feeding regimes, growth, rumen, blood*

INTRODUCTION

Bentonite, as natural clay used in animals' diets, proved to have a positive role on digestion (Abd El-Baki *et al.*, 1995), feed conversion (Abd El-Raouf *et al.*, 1994) and daily body gain (Hassona *et al.*, 1995). Due to the previous results of the authors (Abdelhamid *et al.*, 1999-a,b & c) where they found that addition of Bentonite to rations of Zaraibi does (especially high concentrate and ad lib. rations) improved their performance during both late pregnancy and suckling periods. It improved also birth and weaning weight of born kids. Accordingly the objective of the present work is to study the effect of dietary inclusion of Bentonite as well as feeding variable levels and R/C ratios on growth performance of kids after weaning.

MATERIALS AND METHODS

This study was carried out at El-Serw Experimental Station (Domietta Governorate), Animal Production Research Institute, Ministry of Agriculture. The experiment consisted of 9 groups, each of 7 Zaraibi male kids. The treatments started on dams during pregnancy, then on kids for three months post weaning according to the following scheme:

Feed of pregnant dams	Feed of kids post weaning
100 % of NRC allowances (High concentrate)	
Group 1: 80% FM + 20 % BH + 3 % Bentonite	The same
Group 2: 80% FM + 20 % BH + 3 % Bentonite	The same but with bentonite
Group 3: 80% FM + 20 % BH	The same
Low concentrate:	
Group 4: 60% FM + 40 % BH + 3 % Bentonite	The same
Group 5: 60% FM + 40 % BH + 3 % Bentonite	The same but with bentonite
Group 6: 60% FM + 40 % BH only	The same
Ad Lib Feeding:	
Group 7: on both FM & BH + 3% Bentonite	The same
Group 8: on both FM & BH + 3% Bentonite	The same but with Bentonite
Group 9: on both FM & BH only	The same

Where FM was feed mixture and BH was Berseem hay

Table 1. Chemical composition (DM base) of ingredients

Item	DM, %	OM	CF	CP	EE	NFE	Ash
Feed mixture	87.90	89.98	14.24	16.13	3.02	56.59	10.02
Yellow corn	89.50	98.25	2.60	8.30	4.22	83.13	1.75
Berssem hay	87.60	86.20	26.65	11.00	2.65	45.90	13.80

Table 2. Minerals and vitamins content, per kg of the blocks

Minerals	Content, g	Vitamins	Content IU	Content Mg
Phosphorus	40.00	A	400000	
Sulfer	12.00	D_3	40000	
Potassium	10.00	E	8000	
Iron	7.00	B1		7.00
Magnesium	5.00	B2		3.00
Zinc	4.50	B6		3.00
Manganese	4.50	Choline chloride		600.00
Cupper	2.00	Niacin		40.00
Iodine	0.003	Pantothenic acid		8.00
Cobalt	0.50			
Selenium	0.12			
Sodium chloride	570.00			

The animals were weighed at the beginning and bi-weekly thereafter. They were fed 2-weeks, as a transitional period, on the tested rations before the start of the experimental work.

Maintenance and production requirement as total digestible nutrients (TDN) and digested crude protein (DCP) for the growing Zaraibi kids were based on the NRC (1981) allowances for the first four restricted feeding groups while the other groups were fed *ad lib.* Bentonite was bought from Sinai Co.

for Phosphate and Manganese (Fayoum). It was added to FM at the rate of 3% of the total daily feed intake. The rations were offered twice daily at 8:00 am and 3:00 pm where kids were fed in groups. The feed mixture consisted of 25% un-decorticated cottonseed meal, 25% wheat bran, 17% yellow corn, 15% rice bran, 11% soybean meal, 3% molasses, 2.5% limestone and 1.5% common salt. The yellow corn was used with feed mixture to adjust the nutritional requirements of both energy and protein according to the allowances of NRC. The structure and chemical analyses of the Bentonite as well as chemical composition of the dietary ingredients are presented in Table 5. Water was available all times, where the water consumption was daily measured. The kids were supplemented with vitamins and minerals via licking blocks (Biomix-333, where its composition is presented in Table 6.

Samples of rumen fluid were taken from all kids using stomach tube before and post-feeding (2, 4 and 6 hrs.) at the end of growing period. The samples were filtered through 3 layers of gauze for the determination of pH-value. Ammonia nitrogen (NH3-N) concentration was measured according to Conway (1957) method whereas total volatile fatty acids (VFA's) according to the technique described by Warner (1964). Total number of protozoa was counted using Fuchs-Rosenthal Chamber, and microbial protein level was estimated by the method of Shultz and Shultz (1970).

Blood samples were collected from all kids once at the end of the experiment from the jugular vein. The whole blood was immediately directed to hematological estimations. Another blood samples were centrifuged at 4000 rpm for 20 minutes. Part of the separated sera was directed to enzymes determination while the other part was stored frozen at -20°C till the biochemical analysis. Commercial kits were used for colorimetric determinations according to the following references:

Feed conversion efficiency was expressed either as Kg DM, TDN or DCP required to produce one Kg weight gain. The economical efficiency was calculated as the ratio between income (price of the weight gained) and cost of feed consumed.

Criteria	References
Hemoglobin (Hg)	Linne and Ringsrud (1992)
Hematocrit (Hct)	Linne and Ringsrud (1992)
Red blood cells (RBC's)	Miller and Weller (1971)
White blood cells (WBC's)	Coles (1986)
Total proteins	Doumas *et al.* (1981)
Albumin	Hill and Wells (1983)
Urea N	Freidman *et al.* (1980)
Creatinine	Ullmann (1976)
Glucose	Teuscher and Richterich (1971)
Total lipids	Schmit (1964)
Cholesteral	Schettler and Nüssel (1975)
Glutamic oxaloacetic transaminase (GOT)	Reitman and Frankel (1957)
Glutamic pyruvic transaminase (GPT)	Reitman and Frankel (1957)

All numerical data collected were statistically analyzed for one way analysis of variance according to Snedecor and Cochran (1981). When F-test was positive, least significant differences were calculated (Duncan, 1955) to differentiate among significant and non-significant means.

RESULTS AND DISCUSSION

1- Feed intake

The average daily feed intake of growing Zaraibi kids are summarized in Table 3. Zaraibi kids on restricted rations were fed on FM and BH to cover about 100% of TDN and DCP requirements as reported in NRC (1981) for goats. The feed intake of total ration per KgW $^{0.75}$ ranged from 76.45 to 79.08 g for high concentrate vs. 82.19 to 86.17 g dry matter (DM) for low concentrate. But, values of ration consumed reached 105.1 g/KgW $^{0.75}$ for open feeding (*ad lib.*) plus Bentonite. Thus, the role of Bentonite was more pronounced with the *ad lib.* feeding. These results agree with those of Ahmed (1995) on Zaraibi kids fed Bentonite. In this connection, Pond and Yen (1985) found that supplementation with clays stimulated the appetite of animals and consequently increased their feed intake.

The study revealed that R/C ratio was 28 : 72 vs. 50:50 for high and low concentrate rations, respectively. But it was 31:69 and 33.67 with open feeding, with and without Bentonite-rations, respectively. These data revealed that addition of clay into *ad lib.* feeding increased daily feed intake. Such increase was mainly from the concentrate which was reflected on the R/C ratio as became wider with T7 (*ad lib.* + BT) than with T8 and T9 (*ad lib.* without BT). In this respect, Hassona *et al.* (1995) stated that feed intake of FM was increased with growing Zaraibi goats fed rations supplemented with clays, especially Bentonite.

Table 3. Average daily feed intake[1] and water consumption[1] by the growing Zaraibi kids as affected by feeding schemes and addition of Bentonite clay

Items	High concentrate			Low concentrate			*Ad lib.* feeding		
	T_1	T_2	T_3	T_4	T_5	T_6	T_7	T_8	T_9
DM intak									
Ration:g/h/d	668.9	629.1	623.1	685.3	658.7	652.0	949.2	880.0	843.7
$g/Kgw^{0.75}$	79.08	76.45	77.52	86.17	82.95	82.19	105.1	97.50	96.98
Hay g/h/d	184.4	173.5	171.8	345.2	331.8	328.5	294.4	291.7	278.4
$g/Kgw^{0.75}$	21.79	21.07	21.37	43.41	41.79	41.40	32.57	32.72	31.74
% of ration	27.56	27.56	27.56	50.38	50.38	50.38	31.00	33.13	33.00
R/C ratio	28:72	28:72	28:72	50:50	50:50	50:50	31:69	33:67	33:67
Water									
ml/h/d	1503	1610	1621	1861	1925	1931	1750	1820	1839
$ml/Kgw^{0.82}$	145.9	157.8	163.7	193.9	200.5	201.1	156.1	166.6	172.7
ml/g DM	2.25	2.56	2.60	2.72	2.92	2.96	1.84	2.07	2.18

2- Water consumption

Table 3 presents data of the drinking water consumed by Zaraibi kids during the growing period. The values of water consumption were higher with high roughage rations. Abdelhamid *et al.* (1999-a) found that feeding high roughage rations elevated the water consumption than feeding high concentrate.

Using Bentonite led to decrease daily water consumption, whether on restricted (high and low concentrate) or voluntary (*ad lib.*) feeding. These results are in accordance with those of Aiad (1997) and Galal (1997) who observed that water consumption was decreased with the addition of clays to ruminant rations. But, Abd El-Baki *et al.* (1995) reported that addition of local clays (Bentonite, Tafla and Kaolin) to ration of Zaraibi bucks and Rahmani rams did not significantly affect water consumption.

3- Growth performance

The daily body gain (DBG) was significantly increased in Zaraibi kids fed *ad lib.* rations (without clay) than those fed restricted rations (without clay also). The DBG was higher by growing kids fed high concentrate rations (without clay) than those fed low concentrate as shown in Table 4. In this respect, Mousa (1996) found that average live body weight (LBW), total gain and DBG of growing Zaraibi kids fed high feeding level were higher than those fed normal control ration. Using Bentonite with all rations (restricted levels of high and low concentrate and *ad lib.* rations) improved DBG. This improvement was significant ($P < 0.05$) with high concentrate and *ad lib.* The highest value of DBG was recorded with *ad lib.* ration with Bentonite (115.2 g) while the lowest value was recorded with high roughage without Bentonite (64.60 g). The results showed that there was significant effect of clay on weight gain. These results agreed with those of Dunn *et al.* (1979) on Bentonite added to lambs' ration and Ahmed (1995) with Zaraibi kids and Rahmani lambs fed Bentonite, Tafla and Kaolin supplemented rations.

The improvement in body gain of Zaraibi kids fed rations contained Bentonite may be due to the role of clay on decreasing rate of passage and improving NH3 ion exchange capacity (Grim, 1968), increasing digestibility and absorption of nutrients (Nowar *et al.*, 1993 and Abdelhamid, 1999d) and its reaction with dietary protein and forming a complex compound which has a retarding effect on protein degradability and improving nitrogen utilization (Britton *et al.*, 1978).

4- Feed conversion

Table 4 presents feed conversion values of the growing Zaraibi kids as Kg of consumed feed/Kg of produced gain. The restricted high concentrate ration was better converted into gain than *ad lib* fed group, whether as dry matter (DM), TDN or DCP. The improvement of feed conversion by high concentrate (100% of NRC) may be attributed to level of feeding, since *ad lib.* may reduce nutrients digestibility for the increased rate of passage of digesta (Church, 1971).

The dietary inclusion of Bentonite had improved feed conversion as DM, TDN and DCP/body gain in all tested feeding treatments and R/C ratios. These results are in line with the findings of Abdel-Raouf *et al.* (1994) and Ahmed (1995). This improvement in feed conversion by Bentonite inclusion may be due to the ability of clay to bind with digesta and consequently increases the reactive surface area aiding the action of digestive enzymes and increases the surface area of contact with the mucous membrane of the digestive tract (Pulatove *et al.*, 1983). This binding improves feed conversion by slowing feed passage through the alimentary tract, which allows greater digestion and absorption (Almquist *et al.*, 1967).

Table 4. Growth performance of kids as affected by feeding system, concentrate to roughage ratio and dietary Bentonite addition.

Items	High concentrate			Low concentrate			*Ad lib.* feeding		
	T_1	T_2	T_3	T_4	T_5	T_6	T_7	T_8	T_9
Initial BW (Kg)	14.64^{a}	14.59^{a}	14.40^{a}	14.13^{a}	14.04^{a}	14.13^{a}	15.21^{a}	15.14^{a}	14.86^{a}
Final BW (Kg)	22.47	21.43^{d}	20.67^{de}	21.06^{d}	20.27^{de}	19.94^{e}	25.59^{a}	24.20^{b}	23.19^{bc}
Total gain (Kg)	7.80	6.84^{d}	6.27^{de}	6.93^{d}	6.23^{de}	5.81^{e}	10.38^{a}	9.06^{b}	8.33^{bc}
Daily body weight gain (DBG, g)	86.98^{c}	76.03^{d}	69.68^{de}	76.98^{d}	69.21^{de}	64.60^{e}	115.2^{a}	100.6^{b}	92.54^{bc}
Total DM intake (g/h/d)	668.9	629.4	623.1	685.3	658.7	652.0	949.2	880.0	843.7
TDN intake (g/h/d)	490.7	461.8	457.2	459.4	441.6	437.1	687.3	632.0	606.3
DCP intake (g/h/d)	46.21	43.48	43.04	47.38	45.54	45.08	65.58	60.80	58.30
Feed conversion									
Kg DM/Kg LBW gain	7.69	8.28	8.94	8.90	9.52	10.09	8.23	8.74	9.12
Kg TDN/Kg LBW gain	5.64	6.07	6.56	5.97	6.38	6.77	5.96	6.28	6.55
Kg DCP/Kg LBW gain	0.53	0.57	0.62	0.61	0.66	0.70	0.57	0.60	0.65
Economic efficiency	2.63	2.44	2.26	2.53	2.36	2.23	2.50	2.38	2.29

Means followed by the same letter (from a to e) are not significantly ($P \geq 0.05$) differ.

5- Economical efficiency:

Table 4 presents economical efficiency of feeding Zaraibi kids on the different experimental rations. Concerning the effect of nutritional status, the values of economical efficiency were better with high level of nutrition without Bentonite (2.29) than on restricted feeding, whether as high concentrate (2.26) or high roughage (2.23).

The positive effect of high level of nutrition was observed also by the same authors (Abdelhamid *et al.*, 1999c) on Zaraibi does fed rations differed in R/C ratios at different feeding levels with or without clays. However, the effect of high level of feeding was greater (1.36) compared with high concentrate (1.18) and high roughage (1.12).

The economical efficiency was higher by the addition of Bentonite clay to all growing kids' rations. The same trend was reported by Ahmed (1999). May and Barker (1988) reported that feed cost per unit weight gain was less in animals fed rations with Bentonite than those fed feed mixture without Bentonite. In this respect, Hassona *et al.* (1995) found also that economical efficiency was higher by adding clays to lamb's rations, but it was slightly increased with Bentonite and Tafla supplemented rations fed to Zaraibi kids than other rations.

6- Rumen liquor parameters

6-1- pH values

Table 5 shows that maximum pH-values were recorded at 0 hr and gradually decreased to the minimum at 4 hrs post-feeding then increased thereafter with all treatments. The pH values were decreased by *ad lib.* feeding (T7) than with the restricted feeding (without clay, T1 and T4) at 4 hrs. This may be due to the increased production of VFA's.

The results indicated also that Bentonite addition significantly lowered pH-values with open feeding (*ad lib.*) at 2 hrs post-feeding. This may be attributed to the decrease ($P < 0.05$) of rumen NH3-N concentration at the same time. These results agree with those reported by Abdelhamid *et al.* (1999-a).

Table 5. Rumen liquor parameters of kids fed the experimental rations

Rumen fluid	Hr. post	High concentrate			Low concentrate			*Ad lib.* Rations		
Parameters	Feeding	T_1	T_2	T_3	T_4	T_5	T_6	T_7	T_8	T_9
PH-value	0	6.8	6.80^{a}	6.79^{a}	6.84^{a}	6.80^{a}	6.79^{a}	6.80^{a}	6.85^{a}	6.82^{a}
	2	6.4	6.50^{a}	6.51^{a}	6.46^{c}	6.48^{b}	6.50^{a}	6.40^{dl}	6.53^{a}	6.55^{al}
	4	6.3	6.36^{a}	6.37^{a}	6.33^{a}	6.35^{a}	6.36^{a}	6.24	6.30^{b}	6.34^{ab}
	6	6.6	6.63^{c}	6.60^{c}	6.60^{c}	6.58^{d}	6.58^{d}	6.69^{a}	6.72^{a}	6.73^{ak}
NH_3-N (mg/100ml)										
	0	16.	16.10	16.24	16.59	16.10	16.45	19.75	19.95	20.30
	2	28.	29.05	29.19	28.49	28.91	29.05	38.15	40.55	40.00
	4	29.	29.95	29.99	28.84	29.26	29.40	39.20	40.90	41.30
	6	26.	26.25	26.13	26.60	26.25	25.95	35.90	36.40	36.75
Total VFA's (meq/100 ml)		10.0	9.02^{ef}	8.95^{f}	9.48^{d}	8.83^{f}	8.58^{f}	11.48	10.75	10.55
Protozoa (X 10^3/ml)		796	643^{c}	628^{c}	786^{b}	768^{b}	736^{b}	881^{a}	808^{b}	8011^{b}
Microbial protein (g/100 ml)		0.37	0.33^{d}	0.32^{d}	0.36^{b}	0.345	0.328	0.435	0.398	0.390

Means, in rows, followed by the same letter (from a to e) are not significantly ($P \geq 0.05$) differ.
Means, in columns, followed by the same letter (from j to m) are not significantly ($P \geq 0.05$) differ.

6-2- Ammonia-N (NH3-N)

The average values of NH3-N in the rumen fluid of Zaraibi kids are presented in Table 5. The maximum NH3-N values were recorded 4 hrs post-feeding. The average of ruminal NH3-N values of Zaraibi kids during growing period was affected by the feeding schemes and addition of Bentonite. Restricted rations (high and low concentrate) significantly lowered values of rumen NH3-N than *ad lib.* feeding at all sampling hours. The results also revealed that values of NH3-N slightly influenced by R/C ratios. Similarly, Abdelhamid *et al.* (1999a) observed that NH3-N concentration was significantly decreased before and after -feeding of Zaraibi does fed restricted rations than that of those fed *ad lib.* They found also no significant differences in NH3-N concentration at 0, 12 and 18 hrs between groups fed high and low concentrate (restricted rations).

Data in Table 5 revealed that the addition of Bentonite significantly decreased NH3-N concentration in ruminal fluid of kids fed *ad lib.* at 2, 4 and 6 hrs. The same trend was also observed with restricted rations (100% of NRC) in both high and low concentrate rations at 2 and 4 hrs. The lowering of NH3-N level, due to Bentonite addition especially when it was of high concentration at the first hours post-feeding, was recorded also by Abd El-Baki *et al.* (1992) and Abdelhamid *et al.* (1999a). Hassona *et al.* (1995) concluded that Bentonite is the best clay as a regulatory factor for NH3-N concentration in the rumen.

6-3- Total VFA's

Mean values of total VFA's (Table 5) showed significant differences due to feeding scheme and using Bentonite. The low level of feeding (100% of NRC) significantly lowered rumen total VFA's concentrations than the *ad lib.* feeding. In addition, VFA's levels were higher with high concentrate than with high roughage rations. These results are in agreement with those found by Ahmed (1999). Feeding Bentonite with all rations (high and low concentrate-as restricted feeding-and *ad lib.* feeding) significantly improved ruminal VFA's concentrations. This improvement was better with high concentrate than with low concentrate. Similarly, Hassona *et al.* (1995) found that the addition of Bentonite had increased VFA's concentration in the rumen of growing Zaraibi goats than control (without clay).

6-4- Total number of protozoa and microbial protein concentrations

Table 5 shows that total number of protozoa and microbial protein concentration in rumen liquor were significantly influenced by the feeding statuses. The values of both parameters tended to increase with *ad lib.* feeding than with restricted rations. The high roughage rations (without Bentonite) significantly elevated the values of protozoa than the high concentrate one. The same trend was observed also for microbial protein concentration. In this respect, Tawari *et al.* (1990) suggested that high feeding level (115% of NRC) might increase rumen microbial growth by enhancing the efficiency of conversion of organic matter into bacterial biomass. Feeding Bentonite with restricted (100% of NRC) and *ad. lib.* rations improved the ruminal total number of protozoa and microbial protein concentration. This improvement was significant with high concentrate and *ad lib.* feeding. This result agrees with the findings reported by Aiad (1997), Galal (1997) and Abdelhamid *et al.* (1999a).

7- Blood parameters

7-1- Hematological parameters

Data of hematological parameters of Zaraibi kids fed different experimental rations during growing period are presented in Table 6. Concerning the effect of feeding scheme, the obtained results indicated that values of Hb and RBC's were significantly increased with *ad lib.* (without clay) than with high and low concentrate (without clay). The values of Hct and WBC's took the same trend between restricted and *ad lib.* rations. Also, Hb, RBC's, Hct and WBC's were higher in kids fed high concentrate (without clay) than in those fed high roughage (without clay).

It could be noticed that goats offered high level of feeding (*ad lib.*) were better than those on restricted rations regarding most of the hematological parameters. However, goats fed on high concentrate showed better results than those fed high roughage. This may be due to the high content of minerals, vitamins and proteins (in the high concentrate ration), which are essential for erythropoesis (Coles, 1986).

Addition of Bentonite to *ad lib.* rations significantly increased RBC's, Hct and WBC's values. The same effect was observed on Hb, RBC's, Hct and WBC's with using Bentonite in high concentrate rations. Moreover, feeding high roughage ration with Bentonite elevated the WBC's compared to their control (without clay). Accordingly, using Bentonite had no effect on Hb, RBC's and Hct concentrations. These results are in line with the findings of Aiad (1997) who reported that lambs fed complete pelleted diets contained 3% Tafla clay showed significantly ($P < 0.01$) higher hematological parameters (Hb, Hct, MCHC and RBC's) than those fed on the control ration.

7-2- Biochemical parameters

7-2-1- Proteins and nitrogenous metabolites

Table 6 presents data of serum total protein, albumin, globulin, urea-N and creatinine concentrations in Zaraibi kids as affected by feeding status. Kids given high level of feeding (without clay) accoplished higher serum total protein and globulin concentrations than those fed restricted rations (without clay), but the obtained values were within the normal range reported by Kaneko (1989). The results revealed that the highest A/G ratio was recorded with high roughage rations (without clay). The dietary inclusion of Bentonite reduced serum total protein, albumin and globulin concentrations, especially with high concentrate and *ad lib.* feeding. Similar results were obtained by Aiad (1990) and Nowar *et al.* (1993) using clays addition to sheep diets.

Zaraibi kids fed restricted rations (without clay) had significantly lower values of serum urea-N than those fed *ad libitum.* (without clay). The values of serum creatinine were increased also with increasing the level of nutrition. These findings agree with those reported by El-Shaer *et al.* (1982). They stated that the level of urea-N in serum was increased ($P < 0.01$) in both goats and sheep with increasing daily feed intake or level of nutrition. The same authors noticed high and significant correlation between serum urea-N and rumen ammonia-N for both species. Feeding Bentonite with all rations (high and low concentrate and *ad lib.* feeding) significantly reduced serum urea-N concentrations. The same trend was found by Abd El-Baki *et al.* (1992), Nowar *et al.* (1993), El-Hakim *et al.* (1994) and Hassona *et al.* (1995).

7-2-2- Glucose, lipids and cholesterol

Blood glucose concentrations did not significantly differed between restricted and *ad lib.* rations (with or without clay) as shown in Table 6. The highest value was obtained with *ad lib.* feeding plus Bentonite, whereas the lowest value was recorded with high concentrate (without clay) but all values were within the normal physiological range of goats reported by Kaneko (1989). Everts (1990) reported that blood glucose concentration was higher with increasing metabolizable energy intake. In this respect, Aiad (1997) revealed that serum glucose level tended to increase with adding clays in small ruminant's diets.

Blood total lipids and cholesterol concentrations (Table 6) tended to decrease with restricted rations (without Bentonite) than in *ad lib.* feeding (without Bentonite). Bentonite with high roughage and open feeding decreased levels of both parameters than in the control. Serum total lipids level was 300.0 mg/100 ml (lowest value) with high roughage plus Bentonite, whereas it was 391.8 (highest value) with *ad lib.* feeding (without Bentonite). The same result was obtained with serum cholesterol (Table 6).

Abdelhamid *et al.* (1999-b) observed that Zaraibi does fed *ad lib.* had increases in serum total lipids and cholesterol concentrations than those fed restricted rations. They found also that Bentonite with open feeding or restricted rations decreased level of both parameters where this decrease was significant with open feeding only.

Table 6. Blood parameters of Zaraibi kids as affected by feeding schemes and addition of Bentonite.

Criteria	High concentrate			Low concentrate			*Ad lib.* feeding		
	T_1	T_2	T_3	T_4	T_5	T_6	T_7	T_8	T_9
Hemoglobin (Hb) g/dl	11.18^a	9.88^b	9.71^{bc}	9.10^{cd}	9.15^{cd}	8.88^d	11.13^a	10.78^a	10.80^a
Hematocrit (Hct) %	35.25^b	33.75^c	34.50^{bc}	32.00^d	32.25^d	32.25^d	37.75^a	35.35^b	35.00^{bc}
Red blood cells (RBC's) 10^6/ul	12.75^b	9.75^c	9.83^c	9.35^c	9.33^c	9.40^c	14.34^a	13.08^b	12.96^b
White blood cells (WBC's) X 10^3/ul	17.33^a	10.03^{cd}	9.30^d	12.33^b	9.18^d	8.95^d	16.78^a	11.03^c	10.90^c
Total protein, g/100 ml	6.25^b	6.48^{ab}	6.45^{ab}	6.43^{ab}	6.55^a	6.45^{ab}	6.46^{ab}	6.68^a	6.69^a
Albumin, g/100 ml	3.60^a	3.70^{ab}	3.78^a	3.88^a	3.88^a	3.88^a	3.63^b	3.75^a	3.88^a
Globulin, g/100 ml	2.65^{ab}	2.78^{ab}	2.68^{ab}	2.55^b	2.68^{ab}	2.58^{ab}	2.83^{ab}	2.93^a	2.81^{ab}
A/G ratio	1.36^b	1.34^b	1.42^{ab}	1.52^a	1.46^a	1.52^a	1.30^b	1.29^b	1.42^{ab}
Urea-N, mg/100 ml	15.25^d	18.25^{bc}	19.00^b	16.25^{cd}	18.50^b	18.02^{bc}	18.75^b	20.93^a	21.10^a
Creatinine, mg/100 ml	0.80^a	0.95^a	0.93^a	0.88^a	0.95^a	0.90^a	0.90^a	0.98^a	1.00
Glucose, mg/100 ml	63.5^a	61.0^a	59.0^a	62.0^a	61.5^a	60.25^a	64.75^a	62.25^a	62.00
Total lipids, mg/100 ml	350.0^a	368.3^a	348.8^a	300.0^a	360.8^a	349.8^a	339.3^a	370.5^a	391.8
Cholesterol, mg/100 ml	86.25^a	83.25^a	86.00^a	75.00^a	88.00^a	82.50^a	85.00^a	86.25^a	90.00
SGOT, u/l	67.0^c	84.75^a	82.25^{ab}	71.25^{bc}	78.75^{ab}	80.75^{ab}	79.25^{ab}	88.00^a	86.25^a
SGPT, u/l	16.00^{cd}	20.25^{ab}	19.50^{ab}	15.00^d	19.50^{ab}	18.50^{bc}	18.25^{bc}	21.00^{ab}	22.00^a

Means followed by the same letter (from a to d) are not significantly ($P \geq 0.05$) differ.

7-2-3- Enzymes

Zaraibi kids given high level of feeding had higher serum activities of SGOT and SGPT than those fed restricted rations (Table 6). A Similar result was obtained by Salem *et al.* (1979). They reported increases in serum activities of GOT and GPT with increasing energy intake. Moreover, Smernov (1974) noticed some elevations of transaminases activity due to the increase of dietary protein level.

Adding Bentonite to kids' rations lowered serum activities of GOT and GPT. The decrease was significant ($P < 0.05$) only for GOT and GPT on high concentrate and GPT on high roughage. The same trend was observed by Abd El-Baki *et al.* (1992). Nowar *et al.* (1993) reported that dietary clay inclusion decreased serum activity of GOT and GPT, but the differences were not significant.

In conclusion, feeding growing male kids on Bentonite was beneficial, (whether for body weight gain, or blood picture). However, feeding dams on Bentonite positively affected their kids via maternal effect, either through suckling or by producing kids with heavier birth weight than those fed on Bentonite free diets. Also, feeding high concentrate with Bentonite was more economical than feeding on high roughage or *ad lib.* , in addition, *ad lib.* feeding without Bentonite was more economic than restricted feeding, whether on high concentrate or high roughage.

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