Studies on Digestion Coefficients and Rumen Fermentation of some Improved Rations by Males of Sinai Sheep and Goats

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Abstract: In order to improve the productivity of Sinai sheep and goats, the effects of feeding with mineral mixture additives (experiment 1) and the mixture of mineral with alfalfa (experiment 2) on the digestion coefficients (dry matter (DM), organic matter (OM), crude protein (CP), crude fiber (CF), ether extract (EE) and nitrogen free extract (NFE)), nutritive values (total digestible nutrients (TDN) and digestible crude protein (DCP)) and rumen fermentation were evaluated. Experiment 1 was applied to evaluate two rations (1 and 2). Ration 1 contained concentrate feed mixture (CFM) and wheat straw (ratio 2:1) and ration 2 contained CFM with additive of 0.2% mineral mixture and wheat straw. Experiment 2 was applied to evaluate two rations (A and B). Ration A contained CFM, Alfalfa and wheat straw and ration B contained CFM mixed with 0.2% mineral mixture additive, Alfalfa and wheat straw. Three Sinai rams and three Sinai bucks aged 2-3 years were used. The rumen parameters as pH, ammonia-N, Volatile fatty acids, microbial protein and protozoa were measured in rumen fluid at 0, 2 and 4 hours after feeding. Results of experiment 1 indicated that the differences of digestion coefficients of nutrients between ration 1 and ration 2 were not significant, while the EE digestibility in ration 2 (55.6%) was significantly higher ($P<0.05$) than ration1 (53.3%) in the sheep. The digestion coefficients of DM (65.1%) and OM (67.1%) in ration 2 were significantly higher ($P<0.05$) than ration 1 (62.5% and 64.1%, respectively) in the goats. The digestion coefficients of CF (58.6%) and EE (58.5%) of ration B were significantly higher ($P<0.05$) than ration A (56.5% and 56.2%, respectively) in the sheep. The digestion coefficients of DM (67.4%) and OM (68.6%) in ration B were significantly higher ($P<0.05$) than ration A (65.7% and 67.1%, respectively) in the goats. In sheep, NFE of ration B was significantly ($P<0.05$) lower than ration A (70.4% and 72.9%, respectively). In goats, TDN values were significantly ($P<0.05$) higher in ration 2 than ration 1 (64.3% and 63.1%, respectively) and also in ration B than ration A (64.9% and 62.4%, respectively). The difference of NH_3-N at 4h post feeding in rumen of goats was significantly ($P<0.05$) lower in ration 2 than ration 1 (17.7 mg and 21mg per 100 ml rumen liquid, respectively). The lowest values ($P<0.05$) of pH were recorded at 4 h after feeding in both breeds. In sheep, microbial protein (MP) in the rumen fluid was significantly ($P<0.05$) higher in ration B than ration A (0.90 g and 0.84 g per 100 ml rumen liquid, respectively). It could be concluded that using of the mixture of mineral additives (N.Candles© Pharm) in feeding Sinai sheep and goats can improve the digestion coefficients, nutritive values and rumen fermentation. Further studies in this area are recommended to evaluate effect of mineral additives on animal performance and its economical return.

Keywords: Sheep, goats, mineral, alfalfa, digestibility, rumen.

INTRODUCTION

Sheep and goats are important animals in Sinai Peninsula (Alsheikh, 2013). Sinai Peninsula is an arid region and its natural vegetation is nutritionally poor in quantity and quality (Shkolnik *et al.,* 1972). Some studies noticed that trace minerals additives improved digestibility (Salama *et al.,* 2003; Fathul and Wajizah, 2010; Xun *et al.,* 2012; Abd El-Hafez *et al.,* 2016; Ibrahim, 2017). However, Kwak *et al.* (2016) and Pino and Heinrichs (2016) found that, digestibility was not affected by mineral additives. On the other hand, some studies explained that some rumen parameters may be affected by mineral additives. Mousa and Orabi (2014) found that rumen pH value was lower with mineral premix additives at 4 h post feeding. Shi *et al.* (2011) and Xun *et al.* (2012) found that rumen pH values were lower with Selenium (Se) supplementation in the diet, however some studies reported that pH values were not significantly affected by mineral mixture additives (El Ashry *et al.,* 2012; Deng *et al.,* 2013). Deng *et al.* (2013) found that rumen ammonia -N of goats was significantly increased by feeding with mixture of Sodium, Zinc and Manganese than without additives. Xun *et al.* (2012) found that, ammonia-N concentration was significantly decreased with Se supplementation to sheep rations. However, Kwak *et al.* (2016) found that rumen ammonia-N was not affected with supplementation of trace minerals mixture. Deng *et al.* (2013) found that the total of rumen volatile fatty acids of goats was significantly increased by feeding with mixture of Sodium, Zinc and Manganese than without additives at 2 and 4 h post feeding, however the differences at 0, 6, 8 and 10 h were not significant. Xun *et al.* (2012) found that total volatile fatty acids concentration was significantly increased with Se supplementation to sheep rations containing alfalfa hay. Shi *et al.* (2011) noticed that total volatile fatty acids concentration was higher in rumen of sheep fed the diet supplemented with 0.3 mg Se/kg DM, however Engle and Spears (2000), Spears *et al.* (2004), Fathul and Wajizah (2010) and Kwak *et al.* (2016) noticed that total volatile fatty acids concentration was not affected in the rumen with minerals additives.

Minerals are one of the important components associated with production and reproduction of animals (Khan *et al.,* 2014). Nawito *et al.* (2015) found that trace mineral levels were low in blood of sheep and goats grazing in Sinai. The poor nutrition level of Sinai

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sheep and goats are causing low rates of their production and reproduction. Therefore, sustainable sources of feed resources especially high quality forage crops which are tolerant to soil salinity and drought are necessarily needed in Sinai such as alfalfa (Fayed *et al.,* 2010; Abd El-Naby *et al.,* 2013; Mohamed *et al.,* 2013; Al-Geldawy, 2014). Therefore, the present study aimed to evaluate some rations with or without mineral mixture additives on digestibility, nutritive values and rumen fermentation parameters by Sinai sheep and goats.

MATERIALS AND METHODS

This study was carried out at the Animal Production Experimental Farm and laboratories of Animal Production Department, Faculty of Agriculture, Suez Canal University. Three Sinai rams aged 2 - 3 years and averaged weight 44±1.42 kg and three Sinai bucks aged 2 - 3 years and averaged weight 37±1.33 kg were used. Animals were individually housed in separate pens. Four experimental rations were evaluated in this study in two experiments. Experiment 1 was applied to evaluate two rations (1 and 2). Ration 1 contained concentrate feed mixture (CFM) and wheat straw (ratio 2:1) and ration 2 contained CFM with additive of 0.2% mineral mixture and wheat straw. Experiment 2 was applied to evaluate two rations (A and B). Ration A contained CFM, Alfalfa and wheat straw and ration B contained CFM mixed with 0.2% mineral mixture additive, Alfalfa and wheat straw. The rations in experiment 1 and 2 were isocaloric and isonitrogenous according to NRC 1985 for sheep and 1981 for goats.

The composition of CFM is yellow maize (57%), soybeen meal (15%), wheat bran (25.5%), lime stone (2%), common salt (0.5%) and anti-toxic (0.1%). The chemical compositions of CFM, wheat straw and alfalfa are shown in Table (1). The main values of DM, OM, CP, CF, EE, NFE and ash for rations are presented in Table (2).

Table (1): Chemical composition of CFM**,** Alfalfa and Wheat Straw

Items	DM (%)	Chemical composition (%) as fed					
		OM	CP	CF	EE	NFE	Ash
CFM	87.89	80.00	13.65	7.12	7.67	51.56	8.19
Wheat Straw	91.24	80.29	1.05	36.43	1.49	61.03	10.95
Alfalfa	19.28	16.92	3.80	5.64	0.41	7.07	2.36
Chemical composition (%) on DM basis							
CFM	100	90.68	15.53	8.10	8.73	58.32	9.32
Wheat Straw	100	88.00	1.15	39.93	1.63	45.29	12.00
Alfalfa	100	87.76	19.72	29.24	2.14	36.66	12.24

Mineral mixture additives (0.2%) contain 10.33g/kg calcium (Ca), 8.24g/kg phosphorus (P) as Dicalcium Phosphate ($CaHPO_4.2H_2O$), 3g/kg Magnesium (Mg) as Magnesium sulfate ($Mg\ SO_4$), 2.24g/kg Manganese (Mn) as Manganese sulfate ($Mn\ SO_4$), 3.67g/kg Iron (Fe) as Ferrous sulfate ($Fe\ SO_4$), 0.09g/kg Potassium (K) as Potassium iodide (*KI*), 151mg/kg Zinc (Zn) as Zinc sulfate ($Zn\ SO_4$), 301mg/kg Copper (Cu) as Copper sulfate ($Cu\ SO_4$), 94.4 mg/kg Cobalt (Co) as Cobalt sulfate ($Co\ SO_4$) and 6.14mg/kg selenium (Se) as Sodium selenite (Na_2SeO_3). The chemical composition of the rations 1, 2, A and B of sheep and goats were calculated from ingredients intake as shown in Table (2).

Table (2): Calculated chemical composition of the rations (% on DM basis)

Items	Ration 1	Ration 2	Ration A	Ration B
DM	100	100	100	100
OM	89.75	89.64	89.26	89.17
CP	10.62	10.62	13.09	13.09
CF	18.9	18.9	21.42	21.42
EE	6.30	6.30	5.27	5.27
NFE	53.87	53.75	49.48	49.39
Ash	10.23	10.36	10.74	10.83

The amounts of rations were divided into two equal amounts and offered to animals daily at 8:00 am and 4:00 pm. The water was available at all times. The digestibility trials were carried out for determining the digestion coefficients of feed nutrients and consequently calculate nutritive values of the rations. The digestibility trial and rumen parameters lasted 36 days as 7 days adaptation period, 21 days preliminary period, 5 days for collection period of samples and 3 days for rumen parameters. Representative samples of food and faeces were subjected to chemical analysis for determination of DM, OM, CP, CF, EE, ash and NFE following the methods of AOAC (1985). The total digestible nutrients (TDN) and digestible crude protein (DCP) were calculated. The digestibility was carried out by acid insoluble ash (AIA) as a natural marker according to Van Keulen and Young (1977). Fresh feces samples were collected for five consecutive days and dried in oven at 65°c for 24 h, then mixed, and used as representative samples. The feed and feces samples were milled to pass through a 1 mm screen and stored in plastic bags for chemical analysis. Rumen fluid samples were taken by using a stomach plastic tube at 0 time (before feeding), 2 and 4 hours post feeding. These samples were filtered through three layers of surgical gauze without squeezing. Ruminal pH was immediately estimated by digital pH meter. Rumen ammonia-N (NH_3-N) was determined according to Conway (1957). Total volatile fatty acids (TVFA's) were measured by the steam distillation method as described by Warner (1964). Total number of protozoa was counted by using Fuchs Rosenthal chamber. Rumen microbial protein was determined according to Shultz and Shultz (1970).

Data were subjected to statistical analysis by using SPSS (2011) program. Differences among treatment means were tested for significance ($p<0.05$) using Duncan' multiple range test (Duncan, 1955).

The mathematical model as the follows:

$Y_{ij} = \mu + T_i + e_{ij}$

Where:

Y_{ij} = Individual observation.

μ =The overall mean for the trial under consideration.

T_i= The effect of the i treatments.

e_{ij} = Random residual error.

RESULTS

The digestion coefficients and nutritive values as total digestible nutrients (TDN and DCP) of rations in the experiment 1 of sheep and goats are shown in Table (3). The differences of digestion coefficients of all nutrients and nutritive values as TDN and DCP of sheep between ration 1 and ration 2 were not significant except EE digestibility of ration 2 was significantly ($P<0.05$) higher than ration 1. The digestion coefficients of DM and OM and TDN of goats of ration 2 were significantly ($P<0.05$) higher than ration 1, while the differences of CF, EE and NFE digestibility and DCP between ration 1 and ration 2 were not significant.

Table (3): Digestion coefficients and nutritive values of the rations fed by sheep and goats in the experiment 1

Items	Sheep		Goats	
	Ration 1	Ration 2	Ration 1	Ration 2
Digestion coefficients, %				
DM	66.29 ±1.58	66.90 ±1.29	62.45^b ±0.25	65.11^a ± 0.23
OM	67.35 ±1.62	68.21 ±1.25	64.07^b ± 0.51	67.11^a ± 0.24
CP	64.91 ± 0.48	66.30 ± 0.33	60.25 ± 0.58	61.62 ± 0.43
CF	54.50 ± 0.53	55.97 ± 0.75	53.33 ± 1.01	54.98 ± 0.34
EE	53.27^b ± 0.40	55.60^a ± 0.31	47.44 ± 1.23	49.68 ± 1.05
NFE	75.64 ± 0.21	75.77 ± 0.38	74.09 ± 2.13	74.91 ± 1.56
Nutritive values, %				
TDN	65.45 ± 0.23	66.27 ± 0.30	63.09^b ± 1.63	64.30^a ± 0.76
DCP	6.81 ± 0.05	6.96 ± 0.34	6.33 ± 0.32	6.47 ± 0.27

[a and b] means in the same rows with different superscripts are significantly different ($P<0.05$).

The digestion coefficients and nutritive values of the experiment 2 of sheep and goats are presented in Table (4). The differences of digestion coefficients of DM, OM, CP and TDN and DCP of sheep between ration A and ration B were not significant, while the CF and EE digestibility were significantly ($P<0.05$) higher and NFE digestibility was significantly ($P<0.05$) lower in ration B than ration A. The digestion coefficients of DM and OM and TDN of goats of ration B were significantly ($P<0.05$) higher than ration A, while the differences of digestion coefficients of CP, CF, EE and NFE and DCP between ration A and ration B were not significant.

Table (4): Digestion coefficients and nutritive values of the rations fed by sheep and goats in the experiment 2

Items	Sheep		Goats	
	Ration A	Ration B	Ration A	Ration B
Digestion coefficients, %				
DM	67.25 ± 0.54	67.47 ± 0.56	65.67^{b} ± 0.52	67.40^{a} ± 0.30
OM	69.25 ± 0.53	69.72 ± 0.77	67.11^{b} ± 0.44	68.55^{a} ± 0.29
CP	69.64 ± 0.77	69.97 ± 1.04	68.71 ± 2.26	69.74 ± 2.21
CF	56.46^{b} ± 0.34	58.61^{a} ± 1.05	56.91 ± 0.06	57.84 ± 1.49
EE	56.16^{b} ± 0.50	58.48^{a} ± 0.78	53.99 ± 0.38	55.53 ± 0.38
NFE	72.92^{a} ± 0.51	70.35^{b} ± 0.45	72.79 ±1.33	72.10 ± 1.24
Nutritive values, %				
TDN	63.22 ± 0.69	64.70 ± 0.11	62.39^{b} ± 0.59	64.90^{a} ± 0.93
DCP	9.16 ± 0.25	9.19 ± 0.03	9.01 ± 0.45	9.31± 0.43

$^{a\ and\ b}$ means in the same rows with different superscripts are significantly different (P<0.05)

The rumen pH, ammonia-N (NH_3-N), TVFA's, MP and protozoa in the experiment 1 of sheep and goats are shown in Table (5). The differences of pH and NH_3-N in the rumen fluid of sheep or goats between rations 1 and 2 were not significant except the NH_3-N at 4 h post feeding in rumen of goats was significantly (P<0.05) lower in ration 2 than ration 1. On the other hand, the pH values were significantly (P<0.05) lower and NH_3-N values were significantly (P<0.05) higher at 2 h and 4 h than 0 h after feeding in sheep and goats. The differences of total volatile fatty acids (TVFA's), microbial protein (MP) and protozoa numbers in the rumen fluid of sheep or goats between ration 1 and ration 2 were not significant.

Table (5): pH, ammonia-N (NH_3-N) (mg/100ml), total VFA's (mEq/100ml), MP (g/100ml) and protozoa numbers ($\times 10^3$/ml) in rumen fluid of sheep and goats in the experiment 1

Items	Time	Sheep		Goats	
		Ration 1	Ration 2	Ration 1	Ration 2
pH	**0**	6.60^{A} ± 0.05	6.57^{A} ± 0.02	7.22^{A} ± 0.04	7.21^{A} ± 0.02
	2	6.46^{A} ± 0.15	6.25^{B} ± 0.81	6.56^{B} ± 0. 07	6.48^{B} ± 0.08
	4	5.97^{B} ± 0.05	5.91^{C} ± 0.09	6.37^{B} ± 0.09	6.35^{B} ± 0. 12
NH_3-N	**0**	18.05 ±1.12	17.11^{B} ± 0.82	14.93^{B} ±1.43	13.69^{B} ± 1.36
	2	21.93 ± 1.68	19.60^{A} ± 1.62	20.53^{A} ± 0.93	18.04^{A} ± 2.24
	4	21.16 ± 2.04	19.13^{A} ± 0.47	21.00^{aA} ± 0.81	17.73^{bA} ± 0.93
TVFA's	**4**	8.22 ± 0.22	9.44 ± 0.30	8.66 ± 0. 66	9.38 ± 0.66
MP	**4**	0.73 ± 0.03	0.79 ± 0.03	0.73 ± 0.02	0.77 ± 0.04
Protozoa	**2**	247.222 ± 27.64	262.778 ± 22.62	262.333 ± 19.73	290.556 ± 20.73

$^{a\ and\ b}$ means in the same rows with different superscripts are significantly different (P<0.05).
$^{A,,B\ and\ C}$ means in the same column with different superscripts are significantly different (P<0.05).

The rumen pH, ammonia-N (NH_3-N), TVFA's, MP and protozoa in the experiment 2 of sheep and goats are presented in Table (6). The differences of pH values at all times in the rumen fluid of sheep between ration A and ration B were not significant, while the pH values in the rumen fluid of goats were significantly (P<0.05) lower in ration B than ration A. On the other hand, the pH values of sheep and goats were significantly (P<0.05) lower at 2 and 4 h post feeding than 0 h. The lowest (P<0.05) values of pH were recorded at 4 h after feeding in both breeds. The differences of NH_3-N in the rumen fluid of sheep or goats between ration A and ration B were not significant. The highest values (P<0.05) of NH_3-N were recorded at 2 h post feeding. The differences of TVFA's and protozoa numbers in the rumen fluid of sheep or goats between ration A and ration B were not significant. The MP in the rumen fluid of sheep was significantly (P<0.05) higher in ration B than ration A, while the difference of MP in goats was not significant.

Table (6): pH, ammonia-N (NH_3-N) (mg/100ml), total VFA's (mEq/100ml), MP (g/100ml) and protozoa numbers ($\times10^3$/ml) in rumen fluid of sheep and goats in the experiment 2.

Items	Time	Sheep		Goats	
		Ration A	Ration B	Ration A	Ration B
pH	0	$7.60^{A} \pm 0.07$	$7.49^{A} \pm 0.08$	$7.67^{aA} \pm 0.02$	$7.32^{bA} \pm 0.06$
	2	$6.86^{B} \pm 0.09$	$6.80^{B} \pm 0.14$	$7.07^{aB} \pm 0.03$	$6.52^{bB} \pm 0.07$
	4	$6.52^{C} \pm 0.05$	$6.50^{C} \pm 0.05$	$6.67^{aC} \pm 0.02$	$6.18^{bC} \pm 0.06$
NH_3-N	0	$25.20^{B} \pm 1.62$	$24.73^{B} \pm 1.23$	$28.93^{B} \pm 1.87$	$26.60^{B} \pm 2.14$
	2	$32.61^{A} \pm 0.51$	$31.73^{A} \pm 0.93$	$32.67^{A} \pm 0.47$	$32.46^{A} \pm 0.58$
	4	$30.64^{A} \pm 1.32$	$28.93^{A} \pm 0.47$	$30.18^{B} \pm 1.25$	$29.33^{B} \pm 0.78$
TVFA's	4	10.00 ± 0. 80	11.34 ± 1.23	10.66 ± 0.66	11.34 ± 0.66
MP	4	$0.84^{b} \pm 0.02$	$0.90^{a} \pm 0.01$	0.88 ± 0.01	0.89 ± 0.01
Protozoa	2	238.333 ± 11.10	245.556 ± 10.64	248.889 ± 14.08	260.556 ± 14.44

$^{a\ and\ b}$ means in the same row with different superscripts are significantly different (P<0.05).
$^{A,,B\ and\ C}$ means in the same column with different superscripts are significantly different (P<0.05).

DISCUSSION

The results of the present study revealed that mineral mixture supplementation had slightly improved digestion coefficients and nutritive values especially EE digestibility of sheep in experiment 1 and CF and EE, and NFE digestibility of sheep experiment 2, also DM and OM digestibility and TDN of goat in both experiments. These results agreed with the results obtained by Fathul and Wajizah (2010). Salama *et al.* (2003) showed that Zn supplementation increased digestibility of DM and OM of goats. However, Kwak *et al.* (2016) and Pino and Heinrichs (2016) found that the digestion coefficients of DM, OM, CP, EE, CF and NFE% were not affected by additives of trace minerals. The obtained data showed that TDN values were significantly increased with mineral additives of the goat in both experiments. Abd El-Hafez *et al.* (2016) found that Se additive significantly increased TDN. As essential component of the antioxidant defense system, Se plays a role in metabolism through their participation in enzyme reactions (Willshire and Payne, 2011). The role of Se in improving nutrient digestibility could relate to its effect on increasing rumen microbial population and activity (Faixova *et al.,* 2007 and Xun *et al.,* 2012). However, Ibrahim (2017) found that TDN and DCP were not affected with Se supplementation. The improvement of NFE digestibility might be due to Cu enhanced ruminal fermentation (Engle and Spears, 2000).

The rumen pH is affected by fermentation products in the rumen, therefore, the pH is the most direct and important parameter reflecting rumen fermentation status (Prasad *et al.,* 1972). The variation of rumen pH is affected by dietary composition and nutrient levels (Russell and Rychlik, 2001). In this study the data explained that pH values in the both experiments ranged from 5.91 to 7.1 after feeding. The mineral addition did not significantly affect pH values except the pH in ration B was significantly lower than ration A in goats. These results agreed with those obtained by Deng *et al.* (2013) who found that rumen pH values were not significantly affected by feeding with mineral mixture. Mousa and Orabi (2014) found that pH value was lower at 4 h post feeding with mineral premix additive. Also Osman *et al.* (2007) found that the lowest pH values recorded at 2h post feeding, while Saleh (2003) and Shakweer (2003) noticed that the lowest ruminal pH values were recorded at 3 h post feeding. Fathul and Wajizah (2010) found that the addition of copper and manganese did not affect ruminal pH. The decrease in pH values after feeding may be due to the increasing in TVFA's production in the rumen. The NH_3-N values in this study increasing after feeding until 21.93 mg /100 ml in sheep rumen fluid in the experiment 1 and 32.67 mg/100 ml in goats rumen fluid in the experiment 2 at 2 h post feeding. The data obtained in this study explained that the differences of NH_3-N in the rumen fluid of sheep or goats between ration 1 and ration 2 were not significant except the NH_3-N at 4 h post feeding in rumen of goats was significantly lower in ration 2 than ration 1. The NH3-N values were significantly higher at 2 h and 4 h than 0 h in sheep and goats. Qi *et al.* (1992), Fathul and Wajizah (2010) and Kwak *et al.* (2016) found that mineral additives did not affect ruminal NH_3-N. However, Xun *et al.* (2012) found that ruminal ammonia N was significantly decreased with Se supplementation. In this study, the increasing in NH_3-N in the experiment 2 than the experiment 1 may be due to the high percent of protein in alfalfa consumed by animals in the experiment 2. Also, the highest values of NH_3-N were recorded at 2 h for goats post feeding. These results agreed with those obtained by Osman *et al.* (2007). However, Saleh (2003) found that the highest NH_3-N values were recorded at 3 h post feeding, while Shakweer (2003) found that the highest NH_3-N values were recorded at 6 h post feeding. Generally the NH_3-N values in the rumen are affected by values feed nitrogen and degradability of nitrogen sources to NH_3. The TVFA's are the main end products of the fermentation of carbohydrates in the rumen. The total VFA's in these study ranged from 8.22 to 9.44 mEq/100ml rumen fluid in the experiment 1 and ranged from 10.00 to 11.34 mEq/100ml rumen liquor in the experiment 2. The effect of mineral mixture additives on TVFA's production in the rumen was not significant. These results agreed with those obtained by Engle and Spears (2000), Spears *et al.* (2004), Fathul and Wajizah (2010) and Kwak *et al.* (2016). However, Zhang *et al.* (2007), Shi *et al.* (2011), Xun *et al.* (2012) and Deng *et al.* (2013) found that total of TVFA's concentration was increased in the rumen with mineral supplementation. Generally, the production of TVFA's in the rumen depends on dietary composition, rumen environment and microbial population (Weimer, 1998). The rumen microbial protein (MP) in this study ranged from 0.73 to 0.79gm/100ml rumen fluid in the experiment 1 and ranged from 0.84 to 0.90 gm/100ml rumen fluid in the experiment 2. The highest values of MP in experiment 2 than experiment 1 may be due to the high production of NH_3 in the rumen. Or-Rashid *et al.* (2001) stated that ammonia-N concentration in the rumen directly influences microbial protein synthesis. In both experiments, mineral additives were not significantly affect MP production in the rumen except MP in rumen of sheep fed ration B was significantly higher than ration A. Sonawane and Arora (1976) noticed that the microbial protein synthesis was increased with additional Zn. Also, Se supplementation may increase the ruminal microbial protein synthesis as effective ruminal degradability and the nutrient digestion in the total tract was improved and increased ruminal VFA concentration and switched rumen fermentation pattern from acetate to propionate (Xun *et al.,* 2012). Se supplementation could increase rumen microbial population and activity (Mihaliková *et al.,* 2005, Faixova *et al.,* 2007 and Wang *et al.,* 2007). The reduction of ammonia-N concentration by Se supplementation could be due to an enhanced growth of ruminal microbial populations which increased the ammonia N consumption (Xun *et al.,* 2012). Generally, the synthesis of microbial protein depends on different factors such as roughage: concentrate ratio in the diet, the sources of carbohydrates and proteins, the level of voluntary intake, the rumen recycle of microbes and the synchronization of nutrient releaseinthe rumen as stated by Rodríguez *et al.* (2007). In both experiments, results showed that the mineral additives were not significantly affecting rumen protozoa. Generally, the count and species of the rumen protozoa were influenced by several factors such as composition of the diet, rumen pH, frequency of feeding and level of feeding as reported by Santra and Karim (2002).

CONCLUSION

It would be concluded that using of the mixture of mineral additives (N.Candles© Pharm) in feeding males of Sinai sheep and goats may improve the digestion coefficients**,** nutritive values and rumen fermentation. Mineral mixture could be added (0.2%) to the rations contained concentrate feed mixture and wheat straw with or without alfalfa. Further studies in this area are recommended to evaluate effect of mineral additives on animal performance and its economical return.

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"دراسات على معاملات الهضم وتخمرات الكرش لبعض العلائق المحسنة في ذكور الأغنام والماعز السيناوى"

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من أجل تحسين إنتاجية الأغنام والماعز في سيناء تم تقييم تأثير التغذية باستخدام إضافات مخلوط الأملاح المعدنية (التجربة ١) ومخلوط الملاح المعدنية مع البرسيم الحجازي (التجربة ٢) على معاملات الهضم والقيم الغذائية وتخمرات الكرش. تم تطبيق التجربة ١ لتقييم عليقتين، حيث احتوت العليقة ١ على خليط الأعلاف المركزة وتبن القمح (نسبة ٢: ١). احتوت العليقة ٢ على خليط الأعلاف المركزة مع إضافة مخلوط الاملاح المعدنية بنسبة ٠.٢ ٪ وتبن القمح. تم تطبيق التجربة ٢ لتقييم عليقتين ، حيث احتوت العليقة أ على خليط الأعلاف المركزة والبرسيم الحجازي وتبن القمح. وتحتوي العليقة ب على خليط الأعلاف المركزة ممزوج بنسبة ٠.٢٪ من مخلوط الأملاح المعدنية، البرسيم الحجازي وتبن القمح. تم استخدام ثلاثة كباش وثلاثة جديان من سيناء تتراوح أعمارهم بين ٢ و ٣ سنوات. تم قياس الرقم الهيدروجيني، الأمونيا- ***N*** ، والأحماض الدهنية المتطايرة ، البروتين الميكروبي والطفيليات في سائل الكرش في ٠ و ٢ و ٤ ساعات بعد التغذية. أشارت نتائج التجربة ١ إلى أن الفروق في معاملات الهضم بين العليقة ١ العليقة ٢ لم تكن معنوية ، في حين أن قابلية هضم مستخلص الأثير في العليقة ٢ (٥٥.٦ ٪) كانت أعلى معنويا ***(P<0.05)*** من العليقة ١ (٥٣.٣%) في الأغنام. كان معامل الهضم للمادة الجافة (٦٥.١٪) والمادة العضوية (٦٧.١٪) في العليقة ٢ أعلى معنويا ***(P<0.05)*** من العليقة ١ (٦٢.٥ ٪ و ٦٤.١ ٪ على التوالي) في الماعز. كانت معاملات الهضم للألياف الخام (٥٨.٦ ٪) ومستخلص الأثير (٥٨.٥ ٪) من العليقة ب أعلى معنويا ***(P<0.05)*** من العليقة أ (٥٦.٥ ٪ و ٥٦.٢ ٪ على التوالي) في الأغنام. كانت معاملات الهضم للمادة الجافة (٦٧.٤٪) والمواد العضوية (٦٨.٦٪) في العليقة ب أعلى معنويا ***(P<0.05)*** من العليقة أ (٦٥.٧ ٪ و ٦٧.١ ٪ على التوالي) في الماعز. في الأغنام، كان المستخلص الخالي من الازوت في العليقة ب اقل معنويا ***(P<0.05)*** من العليقة أ (٧٠.٤ ٪ و ٧٢.٩٪ على التوالي). في الماعز، كان إجمالي الطاقة الكلية المهضومة أعلى معنويا ***(P<0.05)*** في العليقة ٢ عن العليقة ١ (٦٤.٣٪ و ٦٣.١٪ على التوالي) و كذلك في العليقة ب عن العليقه أ (٦٤.٩ ٪ و ٦٢.٤ ٪ على التوالي). كانت قيمه الأمونيا- ***N*** عند الساعة ٤ بعد الأكل اقل معنويا ***(P<0.05)*** في العليقه ٢ عن العليقة ١ (١٧.٧ ملجم و ٢١ ملجم لكل ١٠٠ مل سائل كرش على التوالي). كانت فروق الأس الهيدروجيني في الماعز معنويه ***(P<0.05)*** في العليقة ب عن العليقة أ عند الساعة ٠ و ٢ و ٤ (٧.٧ و ٧.٣ ، ٧.١ و ٦.٥، ٦.٧ و ٦.٢ على التوالي). في الأغنام، كان البروتين الميكروبي أعلى معنويا ***(P<0.05)*** في العليقة ب عن العليقة أ (***0.9*** جم و ٠.٨٤ جم / ١٠٠ مل من سائل الكرش). يمكن الاستنتاج أن استخدام مخلوط الأملاح المعدنية (***N. Candles © Pharm***) في تغذية أغنام وماعز سيناء يمكن أن يحسن معاملات الهضم والقيم الغذائية وتخمرات الكرش**.** لذلك يمكن أن يضاف الخليط المعدني (٠.٢%) إلى العليقة الغذائية المحتوية على خليط الأعلاف المركزة وتبن القمح في حاله عدم وجود علف اخضر والى العليقة المحتوية على خليط الأعلاف المركزة والبرسيم الحجازي وتبن القمح إذا كان البرسيم الحجازي متاحا في التغذية. ويوصى بإجراء مزيد من الدراسات في هذا المجال لتقييم تأثير مخلوط الأملاح المعدنية على أداء الحيوانات وعائدها الاقتصادي.