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EFFECT OF SOME FEED ADDITIVES ON DIGESTIBILITY COEFFICIENTS, BLOOD PARAMETERS, GROWTH PERFORMANCE AND FEED EFFICIENCY OF GROWING LAMBS.

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SUMMARY

This study was conducted at Sedes Experimental Station, Animal Production Research Institute, Agricultural Research Center. A total of 20 growing Frafra lambs averaged 19.5 kg live body weight and aged from 6 to 8 months of age was divided into four similar groups according to their body weights, 5 lambs in each. Lambs in each group were fed a basal diet consisted of concentrate feed mixture (CFM) and rice straw (RS). Lambs in the 1st group were fed control diet (C). While the basal diet of lambs was supplemented with yea-Sacc at a level of 4 g/h/d in the 2nd group (YS), kelp meal at a level of 15 g/h/d in the 3rd group (KM) and acid buf at a level of 5 g/h/d in the 4th group (AB). All feed supplements in tested groups were daily added to CFM. Throughout the experimental period (10 weeks), LBW, total gain and average daily gain (ADG) were calculated for each group. Blood samples were taken from all lambs before morning feeding at the end of experiment to determine concentrations of total protein, albumin and urea in blood serum. Digestion trials were conducted using 16 mature Frafra rams, four animals fed diet of each group. RESULTS *revealed that* average total daily feed intake as fed and on DM basis slightly increased by lambs in YC group and decreased by lambs in KM and AB groups as compared to those in the control group. Digestion coefficient of DM significantly ($P<0.05$) decreased, while those of OM, CP, CF, EE and NFE significantly ($P<0.05$) increased in all supplemented groups than in the control one. All dietary supplementations led to insignificant changes in concentration of total protein, albumin, globulin and albumin to globulin ratio in blood plasma of lambs in all supplemented groups. However, significant ($P<0.05$) increase in concentration of urea was observed in blood plasma of all supplemented groups as compared to the control group, being the highest in AB group. Final weight, total gain and average daily gain was significantly ($P<0.05$) the highest in lambs fed YS diet. On the basis of the foregoing results, it could be concluded that feeding Frafra lambs on CFM supplemented with Yeast culture has beneficial effects on growth performance, digestibility coefficients and blood parameters, but in light on the economic point of view, feeding Frafra lambs on CFM supplemented with Acid buf show the highest

economic feed efficiency in term of the lowest cost of each kg gain as compared to Yeast culture, Kelp meal and the control diets.

***Keywords:** lambs, Yea-Sacc, kelp meal, acid buf, growth performance.*

INTRODUCTION

Throughout the recent years in Egypt, there are many attempts to solve the shortage in meat production to meet the increasing demands of human consumption. Some of these efforts were conducted by using feed supplements such as yeast culture, minerals, vitamins and buffering agents of ruminal condition.

Several authors reported that using yeast culture (YC) in ruminant feeding increases, the efficiency of energy utilization and growth performance of buffalo calves (El-Ashry *et al.*, 2002), Friesian calves (Ibrahim *et al.*, 1997 and Abdel-Khalek *et al.*, 2000) and lambs (El-Shaer, 2003). Also, dietary YC supplementation improves metabolites (Abdel-Khalek *et al.*, 2000) and flow of bacterial nitrogen to the small intestine (Erasmus *et al.*, 1992), which stimulates protein synthesis in growing animals.

There is a great attention on using seaweed in ruminant feeding in the recent years in Egypt. Kelp meal is *Ascophyllum nodosum* seaweed and has been used as a natural source feed supplement for organic macro and micro minerals (Acadian Seaplants Limited, Canada). Also, Acid buf is a novel product working as a rumen buffer, which has been derived from mineralized seaweed. Addition of Acid buf dramatically prevents change of pH in the rumen, thereby stabilizing the microbial population (Celtic Sea Minerals, Strand Farm, Currabinny, Co. Cork, Ireland).

Using seaweed in feeding growing calves significantly improved digestibility coefficient of most nutrients and growth performance of supplemented animals than the controls (Mehany *et al.*, 2003). However, no available information on the effect of seaweed on feed efficiency and productivity of lambs.

This work was carried out to study the effects of dietary supplementation of Yea-Sacc, Kelp meal and Acid buf on growth performance, digestibility coefficients, blood parameters and economic feed efficiency of growing lambs.

MATERIALS AND METHODS

This study was conducted at Sedes Experimental Station, Animal Production Research Institute, Agricultural Research Center, Ministry of Agriculture.

Animals and feeding system:

A total of 20 growing Frafra lambs averaged 19.5±0.5 kg live body weight and aged from 6 to 8 months of age was divided into four similar groups (5 lambs in each) according to their body weight. Lambs were fed a basal diet consisted of concentrate feed mixture 60% CFM and 40% rice straw RS. Lambs in the 1st group were fed basal diet without any supplementation and was served as a control (C). While 2nd group was supplemented with yea-Sacc at a level of 4 g/h/d (YS). Supplementation of kelp meal at a level of 15 g/h/d was served in the 3rd group (KM) and acid buf at a level of 5 g/h/d in the 4th group (AB). All feed supplements in tested groups were daily introduced at the the time of feeding CFM.

The CFM consisted of 35% decorticated cotton seed cake, 25% corn grains, 30% wheat bran, 5% molasses, 2% limestone, 1.5% salt and 1.5% mineral and vitamin mixture.

Yea-Sacc^{1026} is a mixed microbial supplement containing dried fermentation products and live yeast culture (*Saccharomyces cerevesiae*, 1026). Kelp meal (Acadian Sea plants Limited, Canada) is *Ascophyllum nodosum* seaweed and has been used as a natural source feed supplement for organic macro and micro minerals. While, Acid buf is a naturally produced product, derived from mineralized seaweed, which is rich in calcium and other macro and micro minerals.

Animal feeding allowances were biweekly adjusted according to changes in their body weight. Proximate chemical analysis of CFM, RS and other dietary supplements is shown in table (2).

Table (1): Proximate chemical analysis of feed stuffs and additives used in animal feeding.

Feedstuffs	DM%	Chemical analysis (on DM basis)					
		OM	CP	CF	EE	NFE	ASH
CFM	91.2	91.30	14.5	13.6	3.8	59.4	8.7
RS	89.9	87.8	3.4	40.9	2.5	41.0	12.2
YC (Yea-Sacc^{1026})	91.0	91.5	47.2	5.5	1.7	37.1	-
Kelp meal	85.4	74.2	12.1	13.2	2.4	46.4	25.8

CFM=Concentrate feed mixture, RS= Rice straw

Experimental procedures:

Throughout the experimental period (160 days), individual live body weights (LBW) of lambs in all groups were weekly recorded, and then total gain and average daily gain (ADG) were calculated for each group. Blood samples were taken from the jugular vein of all lambs into test tubes before morning feeding at the end of experiment.

Blood serum was separated from the coagulated blood samples by centrifugation at 4000 rpm for 15 min. and kept frozen at -20°C for later analyses. Concentrations of total protein (Gornall *et al*., 1949), albumin (Weichselaum, 1946) and urea-N (Patton and Crouch, 1977) in blood serum were determined using commercial kits (Pasteur Lab. Egypt-USA). However, concentration of globulin was computed by subtracting albumin from total protein. In addition, economic feed efficiency was performed at the end of the experiment.

Digestibility trials:

Digestion trials were conducted using individual metabolic cages and 16 mature Frafra rams (4 animal each). Animal were fed the basal diet and additives in two equal portions at 8.0 and 16 and water was available at all time. Each trail lasted 15 days as a preliminary period and 7 days as a collection period. Chemical analysis of feeds and feces was determined according to A.O.A.C. (1990).

Statistical analysis:

Statistical analysis was carried out for testing the group differences according to Snedecor and Cochran (1982). However the significant differences among groups were performed using Multiple-Range Test (Duncan, 1955).

RESULTS AND DISCUSSION

Digestibility coefficients:

Results presented in table (2) revealed significant (P<0.05) effect of dietary treatment on digestibility coefficients of all nutrients. Digestion coefficients of DM and OM significantly (P<0.05) decreased, while those of CP, CF, EE and NFE significantly (P<0.05) increased in all supplemented groups than in the control one. It is worth noting that feed intake as fed and on DM basis increased in all supplemented groups was associated with increasing digestibility coefficients of most nutrients (Table 2).

Table (2): Digestibility coefficients of mature lambs in different treatment groups at the end of the experimental period.

Item	Treatment group			
	C	YS	KM	AB
Digestibility coefficient (%)				
DM	68.90[a]	60.50[b]	58.07[b]	61.33[b]
OM	64.81[a]	59.53[b]	57.09[b]	60.70[b]
CP	58.57[b]	65.48[a]	62.32[a]	64.86[a]
EE	51.57[c]	61.36[a]	55.10[b]	54.13[b]
CF	45.07[c]	61.66[a]	59.03[a]	50.36[b]
NFE	52.75[b]	64.57[a]	61.02[a]	61.20[a]
Nutritive values (%):				
DCP	6.29[b]	7.04[a]	6.70[a]	6.97[a]
TDN	47.71[d]	56.23[a]	51.92[c]	53.99[b]

[a, b ... d]: Significant group differences at P<0.05.

C= Control, YS= Yea-Sacc treatment, KM= Kelp meal treatment, AB= Acid Buf treatment.

It observed that the tested feed additives were resulted in an increase in digestibility coefficients (Table 2). The increase in nutrients digestion of rams fed YS diet as compared to the control diet is associated with the findings of Williams (1989), who indicated that yeast culture supplemented to diet enhanced initial rate of ruminal digestion of diet. The present results are in agreement with those reported by many authors, who found that YC could increase digestibility of CF (Basiony, *et al.*, 1998; Abdel-Khalek, *et al.*, 2002; Al-Dabeeb and Ahmed, 2002; Ragheb *et al.*, 2003; Shitta, 2005; Salama *et al.*, 2005; Gaafar *et al.*, 2005 and El-Mekass and Safaa, 2007). Addition of *Saccharomyces cerevisiae* culture to the diet of sheep has improved the digestion of CP, and hemicelluloses, which in turn lead to an increase in digestibility of protein and flow of microbial nitrogen to post-ruminal (Allam, *et al.*, 2001).

The beneficial effects of YS supplementation on nutrient digestion were mainly attributed to the observed greater microbial efficiency via stimulation of rumen proteolytic bacteria and increasing the number of rumen cellulytic bacteria by dietary addition of yeast culture (Williams, 1988 and Dawson *et al.*, 1990).

The observed increase in digestibility coefficients of most nutrients in the other two supplemented groups (KM and AB) was mainly attributed to the buffering capacity of seaweeds on rumen condition of rams. Addition of such buffers will dramatically prevent change of pH in the rumen, thereby stabilizing the ruminal microbial population.

Increasing concentrations of beneficial microorganisms and enhanced microbial activities can be expected to lead to enhanced digestive processes and the destruction of metabolic intermediates that can result in ruminal dysfunction.

The improvement in digestibility coefficients of rams fed the supplemented diets lead to significant (P<0.05) increase in the nutritive values of all supplemented diets as TDN and DCP as compared to the control diet, being the highest for YS diet which reflected faster growth and the highest daily gain of lambs of YS group. Similar trend was reported by (Al-Dabeeb and Ahmed, 2002; Khattab *et al.*,2003; and El-Mekass *et al.*,2005).

Blood constituents:

All dietary supplementations led to insignificant changes in concentration of total protein, albumin, globulin and albumin to globulin ratio in blood plasma of lambs in all supplemented groups. However, significant (P<0.05) increase in concentration of urea was observed in blood plasma of lambs in all supplemented groups as compared to the control group, being the highest in AB group (Table 3).

The obtained results come in line with those reported by many investigators using yeast culture in diets of animals. In agreement with the present results, Abdel-Khalek *et al.* (2000) found that concentration of globulin did not significantly differ in supplemented group than the control group. On the other hand, the significant increase in urea concentration of lambs in all supplemented groups, suggesting higher protein utilization in supplemented lambs than the control lambs, being the highest in lambs of AB group. Such trend was associated with significantly higher digestibility coefficient of CP in all supplemented groups than the control one (Table 3).

Table (3): Blood serum constituents of weaned calves fed the experimental diets.

Biochemical content	Treatment group			
	C	YS	KM	AB
Total protein (g/dl)	7.65	7.35	7.42	7.91
Albumin (g/dl)	4.34	4.14	4.37	4.54
Globulin (g/dl)	3.31	3.21	3.05	3.37
Albumin/ Globulin ratio	1.31	1.29	1.43	1.35
Urea (mg/dl)	21.69^{c}	23.49^{b}	24.66^{ab}	25.96^{a}

a, b and c: Significant group differences at P<0.05

- C= Control, YS= Yea-Sacc treatment, KM= Kelp meal treatment, AB= Acid buf treatment.

In contrast to the obtained results, supplementation of yeast culture decreased (P<0.05) blood urea of Friesian calves (Ibrahim *et al,* 1997 and Abdel-Khalek *et al.*, 2000) and Egyptian buffalo calves (El-Ashry *et al.*, 2002). Such trend may reflect the normal physiological status and normal liver function of lambs fed all supplements (Streov and Makarova, 1989). Generally, values of serum total protein and its Fractions were in the normal range recorded by William (1997) who reported that the normal blood of sheep has a range of 6 to 8 gm/100ml for protein values.

Feed intake:

Throughout the entire length of feeding period, average total daily feed intake slightly increased by lambs in YC group and decreased by lambs in KM and AB groups as compared to those in the control group (Table 4).

Table (4): Effect of dietary supplementation on average daily feed intake of lambs on DM basis.

Item	Treatment group			
	C	YS	KM	AB
Feed intake on DM basis (g/h/d):				
CFM	504	504	485	485
RS	321	331	297	319
Total	825	835	782	804
Concentrate: Roughage ratio	61:39	60:40	62:38	60:40

C= Control, YS= Yea-Sacc treatment, KM= Kelp meal treatment, AB= Acid buf treatment.

It is of interest to note that the increase in CFM intake of KM group or the decrease in YC and AB groups was associated with concentrate to roughage ratio (Table 4).

The pronounced increase in feed intake of lambs fed YC as compared to other supplemented groups (KM and AB) may suggest higher efficiency of microbial fermentation in rumen of lambs as affected by dietary supplements. Many authors indicated pronounced increase of feed intake of ruminants fed diets supplemented with YS and rate of rate of passages (Wohlt *et al.*, 1998; Robinson and Garrett, 1999; Dann, *et al.*, 2000; Abdel-Khalek *et al.*, 2002; El-Saadany *et al.*,2002; El-Mekass *et al.*,2005 and El-Mekass and Safaa.,2007). However, the decrease of feed intake of diets supplemented with seaweeds was attributed to the buffering effect of KM and AB on microbial fermentation in rumen of lambs and the less rate of passages as indicated by Mehany *et al.*(2003) when fed growing Friesian calve seaweeds.

Growth performance:

Growth performance of lambs shown in Table (5) indicated that final weight, total gain and average daily gain was significantly ($P<0.05$) the highest in lambs fed YS diet. The pronounced increase in average daily gain of lambs in YS group was mainly attributed to marked pronounced increase in total DM intake (Table 4) and significant ($P<0.05$) improvement of digestibility coefficients of CP and CF as compared to the control and other supplemented groups.

Generally, the pronounced increase in total weight gain and nearly similarity of feed intake of lambs fed YC diet as compared to the control diet was reflected in significant ($P<0.05$) best feed conversion.

However, the marked increase in total weight gain and decrease in feed intake of lambs fed KM or AB diets was associated with significant ($P<0.05$) better feed conversion of these groups compared to those fed the control diet (Table 5).

In agreement with the present results El-Shaer (2003) reported beneficial effects of feeding lambs on diet supplemented with yeast culture. Also, several investigators indicated highest daily gain of calves fed dietary yeast culture (Ibrahim *et al.*, 1997; Abdel-Khalek *et al.*, 2000 and El-Ashry *et al.*, 2002). Also, Mehany *et al* (2003) found that Friesian calves fed Kelp meal as a dietary supplementation led to pronounced improvement in growth performance.

Table (5): Growth performance and feed efficiency of lambs fed the experimental rations.

Item	Treatment group			
	C	YS	KM	AB
Number of animal	5	5	5	5
Feeding period (days)	160	160	160	160
Growth parameters:				
Initial weight (kg)	19.5	19.6	19.7	19.2
Final weight (kg)	43.2^{b}	46.3^{a}	44.6^{ab}	43.6^{b}
Total gain (kg)	23.7^{b}	26.7^{a}	24.9^{ab}	24.4^{ab}
Average daily gain (g)	148^{b}	167^{a}	156^{b}	153^{b}
Feed conversion (kg /kg gain):				
D M	5.57^{c}	5.00^{a}	5.01^{a}	5.25^{b}
TDN	2.66	2.81	2.60	2.83
DCP	0.35	0.35	0.34	0.37

$^{a \text{ and } b}$: Significant group differences at P<0.05

- C= Control, YS= Yea-Sacc treatment, KM= Kelp meal treatment, AB= Acid buf treatment.

Many investigators have attributed the beneficial effects of YS directly to change in the ruminal fermentation and in microbial population and it's syntheses in the rumen and digestive tract (Dawson *et al.*,1990; Wallace, 1994; Valdes *et al.*,2000 and Salem,2003).

However, the beneficial effects of Kelp meal and acid buf were mainly in relation to the role of these seaweeds as dietary supplements in buffering the rumen condition of lambs. Such buffers prevent changes of ruminal pH value, thereby stabilizing the ruminal microbial population in lambs (Prasad *et al.*,1972; Van Soest.,1982; Dominguez.,1992; Wali.,1994 and Salama *et al.*,2005).

Table (6): Economic efficiency of feeding growing lambs on the experimental diets.

Item	Treatment group			
	C	YS	KM	AB
Average daily gain (g)	148	167	156	153
Average daily feed cost (L.E):				
CFM	0.68	0.68	0.62	0.54
RS	0.03	0.03	0.02	0.02
Supplementation	-	0.24	0.11	0.02
Total	0.70	0.94	0.76	0.59
Cost of each kg gain (L.E)	4.76	5.65	4.86	3.84
Cost of kg as % of the control	100	119	102	81

- Price of CFM was 1200 L.E. per ton
- Price of rice straw was 70 L.E. per ton.
- Price of each kg from Yea-Sacc, Kelp meal and Acid buf was 70, 7.5 and 3.5 L.E., respectively. (These preices are for year 2007)
- C= Control, YS= Yea-Sacc treatment, KM= Kelp meal treatment, AB= Acid buf treatment.

Economic efficiency:

Results of economics of feeding lambs on all supplemented diets as compared to the control diet (Table 6) revealed that total cost of each kg gain increased by about 21 and 2% in YC and KM groups, however, it decreased by about 19% in AB group as compared to the control one.

In spite of the highest average daily gain of lambs fed YC diet and the lowest daily gain with AB group, the later one was showed better economic efficiency. This is attributed to the higher cost of YC as compared to other supplementations and the less feed intake of AB group.

CONCLUSION

On the basis of the foregoing results, it could be concluded that feeding Frafra lambs on CFM supplemented with Yeast culture has beneficial effects on growth performance, digestibility coefficients and blood parameters, but in light on the economic point of view, supplementing Frafra lambs with Acid buf could be better economic feed efficiency in terms of feed additives cost.

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تأثير بعض الأضافات الغذائية على معاملات الهضم ، خصائص الدم والنمو والكفاءة الغذائية للحملان النامية

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أجريت هذه الدراسة بمحطة سدس التابعة لمعهد بحوث الانتاج الحيوانى . عشرون حمل من سلالة الفرافرة متوسط وزنها ١٩.٥كج و اعمارهم تتراوح بين ٦ الى ٨ اشهر تم تقسيمها الى ٤ مجاميع متماثلة تبعا لاوزانها واعمارها . ٥ حملان فى كل مجموعة. غذيت الحملان كل المجاميع على عليقة كونترول مكونة من علف مركز و قش ارز . حملان المجموعة الاولى غذيت على عليقة الكونترول فقط بينما اضيف يوميا الى العليقة المركزة فى المجموعة الثانية ٤جم/رأس/يوم خميرة ال ى . ساك و اضيف الى العليقة المركزة فى المجموعة الثالثة ١٥جم/رأس/يوم عشب البحر واضيف الى العليقة المركزة فى المجموعة الرابعة ٥جم/رأس/يوم اسد باف . خلال الفترة التجريبية و مدتها ١٠ اسابيع تم تقدير الوزن الحى واجمالى النمو ومتوسط النمو اليومى لكل المجاميع. تم اخذ عينات دم من كل الحملان قبل اليغذية الصباحية فى نهاية الفترة التجريبية لتحديد البروتين الكلى و الألبومين واليوريا فى سيرم الدم . أجريت تجربة هضم بأستخدام ١٦ كبش من سلالة الفرافرة.أربع حيوانات فى كل مجموعة غذيت مثل مجاميع الحملان. اظهرت النتائج أن كمية المأكول اليومية الطازجة أو على اساس المادة الجافة قد زادت قليلا فى حملان المجموعة التى اضيف اليها خميرة ال ى . ساك و قلت فى المجموعة التى اضيف اليها عشب البحر والمجموعة التى اضيف اليها الأسد باف مقارنة بمجموعة الكونترول. معامل هضم المادة الجافة قل معنويا بينما زاد معنويا معامل هضم المادة العضوية و الالياف و البروتين و الدهن الخام فى كل المجاميع المعاملة مقارنة بمجموعة الكونترول. كما أظهرت كل المجاميع المعاملة عدم وجود تغيير معنوى فى تركيز البروتين الكلى و الالبومين و الجلوبيولين ونسبتهما الى بعضهما فى بلازما الدم فى حين وجد زيادة معنوية فى تركيز اليوريا مقارنة بمجموعة الكونترول. الوزن النهائى و الزيادة الكلية و اليومية فى الوزن كانت اعلى معنويا فى مجموعة الحملان التى اضيف اليها خميرة ال ى . ساك. على اساس النتائج المتقدمة يمكن القول بأن تغذية الحملان على علف مركز مضاف الية خميرة ال ى له اثر ايجابى فى معدلات النمو و معاملات الهضم و قياسات الدم المختلفة ولكن من الوجهة الاقتصادية أظهرت التغذية على علف مركز مضافا اليه اسد باف كفاءة غذائية واقتصادية عن المجموعات التجريبية الأخرى.