EFFECT OF *SACCAROMYCES CEREVISIAE* SUPPLEMENTATION ON RUMEN CHARACTERISTICS IN AWASSI LAMBS FED DIETS WITH DIFFERENT ROUGHAGE TO CONCENTRATE RATIOS

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ABSTRACT

Thirty two Awassi male lambs with initial body weight(27±1.78 kg), and four to five months old, were allocated into four equal groups in factorial experiment to study the effect of two roughage to concentrate rations (R:C, 60:40 and 40:60) supplemented with two levels of *Saccharomyces cerevisiae* (0 and 5 g *S. cerevisiae* / head / day) on rumen fermentations rate[Total volatile fatty acids(TVFA) ,pH and ammonia concentration (NH_3-N)] . The diets were offered in quantity to achieve 150 g daily gain .Results shown no differences in daily dry matter intake(DMI) and daily gain across treatments. As well as no significant effect for R: C ratio on TVFA and pH whereas, propionic, butyric acids and NH_3-N increased significantly (P<0.05) with high concentrate diets, but the molar proportion of acetic significantly (P<0.05) decreased with high levels of concentrate diets. S *cerevisiae* supplementation showed significantly (P<0.05) increased in TVFA, propionic and butyric acid, whereas, significantly (P<0.05) decreased acetic acid and NH_3-N. Significant(P<0.05) interaction were shown between high level of concentrate and S *cerevisiae* supplementation in TVFA, propionic, butyric acid ,acetic acid and NH_3-N whereas, no significant effect on pH .In conclusion ,S *cerevisiae* supplementation to high concentrate diet significantly (P<0.05) increased TVFA, propionic and butyric acid, whereas, significantly (P<0.05) decreased acetic acid and NH_3-N .

Key words : Lambs ,S. cerevisiae, Roughage to Concentrate Ratios, rumen characteristics.

تأثير إضافة خميرة الخبز *SACCAROMYCES CEREVISIAE* على صفات الكرش في علائق الحملان العواسي مع مستويات مختلفة من العلف المركز الى الخشن

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المستخلص

تم اخذ 32 حمل عواسي بوزن ابتدائي (27 ± 1.78 كغم) وبعمر اربعة الى خمسة اشهر ، قسمت الى اربع مجاميع متساوية بتجارب عاملية لدراسة تأثير مستويين من خميرة الخبز (0 و 5 غم /رأس/يوم) في معدل تخمرات الكرش (الأحماض الدهنية الطيارة الكلية TVFA) وتركيز الأس الهيدروجيني والأمونيا NH_3-N. وجهزت كمية الغذاء للحصول على 150 غم زيادة وزنية يومية. أظهرت النتائج عدم وجود فروقات معنوية في المتناول اليومي من المادة الجافة (DMI) والزيادة الوزنية اليومية بين المعاملات وكذلك لا يوجد تأثير معنوي لنسبة العلف المركز الى الخشن على الأحماض الدهنية الطيارة الكلية وتركيز الأس الهيدروجيني ، بينما حصلت زيادة معنوية عند مستوى معنوية (P<0.05) لكل من البروبيونيك وحامض البيوتريك والامونيا مع مستوى عالٍ من العلف المركز ولكن انخفضت النسبة المولية للأسيتيك معنوياً (P<0.05) مع مستوى عالي من العلف المركز. أظهرت اضافة خميرة الخبز حصول زيادة معنوية (P<0.05) في الأحماض الدهنية الطيارة الكلية ، البروبيونيك وحامض البيوتيريك بينما حصل انخفاض معنوي (P<0.05) في حامض الاسيتيك والأمونيا. حصلت زيادة معنوية(P<0.05) لتأثير التداخل بين مستوى عالي من العلف المركز واضافة خميرة الخبز لكل من الأحماض الدهنية الطيارة الكلية والبيروبيونيك وحامض البيوتريك وحامض الاسيتيك والامونيا بينما لايوجد تأثير معنوي على الأس الهيدروجيني.نستنتج ان اضافة خميرة الخبز الى مستوى عالي من العلف المركز ادى الى حصول زيادة معنوية(P<0.05) للأحماض الدهنية الطيارة الكلية والبروبيونيك وحامض البيوتريك ، بينما حصل انخفاض معنوي (P<0.05) في حامض الأسيتيك والأمونيا.

الكلمات المفتاحية: حملان، خميرة الخبز، نسبة العلف المركز الى الخشن، صفات الكرش.

INTRODUCTION

Recent research has focused on the feeding of direct-fed microbial such as S. cerevisiae as feed additives because of its beneficial effects on animal performance (2;25) . Although, there have been numerous theories proposed, the mode of action of yeast culture has not yet been defined. *S. cerevisiae* are able to grow rapidly in the rumen and facilitate fiber digestion (15). Micro-nutrients found in *S. cerevisiae* also stimulate cellulolytic bacteria growth (7). In addition, *S. cerevisiae* also protect ruminal fermentation from lactic acid accumulation (46). Based on the theory proposed by Newbold et al,(44), *S cerevisiae* in the rumen environment can utilize the remaining dissolved oxygen and save anaerobic microorganisms from the toxic effect of oxygen. Previous and recently researches focusing on feeding dairy cows and sheep with *S. cerevisiae* have had variable results. Several reasons may account for these variations including levels of feeding (23), protein levels and degradability(24;25), forage to concentrate ratio (2),quality of the forage and nutrient composition of the diet(22), amount of yeast supplemented, type and number of viable yeast, ect. It was concluded that yeast supplementation in the diets of dairy cows and growing lambs increased the ruminal pH and VFA concentrations (49). However, the digestive advantages of enhanced nutrient digestibility (21), rumen fermentation and subsequent production parameters provide justification for nutritionists to continue to research yeast culture supplementation. The objectives of this experiment were to test the interactions between the *S. cerevisiae* supplementation and roughage to concentrate (R:C) ratios on rumen fermentation rat (TVFA, NH_3-Nconcentration and pH) in Awassi male lambs.

MATERIALS AND METHODS

***Animals and Management*:** Thirty two Awassi male lambs were paired by weight and each assigned to a sequence using 2x2 factorial experimental design . Lambs ranged from four to five months of age and with a mean weight of 27$\pm$1.78 kg. Fourteen days prior to the start of the trial, lambs were vaccinated and de wormed .Lambs were assembled at the Animal Resources Department Field/College of Agriculture/ University of Baghdad and housed individually in 1.5x1.5m pens. Water was provided *ad libitum* and lambs housed and maintained in hygienic environment according to the farm system.

Diets: In the experiment ,two diets with a roughage :concentrate ratios of 60:40 (high roughage, HR) and 40:60 (high concentrate, HC) were formulated, both with and without the inclusion of a yeast (*Saccharomyces cerevisiae*, Lesaffire 59703 Marcq France). The experimental treatments diets were: D1) high roughage with no supplemental *s. cerevisiae* (HR); D2) high roughage with *s. cerevisiae* supplemented (HRSC); D3) high concentrate with no supplemental *s. cerevisiae* (HC); and D4) high concentrate with *s. cerevisiae* supplemented (HCSC). Paragraph supplemental *s. cerevisiae* was added to the concentrate as a top-dressing at each feeding at level of 5 g *s. cerevisiae* /hd/d within the total ration .Diets were formulated to meet recommended requirements for ME and CP and fed at levels to achieve 150 g/d (3).The concentrate ration was composed primarily of barley, yellow corn, wheat, wheat bran and soybean meal, while the roughage component was alfalfa hay. proximate analysis of concentrate ingredients and alfalfa hay are presented in Table 1. Formulation and chemical composition of treatment diets are presented in Table 2.Prior to feeding the treatment diets, all lambs were allowed 14 days acclimatization period and the experimental diets were also gradually introduced.The roughage and concentrate diets were offered once daily, refusals of the diets were collected and weighed before offering of another was made the next day. Offered and refused feed were sampled weekly and stored at -20 ^{0}C freezer specify for subsequent chemical analysis .The quantity of roughage and concentrate diets offered for each lambs were weekly adjusted according to the body weight changes in order to ensure that the intake would be sufficient to achieved daily gain of 150 g .Recording of daily intake and live-weight gain were maintained for nine weeks throughout the feeding trial .The lambs were weighed weekly before compounding for that morning feeding.

Table 1. Chemical analysis of the diets ingredients (% on dry matter basis).

Chemical composition %	Barley	Yellow corn	Soybean meal	Wheat	Wheat bran	Alfalfa hay
DM % of fresh	90.81	87.79	91.00	89.50	95.16	90.24
Organic matter (OM)	88.13	86.59	84.80	87.66	90.32	81.49
Crude protein (CP)	12.34	8.93	44.0	13.22	14.60	16.52
Crude fiber (CF)	6.02	1.97	5.9	2.60	11.06	23.60
Ether extract (EE)	2.01	3.54	4.9	1.9	2.91	1.63
Nitrogen free extract (NFE)ذذ	67.76	72.15	30.00	69.94	61.75	39.74
Neutral detergent fiber (NDF)	26.20	14.60	47.52	25.12	55.50	58.12
Acid detergent fiber (ADF)	4.42	7.25	9.62	5.16	13.16	36.73
Cellulose	3.66	3.49	8.66	4.94	11.20	30.91
Hemi cellulose	21.78	7.35	37.9	19.96	42.34	21.39
Acid detergent lignin (ADL)	1.09	1.89	2.22	1.34	3.49	5.82
Metbolizaible energy (ME, MJ/kg DM)*	12.2	13.1	13.0	12.9	12.9	6.31

***Metabolizable energy (ME) values are estimate according to following equation: ME (MJ/kg DM) = [- 0.45 + (0.04453×% TDN)] × 4.184 . While TDN was estimated according to the equations of Kearl (32) as follows: TDN for roughages (% of DM) = -17.2649+1.2120(%CP) + 0.8352 % NFE+2.4637 % EE+0.4475 %CF;TDN for energy feeds (% of DM) =40.3227+0.5398 % CP+0.4448 % NFE+1.4218 % EE–0.7007 %CF.**

Table 2. Formulation and chemical composition of treatment diets (% on dry matter basis).

Items	HR Diet	HRSC Diet	HC Diet	HCSC Diet
Diet number	D1	D2	D3	D4
Ingredients %				
Alfalfa hay	60	60	40	40
Barley	14	14	21	21
Yellow corn	4	4	6	6
Soybean meal	6	6	9	9
Wheat	4	4	6	6
Wheat bran	11.2	11.2	16.8	16.8
Minerals & Vitamins	0.4	0.4	0.6	0.6
Salt	0.4	0.4	0.6	0.6
S cerevisiae (SC) g/h/d	-	5	-	5
Chemical composition %				
DM	92.86	92.86	94.1	94.1
OM	83.25	83.25	84.14	84.14
CP	14.9	14.9	14.13	14.13
CF	17.27	17.27	14.11	14.11
EE	2.25	2.25	2.57	2.57
NFE	48.83	48.83	53.33	53.33
NDF	49.35	49.35	44.97	44.97
ADF	25.63	25.63	20.09	20.09
ADL	5.94	5.94	6.00	6.00
ME MJ/Kg DM	9.7	9.7	10.3	10.3

HR: High roughage diet, HR SC: High roughage supplemented with *S. cerevisiae*, HC: High concentrate, HCSC: High concentrate supplemented with *S. cerevisiae.*

Rumen fermentation characteristics

At the end of the experiment (last three days) rumen fluid samples were withdrawn from the lambs before morning feeding (zero time), 3 and 6 hours post feeding using a stomach tube as described by Saeed (51). Rumen fluid was immediately measured for pH using Orian 680 digital pH meter, USA, which was adjusted with 4 and 9 standard pH solutions.Samples were then filtered through four layers of cheesecloth to discard the sold unfermented particles.Then 10 ml subsamples were preserved by addition of 0.2 ml of 50% sulfuric acid to kill bacterial action and capture ammonia, and stored at –20 C° until subsequent analysis (31). Frozen strained rumen fluid samples were thawed at room temperature and shaken, then the contents were transferred into glass tubes and centrifuged, the supernatant was analyzed for ruminal ammonia-N by the method of steam distillation with MgO (4), TVFA by the method of Markham (38). The molar proportions of individual VFA were determined by chromatography technique

using high performance liquid chromatography (HPLC) according to Zinn and Owens (62).

Chemical Analysis

Samples of ingredients used in the formulation of concentrate diets, the offered and refused concentrate diets and alfalfa hay during feeding trials were dried in electric oven at 100°C until constant weight, while feces were dried at 60°C (60). Dried samples were then ground by grinder and kept in plastic well closed containers for chemical analysis. The commercial product of Baker's yeast (*S. cerevisiae*) containing about 5.6 × 108 colony forming unit (CFU) was used as additive. Chemical analysis of diets including DM, OM, CP, EE and CF were determined according to AOAC (4). NDF, ADF and ADL were determined according to the method of Goering and Van Soest (19).

Statistical analysis

Data obtained during the experiment was statistically analyzed according to the procedures of SAS (52). Duncan's,(9) multiple range test was used to separate the treatment means using the same software package and the treatments were partitioned into main effects and their interactions.

RESULTS AND DISCUSSION

Daily feed intake

The lambs were consumed all the diets offered and differences in R:C ratio were successfully achieved . The main effect of R:C ratio and *S. cerevisiae* supplementation and their interactions on average daily gain and intake by lambs are shown in Table (3). There were no difference between R:C ratios in DM, and OM intake .Whereas ,differences in CP and CF intake occurred between R:C ratios (P>0.05); these differences were not statistically significant when daily intake was expressed as g / kg $W^{0.75}$. These results could be attributed to the differences in chemical composition of tested feedstuffs and R:C ratios. Same results reported by Kumari et al, (34) when male lambs fed 60:40,50:50, 40:60 and 30:70 roughage to concentrate ratios ;they found dietary variations did not affect the DM Intake; while, CF intake increased with increasing level of roughage with increasing level of concentrate; a mathematical increase in DM, OM and CP intake due to addition of *S. cerevisiae*. Similar observations were shown by Hassan and saeed (24)when lambs fed restricted level of feeding; Whereas e , disagree with El- Hassan et al. (10) when animals fed *ad libitum* access to feed. Whereas, CF increased significantly (P<0.01) with *S. cerevisiae* supplementation ; These result agrees with other findings ,which reported a positive influence of *S. cerevisiae* on intake in growing animals (48; 35; 53 and 37), whereas, other reported no effect (45). The positive effects of addition of *S. cerevisiae* were attributed to: 1) stimulation development of cellulolytic and lactate-utilizing bacteria in the rumen (29), which can improve voluntary feed intake (58).Other authors (56) suggested that *SC* provides stimulatory factors such as amino acids, and peptides that increase the number of cellulolytic bacteria and could lessen the negative effects associated with high concentrate diets by increasing the population of lactic acid-utilizing bacteria such as *Selenomonas ruminantium and Megasphaera elsdenii*; 2) The alterations in ruminal fermentations relating to decreased lactic acid concentrations which can be reflected in improved intake (28). Statistically interaction (P>0.05) were shown between R:C ratios and *SC* supplementation; CF significantly (P<0.05) increased with high roughage and *SC* supplementation. The positive effect of addition of *S. cerevisiae* improved feed intake by stimulation of cellulolytic and lactate-utilizing bacteria in the rumen (29). Sontakke, (54) revealed that SC increased feed intake .

Daily gain

Results in table 3 revealed that FBW and ADG of lambs were not significantly affected by R:C ratios .As well as statistical analysis revealed that FBW was not significantly affected by addition of *S. cerevisiae*, whereas, ADG was significantly (P < 0.05) affected, where, higher values were achieved by a group of lambs fed diet with added *S. cerevisiae* (143.7g/d).;These increases was mainly related to the significant(P<0.05) interaction between R:C ratios and *S. cerevisiae* supplementation ,which shown higher ADG by lambs fed HC supplemented with *S. cerevisiae* (146.6g/d). Many studies reported increasing gain due to the addition of SC to sheep diet (18; 40), goat kids (12).

Table 3. Effect of roughage to concentrate ratios, *S. cerevisiae* supplementation and their interaction on daily intake and live weight gain

Items	Initial BW (Kg)	F BW (Kg)	ABG (g/d)	DMI (g/d)	OMI (g/d)	CPI (g/d)	CFI (g/d)
Roughage : Concentrate ratios							
HR	28.33 ±	36.7 ±1.0	135.9 ±7.2	912 ±30	758 ±25	127 ±4b	160 +5.8a
HC	27.62±(	36.21±1	139.0 ±1	943 ±29	795 ± 24	138 ±4a	137 ±3.9b
SC supplementation							
Without SC	27.91±(	36.0 ±0	131.7±6.6b	914 ±33	767 ±27	132 ±4a	146 ±6.1b
With SC	28.00±(	36.9 ±1	143.7±5.	941 ±27	786 ±23	133 ±4a	152 ±5.9a
Interaction (roughage: Concentrate ratio with SC supplementation)							
HR	28.16±1.6	36.3±1.5	131.6 ±19b	900 ±50	749 ±41	126 ± 4	157 ±6a
HRSC	28.50±1.5	37.2±1.3	140.3±16a	924 ±33	767 ±28	128 ±4 a	164 ±10a
HC	27.66±0.9	35.8±1.3	131.7±10b	928 ±25	785 ±82	138 ±4 a	135 ±4b
HCSC	27.5±1.7	36.6±2.1	146.4±15a	959 ±51	805 ±47	139 ±7 a	139 ±7ab

High roughage ; HRSC : High roughage with SC; HC:High concentrate ; HCSC: High concentrate with SC a, b: Means in the same column for each item with different superscripts differ significantly (P<0.05).

Rumen fermentation characteristics*:*

Effects of roughage to concentrate ratios and addition of SC on rumen fermentation characteristics were estimated as mean values for all sampling time during which samples of rumen liquid were withdrawn from experimental lambs, while, the diurnal changes in these parameters have been illustrated histogramatically taking into consideration that sampling time was not introduced in the statistical analysis to avoid exaggerations and complications.

Main effect of roughage to concentrate ratios on rumen fermentation characteristics:

Table 4 .showed no significant effect for R: C ratio on TVFA and PH whereas, propionic, butyric acids and NH3-N increased significantly (P<0.05) with high concentrate diets, but the molar proportion of acetic significantly (P<0.05) decreased with high levels of concentrate diets. These results may be attributed to high-energy diets causes' rapid accumulation of products of fermentation with accompanying changes in the relative proportion of these sources. This result is contrary to the results of some researchers, where they found an increase in TVFA with high level of concentration and decreased with high level of roughage (8; 6). Gaafar, et. al, (16) showed ruminal PH decreased, but TVFAs and NH3-N concentrations significantly effect with increasing level of concentrate. These results are in accordance with those obtained by Mohsen, et. al., (42) who stated that the concentration of TVFAs and NH3-N in rumen liquor of Friesian calves increased, but PH value decreased with increasing level of concentrate mixture and decreasing level of corn silage in the rations. Vlaeminck, et. al., (59).

Table 4. Mean effect of roughage :concentrate ratios on rumen fermentation characteristics

Items…	Roughage : concentrate ratios		Significance of effects
	60:40	40:60	n =72
pH	6.80±0.02a	6.70±0.10a	N.S
NH_3-N mg/ 100 ml	119.46±0.17b	121.00±0.05a	*
TVFA mmol/l	92.71±2.00a	93.54±1.70a	N.S
Acetic acid (%) C_2	60.53±0..26a	56.25±1.3b	*
Propionic acid (%) C_3	17.71±0.04b	19.28±1.4a	*
Butyric acid (%) C_4	8.91±00b	10.79±0.05a	*

Means in the same row with different superscripts are significantly different
*** (P<0.05) ** (P<0.01) NS= Non significant.**

reported that TVFA concentration increased with dietary concentrate. Flachowsky, et. al., (14) stated that low portions of hay NH3-N, the ration significantly reduced the pH value and increased the concentration. Rotger, et. al., (50) found that heifers fed one of two forage to concentrate ratio decreased NH3-N, but no differences in ruminal pH and total VFA concentration between diets. Herman, (26) showed that cows fed diets with differed in roughage: concentrate ratio, dry matter intake (DM) (kg/day) did not differ between

treatments in NH3-N concentrations and total VFA and lower ruminal acetic: propionic acid compared to the other treatments. Diurnal pattern affect in rumen fermentation parameters as affected by R:C ratio are presented in Figures 1, 2, 3,4 and 5.

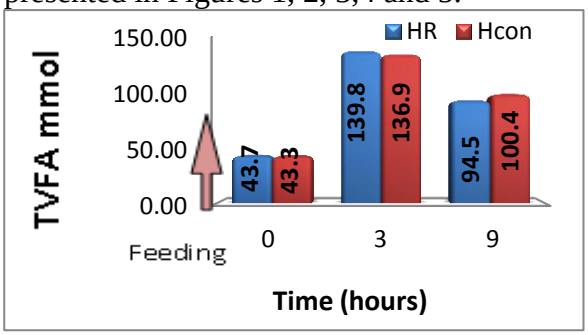

Figure 1.The Diurnal pattern affect of R:C ration of TVFAmmol

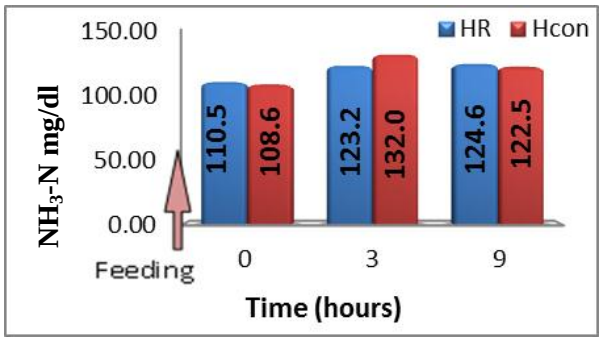

Figure 2.The Diurnal pattern affect of R:C ration of NH_3-N mg/dl

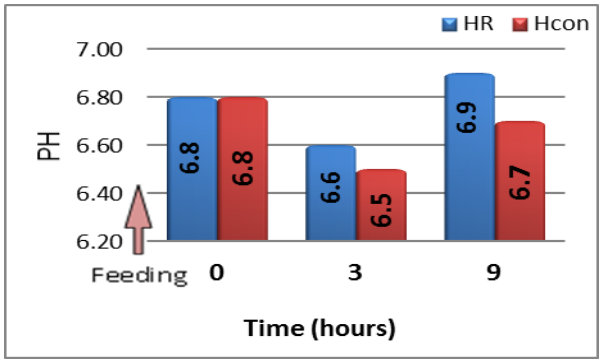

Figure 3.The Diurnal pattern affect of R:C ration of pH

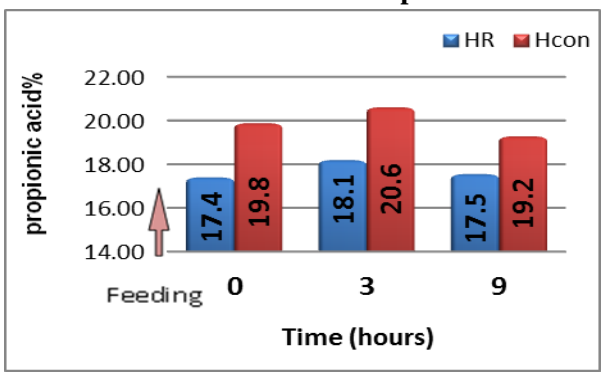

Figure 4.The Diurnal pattern affect of R:C ration of propionic acid%

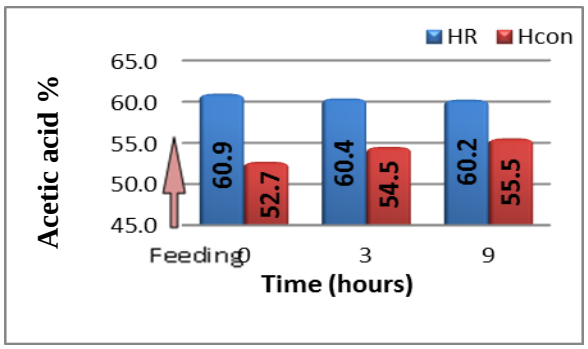

Figure 5.The Diurnal pattern affect of R:C ration of Acetic acid%

Main effect of SC supplementation on rumen fermentation characteristics:

Table 5 revealed significant ($P<0.05$) increased TVFA, propionic and butyric acid, but significant ($P<0.01$) decreased NH3-N, whereas no differences in acetic acid and PH with Sc supplementation. This differences might be due the rumen, therefore decreases of lactic acid concentrations are to the associated with higher ruminal PH this led of much more stable direct effect of Sc,preventing the accumulation of lactic acid in ruminal fermentation. Feeding hay as a sole diet generally maintains a high level of ruminal PH, which favors the increase in the ratio of acetate to propionate (57). This result agrees with Kamel, et. al., (30) showed that a small decrease in NH3-N concentration by inclusion of yeast Sc in a hay diet. Total VFA concentration increased with Sc supplementation. (11; 1) Similarly, Galip, (17) reported that the cultures when added to the ration with grain diet consisted of 70% grain diet and 30% alfalfa hay, no statistic significant effect of Sc on ruminal pH. Similar findings were reported by many studies (1; 33 and 36). This decrease may be resulted from increased incorporation of ammonia into microbial protein. Gaafer, et. al., (2009) ruminal PH value and NH3-N concentration decreased, while ruminal TVFA as concentration increased with baker's yeast supplementation compared to without yeast supplementation. Mousa, et. al., (43) found that sheep fed Sc at levels of 5 or 7.5 g/h/d, TVFA and pH was increased but ammonia-N was lower in. Miller, et. al,. (41) reported that cows when fed direct-microbial (DFM), there was no significant effect on the VFA profile in

the rumen. However and there was a propionic acid and lower acetate: propionate ratio in when treated groups compared to the control groups. Zain, et .al.,(61) demonstrated that added Sc in the diet at 0.25, 0.5 and 0.75% on dry matter in diet were significant for rumen pH, NH3-N and TVFA concentrations. Diurnal pattern affect in rumen fermentation significant (P<0.05) increase in rumen parameters as affected by SC supplementation are presented in Figures 6,7, 8,9 and 10.

Table 5. Mean Effect of SC supplementation on rumen fermentation characteristics

Items	SC supplementation		Significance of effects n = 72
	Without SC	With SC	
pH	6.70±0.09a	6.70±1.03a	NS
NH_3-N mg/ 100 ml	122.34±0.05a	118.16±0.14b	**
TVFA mmol/l	90.74±0.91b	95.50±155a	*
Acetic acid (%) C_2	59.94±0.26a	58.17±1.64a	N.S
Propionic acid (%) C_3	17.58±0.1b	20.05±1.3a	*
Butyric acid (%) C_4	9.83±01b	9.87±0.8a	*

Means in the same row with different superscripts are significantly different
***(P<0.05) ** (P<0.01) NS= Non significant**

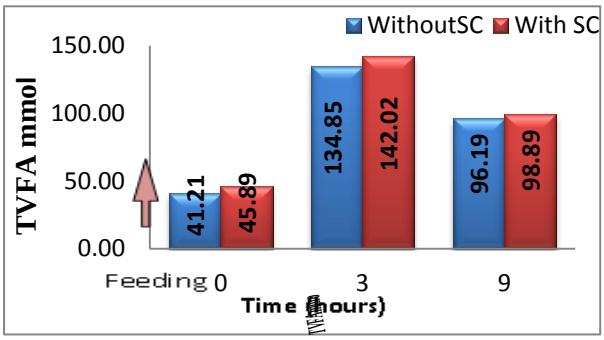

Figure 6. The Diurnal pattern affect of R:C ration of TVFA mmol

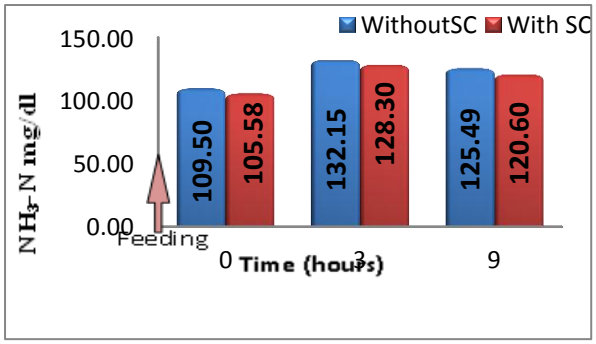

Figure 7.The Diurnal pattern affect of R:C ration of NH_3-N mg/dl

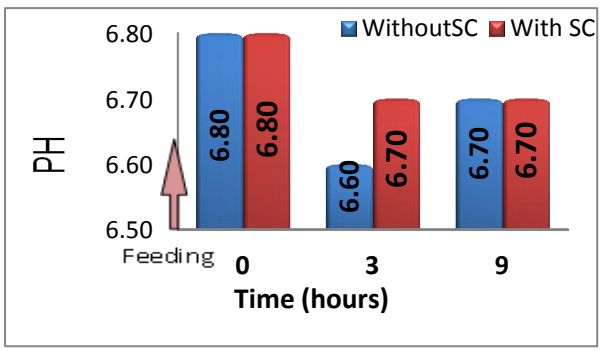

Figure 8.The Diurnal pattern affect of R:C ration of pH

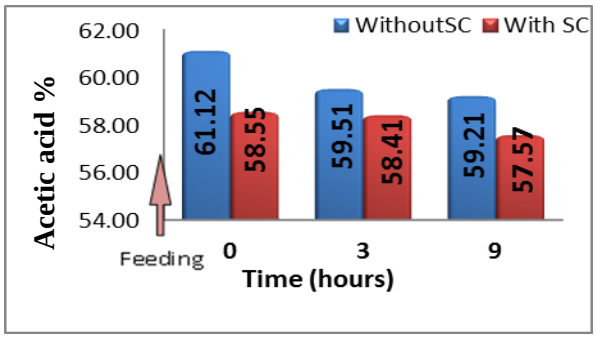

Figure 9.The Diurnal pattern affect of R:C ration of acetic acid%

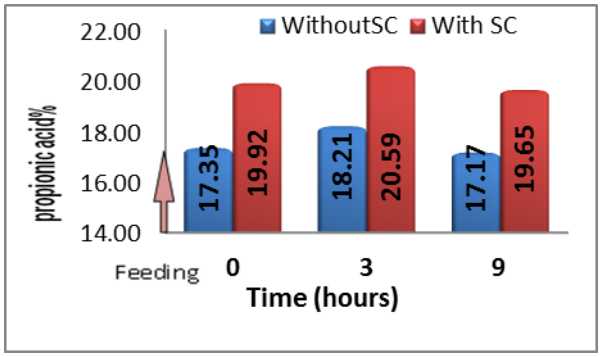

Figure 10.The Diurnal pattern affect of R:C ration of propionic acid%

Interaction effect between roughage to concentrate ratios and SC: Table 6. showed significantly (P<0.05) increased in TVFA, propionic and butyric acid, whereas, significantly (P<0.05) decreased acetic acid and NH3-N whereas, no significant effect on PH with high level of concentrate and Sc supplementation .This may indicate that the Sc supplementation alone had the potential for changing ruminal VFA production pattern

without diet nutrient composition . Tripathi, et. al.,(55) reported that lambs were fed 25:75 roughage to concentrate supplemented with Sc, decreased pH and total volatile fatty acid (TVFA) concentration. There are several studies where ruminal pH was unaffected by yeast supplementation (5; 47). Whereas,

Fatma, et. al., (13) reported that animals fed a diet composed of 25% forage and 75% concentrat supplemented with 4 g/d of live yeast culture containing Sc. Molar proportions of acetate were decreased, and propionate was increased with supplementation of live yeast culture. No differences observed for ruminal PH, TVF and NH3-N concentrations. Hristov, et. al., (27) investigate the effect of yeast culture (Sc) and found little effect on ruminal fermentation. The concentration of ruminal NH3-N and PH, increased (P<0.01), TVFA, propionic and acetic: propionic ratio with (P<0.05), no significant in acetic and butyric acid. In other studies, showed that improvement of ruminal TVFA concentration due to addition of yeast (1; 17). Hamed, et.al.,(20) demonstrated that mature male sheep fed diets contained 50:50 concentrate to roughage significant affected (P<0.05) PH , NH3-N and (TVFA's) concentrations. Mehmet, et. al.,(39) noticed that ruminal PH reductions associated with feeding high dietary concentrate (70%) in dairy cows can be prevented with the LY supplementation .

Table 6. Mean effect of the interaction between roughage :Concentrate ratios and SC

Items	Interaction (Roughage :Concentrate ratios with *S. cerevisiae* supplementation)				Significance of effect
	HR Without Sc	HR With Sc	HC Without Sc	HC With Sc	n=72
PH	6.70±0.33a	6.70±0.05a	6.60±0.05a	6.70±2.5a	N.S
NH_3-N mg/ 100 ml	121.46±0.13a	117.46±0.2b	123.23±0.05a	118.86±0.21b	
TVFA mmol/l	89.24±0.86b	96.17±0.03a	92.25±0.62b	94.85±3.7a	*
Acetic acid (%)C_2	60.30±0.1a	60.76±0.5a	59.58±0.3a	55.58±1.5b	*
Propionic acid (%)C_3	17.76±0.06b	17.66±0.06b	18.09±0.19b	20.48±0.01a	*
Butyric acid (%)C4	9.44±0.02c	8.38±0.0c	10.23±0b	11.36±0.1a	*

supplementation on rumen fermentation characteristics

a, b, and c: Means in the same row for each item with different superscripts different significantly * (P<0.05) ** (P<0.01) N.S : No significant HR (60% roughage: 40% concentrate without baker's yeast). HR (60 %roughage: 40% concentrate with baker's yeast).HC (40%roughage: 60% concentrate without baker's yeast). HC (40% roughage: 60% concentrate with baker's yeast).

REFERENCES

1.Abd El-Ghani, A. A. 2004. Influence of diet supplementation with yeast (*Saccharomyces cerevisiae*) on performance of Zaraibi goats. Small Rumin. Res., 52:223-229.

2.Ali ,B. M. and GÖKSU, S. 2013. Effects of live yeast supplementation on ruminal parameters and lactation performance of dairy cows fed medium or high levels of dietary concentrate. Kafkas Univ. Veterinary Fakultesi Dergisi., 19 :1 -57.

3.Al-Jassim, R .A. M.; Hassan, S. A. and Al-Ani, A. N.1996. Metabolizable energy requirements for maintenance and growth of Awassi lamb. Small Ruminant Res.,20:239-245.

4.AOAC. 1990. Official Methods of Analysis . 15th end. Association of Official Analytical Chemists ,Arlington, Virginia.

5. AvendanÄo, H.; GonzaÂlez, M. S.; Mendoza, M. G. D. and BaÂrcena, G. R .1997. Effect of corn stover level and a yeast culture (*Saccharomyces cerevisiae1026*) on growing lambs, J. Anim. Sci., 73: 616.

6.Chen, S.; Paengkoum Xia, C. P. X. and Na-Lumping,P. 2010. Effects of dietary protein on ruminal fermentation, nitrogen utilization and crude protein maintenance in growingthai-indigenous beef cattle fed rice straw as roughage. J. Anim. Vet. Adva., 9:2396-2400.

7.Dawson, K. A .; Neuman, K.E and Boling, J.A . 1990 . Effects of microbial supplements containing yeast and lactobacilli on roughage-fed ruminal microbial activities. J. Anim Sci., 68: 3392-3398.

8.Driedger, L. J.; Loerch, S. C. and Schoonmake, J. P. 1998. Effects of protein concentration and source on nutrient digestibility and rumen characteristics of steers limit-fed high-concentrate diets. J. Anim. Sci., Vol. 76, Suppl.1.

9.Duncan, D. B .1955. Multiple ranges and multiple"F"test. Biometrics, 11:1-12.

10.El- Hassan, S. M.; New bold, C. J.; Edwards, I .E.; Topps, J. H and Wallace, R. J. 1996. Effects of yeast culture rumen fermentation, microbial protein flow from the rumen and live-weight gain in bulls given high cereal diets. J. Anim. Sci.,62: 43.

11.El-Waziry, A.M.; Kamel, H.E.M. and Yacout, M.H.M. .2000. Effect of baker's yeast supplementation to berseem (*Trifoliumalexan-drinum*) hay diet on protein digestion and rumen fermentation of sheep. Egyptian J. Nutrition and Feeds., 3: 71-82.

12.Fadel-Elseed AMA, Abusamra RMA, 2007. Effects of supplemental yeast (*Saccharomyces cerevisiae)* culture on NDF digestibility and rumen fermentation of forage sorghum hay in Nubian goat's kids. Res J Agric Biol Sci, 3:133-137.

13.Fatma, I.; Emel, G.; Behic, C.; Mustafa, S. A.; Ozcan, B. C.; Esadsam ,P.; Erdogan ,S.; Cahi ,O .2010. The effects of live yeast culture *(Saccharomyces cerevisiae*) on rumen fermentation and nutrient degradability in yearling lambs. Kafkas Univ Vet FakDerg 16, 5: 799-804.

14.Flachowsky, G.; Erdmann, K.; Lebzien, P. and Hüther, L. 2006. Investigations on the influence of roughage to concentrate ratio and linseed oil supplementation on rumen fermentation and microbial protein yield in dairy cows. Slovak J. Anim. Sci., 39, 1: 3-9.

15.Fuller R,1989. Probiotics in man and animals. J . Appl Bact., 66: 365-378.

16.Gaafar,H.M.A.; Mohi El-Din, A.M.A.; Basiuoni , M. I and El-Riedy , K.F.A . 2009. Effect of concentrate to roughage ratio and baker's yeast supplementation during hot season on performance of lactating buffaloes, Slovak J. Anim. Sci., 42 ,4: 188-195.

17.Galip, N. 2006. Effect of supplemental yeast culture and sodiubicarbonate on ruminal fermentation and blood variables in rams. J AnimPhysiolAnimNutr, 90, 446-452.

18.Garg DD, Sharma T, Dhuria RK, 2009. Evaluation groundnut straw based complete feed blocks alone and in combination with yeast in ration of sheep. Anim Nutr Feed Tech, 2:9.

19.Goering, H. K. and Van Soest, P. J. 1970. Forage Analysis. Agriculture Handbook, U.S. Department of Agriculture. Washington DC. 156-194.

20.Hamed, A.; Omer, M. A.; Tawila, A. and Sawsan, M. G. 2012. Feed and water consumptions, digestion coefficients, nitrogen balance and some rumen fluid parameters of Ossimi sheep fed diets containing different sources of roughages. J. life Sci., 9, 3:805-816.

21.Hassan,S.A . and S. F.Mohammmed.2014. Effects of Saccharomyces cerevisiae supplementation on growth rate and nutrient digestibility in Awassi lambs fed diets with different roughage to concentrate ratios. Biochemistry and Biotechnology Research Vol. 2(3), 2354-2136 .ISSN. Full Length Research Paper.

22.Hassan .S.A.,Y. M.A. El-Saady and Tawffek, J. A..2009. Effect substitution gradually percentages of reed silage with alfalfa hay fed with probiotic to Awassi lamb . 1- on daily feed intake ,live weight gain and feed conversion ratio. Iraqi J.of Agric.Sci.,40,1:138-147.

23.Hassan .S.A and Salim H. J. H,. 2009. Effect of bacterial probiotic given with different levels of feeding on karadi lambs performance. 12 th Scientific Conference for Animal Nutrion Egyption. J. of Nutr . and Feeds.12,3:special issue:309-319.

24.Hassan, S.A and Saeed, A. A. 2012. Effect of protein levels and degradability in the ration on Awassi lambs performance, 1-productive parameters, KSU, J. Nat. Sci., 15 , 1: 34-45.

25.Hassan S.A. and Saeed, A.A. 2013. Effect of feeding different levels of dietary protein and addition of baker's yeast (Saccharomyces cerevisiae) on productive parameters of Awassi lambs . Journal of Agricultural Science and Technology A3, 484-497.

26.Herman, N. 2008. Effect of roughage to concentrate ratio on ruminal fermentation and protein degradability in dairy cows Master's Dissertation, University of Pretoria.

27.Hristov, A.; Varga, N. ; Cassidy, G. ; Long, T. ;HeylerK, M. ; Karnati, S.;Corl, K.; Hovde, B. and Yoon, I. C. J. 2010.Effect of *Saccharomycescerevisiae*fermentation product on ruminal fermentation and nutrient utilization in dairy cows. J. Dairy Sci., 93, 2:682-92.

28.Jouany JP, 2001. Twenty years of research and now more relevant than ever the coming

of age of yeast cultures in ruminant diets, in: Responding to a Changing Agricultural Landscape, Alltech's European, Middle Eastern and African Lecture Tour, pp. 44-69.
29.Jouany JP, Morgavi DP, 2007. Use of "natural" products as alternatives to antibiotic feed additives in ruminant production. Animal, 1(10):1443-1466.
30.Kamel, H. E. M.; Sekine, J.; El-Waziry, A. M. and Yacout, M .H .M. 2004. Effect of *Saccharomyces cerevisiae* on the synchronization of organic matter and nitrogen degradation kinetics and microbial nitrogen synthesis in sheep fed Barseem hay (*Trifolium alexandrium*). Small Rumin Res., 52: 211-216.
31.Kazemi-Bonchenari, M.; Rezayazdi,K.; Nikkhah, A.; Kohram, H. and Dehghan-Banadaky, M. 2010. The effects of different levels of sodium caseinate on rumen fermentation pattern, digestibility and microbial protein synthesis of Holstein dairy cows. Afri. J. Biotech. 9 ,13: 1990-1998.
32.Kearl, L. C.1982. Nutrient requirement of ruminant in developing countries. Logan: Utah Stat Uni. P 117-118.
33.Khadem, A. A.; Pahlavan, M.; Afzalzadeh, A. and Rezaeian, M . 2007. Effects of live yeast *Saccharomyces cerevisiae* on fermentation parameters and microbial populations of rumen, total tract digestibility of diet nutrients and on the *in situ* degradability of alfalfa hay in Iranian Chall sheep. Pak. J. Biol. Sci., 10, 4: 590-597.
34.Kumari NN, Reddy YR, Blumme lM, Nagalakshmi D, Sudhakar K, Monika T, Pavani M, 2012. Effect of roughage to concentrate ratio of sweet sorghum (*Sorghum biclor* L. Moench) bagasse-based complete diet on nutrient utilization and microbial N supply in lambs. J Veter Sci, 44(7):17-24.
35.Lascano, GJ., and Heinrichs, A.J. 2007. Yeast culture (*Saccharomyces cerevisiae*) supplementation in growing animals in the dairy industry. CAB Reviews: Perspectives in Agriculture, Veterinary Science, Nutrition and Natural Resources, 2:13.
36.Lascano, G. J., and Heinrichs, A. J. 2009. Rumen fermentation pattern of dairy heifers fed restricted amounts of low, medium, and high concentrate diets without and with yeast culture. Livest . Sci., 124:48–57.
37. Lascano, G.J., Zanton GI, Suarez-Mena FX, Heinrichs A.J. 2009. Effect of limit feeding high- and low-concentrate diets with *Saccharomyces cerevisiae* on digestibility and on dairy heifer growth and first-lactation performance. J Dairy Sci, 92:5100-5010.
38. Markham, R., A. 1942.Steam distillation apparatus suitable for micro-Kjeldahl analysis. Biochem. J., 36: 790.
39.Mehmet, A.; Şerife, B. and ÖKSU, G. 2012. Effects of live yeast supplementation on ruminalparameters and lactation performance of dairy cows fed medium or high levels of dietary concentrate. MakaleKodu (Article Code): 7124.
40.Milewski S, 2009. Effect of yeast preparations Saccharomyces cerevisiae on meat performance traits and blood hematological indices in sucking lambs. Medycyna Wet, 65(1):51-54.
41.Miller, K. A.; Shelor, M. K.; Parsons ,G. L. and Drouillard, J. S. 2009. Optimal roughage level in finishing diets containing combinations of flaked corn and dried distiller's grains with 10etabol. J. Anim Sci., 87:191.
42.Mohsen, M. K.; Mahmoud, S. A.; Abel-Raouf ,E. M.; Bendary, M. M. and Gaafar, H. M. A. .2001. Performance of growing Friesian calves fed rations containing corn silage. 1- Nutrient digestibility, rumen activity, lives body weight gain and economic evaluation. Egyp. J. Nutr, and Feeds, 4, 485-497.
43.Mousa, K. M; El-Malky, O. M.; Komonna, O. F and Rashwan, S. E.2012.Effect of some yeast and minerals on the productive and reproductive performance in ruminants. Fac. Of Agric., Ain-Shams Univ., Cairo, Egypt J.of. Amer.Sci., 8: 2.
44.Newbold, C.J.; Wallace, R.J and Mclntosh, F. M . 1996. Mode of action of the yeast Saccharomyces cerevisiae as a feed additive for ruminants. Brit. J. Nutr., 76: 249-261.
45.Nikkhah, A., Bonadaki, M. D., & Zali, A, 2004. Effects of feeding yeast (*Saccharomyces cerevisiae*) on productive performance of lactating Holstein dairy cow. Ir. J. Agri. Sci., 35, 53-60.
46.Nisbet, D.J and Martin, S.A.1991. Effect of *Saccharomyces cerevisiae* culture on lactate utilization by the ruminal bacterium Selenomonasruminantium. J Anim Sci., 69: 4628-4633.

47.Plata, F. P.; Mendoza, G. D.; Barcena-Gama, J. R. and Gonzalez ,S. M. 1994. Effect of a yeast culture (*Saccharomyces cerevisiae*) on neutral detergent fiber digestion in steers fed oat straw based diets. Anim. Feed. Tech. Sci., 49: 203-210.

48.Pezzi P, Tassinari M, Bertin G, Andrieu S, 2005. Effect of yeast culture (Yea-Sacc®1026) supplementation on Italian dairy cow performance. In: Proceedings of the 21st Annual Symposium Nutritional Biotechnology in the Feed and Food Industries 125.

49.Robinson, P.H and Erasmus, L. J. 2009. Effects of analyzable diet components on responses of lactating dairy cows to Saccharomyces cerevisiae based yeast products: A systematic review of the literature. Anim Feed SciTechnol, 149: 185-198.

50.Rotger A.; Ferret, A.;Calsamiglia, S. and Manteca,X .2005. Changes in ruminal fermentation and protein degradation in growing Holstein heifers from 80 to 250 kg fed high-concentrate diets with different forage-to-concentrate ratios. J Anim Sci., 83, 7:16 -24.

51.Saeed, A.A. 2008. Effect of ensiling and level of supplementation with concentrate on the voluntary intake and digestibility of wheat straw by Arabi lambs. Alquadisya J. Vet. Med.7 (1).

52.SAS, 2001. SAS Procedure Guide, Version 9.1.3.Cary, NC, SAS Institute Inc.

53.Sinclair LA, Ranson K, Ames S, Wilde D, 2006. The effect of including Yea-Sacc ®1026 yeast culture on the intake and performance of high yielding dairy cows fed a diet high in starch. In: Proceedings of the 22nd Annual Symposium, Nutritional Biotechnology in the Feed and Food Industries (Suppl.1), Lexington, KY, USA, Apr. 23-26.

54.Sontakke U, 2012. Benefits of *Saccharomyces cerevisiae* as a feed additive in ruminants. National Dairy Research Institute, Karnal: 1714.

55.Tripathi, M. K.; Karim, S.A.; Chaturvedi, O.H. and Verma D. L.2008. Effect of different liquid cultures of live yeast strains on performance, ruminal fermentation and microbial protein synthesis in lambs. J dairy SciNutr., 92, 631-639.

56.Wiedmeier RD, Arambel MJ, Walters JL, 1987. Effect of yeast culture and Aspergillus oryzae fermentation extracton ruminal characteristics and nutrient digestibility. J Dairy Sci, 70:2063-2068.

57.Williams, P.E.V.; Tait, C.A.G.; Innes, G. M. and Newbold, C. J.1991. Effects of the inclusion of yeast culture *(Saccharomyces cerevisiae*plus growth medium) in the diet of dairy cows on milk yield and forage degradation and fermentation patterns of the rumen of steers. J. Anim. Sci., 69:3016.

58.Wohlt JE, Corcione TT, Zajac PK, 1998. Effect of yeast on feed intake and performance of cows fed diets based on corn silage during early lactation. J Dairy Sci, 81:1345-1352.

59.Vlaeminck, B., Fievez, V., Demeyer, D ., Dewhurst, R. J. 2006. Effect of forage: concentrate ratio on fatty acid composition of rumen bacteria isolated from ruminal and duodenal digest. J. Dairy Sci., vol. 89, 2668-2678.

60.Yuangklang, C., Vasupen, K., Wongsutha-vas, S., Bureenok, S., Panyakaew, P., Alhaidary, A., Mohamed, H. E. , Beynen, A. C. 2010. Effect of replacement of soybean meal by dried tomato pomace on rumen fermentation and nitrogen metabolism in beef cattle. Am. J. Agri. And Biol. Sci., 5.3: 256-260.

61.Zain, M., Jamarun, N., Arnim, A., Ningrat, R. W. S., Herawati, R. 2011. Effect of yeast (*Saccharomyces cerevisiae*) on ferment ability, microbial population and digestibility of low quality roughage in vitro ArchivaZootechnica 14:4,51-58.

62.Zinn, R. A., Owens, F. N. 1986. A rapid procedure for purine measurement and its use for estimating net ruminal protein synthesis. Can. J. Anim. Sci., 66: 157-166.