The Use of Yeast Culture Supplement in Rations for Sheep

By

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Abstract

This work was carried out to study the effect of Yea-Sacc^{1026} (YS) supplementation, in rations for sheep on average daily intake of the roughage (rice straw) (ADI, R), average daily gain (ADG) and nutrient digestibility coefficients. Also, "In Sacco" disappearance of DM, OM and CF from concentrate mixture and rice straw were determined by incubation of sample in the rumen of two fistulated buffalo calves. The supplementation levels of YS were 2, 2.5, 3.0 and 6.0 gm kg^{-1} concentrate mixture. Effects of supplementation on ADI,R or ADG were inconsistent and divergent. ADI,R varied remarkably according to the amount of concentrate given. As daily concentrate allowances was raised through 300 to 900 gm ADI,R was lowered from 475 to 208 gm or from 521 to 228 gm head^{-1} in YS supplemented or un-supplemented male lambs and from 413 to 208 gm or 406 to 197 gm head^{-1} in the supplemented or un-supplemented female lambs. Four digestibility coefficients of DM, OM, CF, CP, EE and NFE were not affected by YS supplementation. DMD, OMD, CFD% of rice straw were not affected by YS supplementation ($P<0.05$). Relevant values of the concentrate mixture were inconsistent and reflect no conclusive trend.

Introduction

In remote area like Sinai regions and northern coastal zones of Egypt, sheep and goats are the dominant animal species. High productivity in these parts of the country might not be a first priority because of limited feed resources and the high and fluctating prices of concentrate feeds. However, it might be thought that under such conditions, feasible feeding strategy should result on roughage based diets and the use of concentrates at a given level where their cost permits profitable production.

Over the last two decades, voluminous work had been carried out to improve digestibility and nutritive value of such fibrous materials in order to raise their voluntary intake and nutritive value by ruminant animals.

The ultimate goal was therefore, to maximize efficiency of utilization of the lignocellulosic material of roughage and to alleviate the pressing demand for imported grains and other concentrate feeds of higher prices.

In recent years direct fed microbial (DFM) additives like yeast culture has been evolved and regarded as a safe dietary supplement suggesting improved fermentation activities in the rumen.

Depending on the source of yeast culture and variable methods of preparation, inclusion rates are typically 4-100g day^{-1} which is well below the levels fed before in the 1940 and 1950 (~ 1% of DM) as a protein source in the diet (Bruning and Yokoyama, 1988).

The only species of yeast used to date has been *Saccharomyces* cervisiae. The product or the supplement usually contains dried yeast cells and components of growth media which is most likely more important than viable yeast per-se. Thus the accepted terminology for the product is yeast culture rather than simply yeast (AAFCO, 1986).

Therefore the present work was designed to explain the effect of yeast culture on roughage intake, total digestibility of nutrients via possible alterations in the rumen fermentation rate which might yield production benefits.

Materials and Methods

A total of twenty-seven local lambs, 14 males and 13 females were included in this work. Average age of these lambs was 3-4 months with an average live body weight of 19 kg. Lambs were divided into four groups as follows :

Two groups included 14 lambs, 7 males and 7 females as control groups. The other two groups included 13 lambs, 7 males and 6 females as two supplemented groups.

Percentage composition of the concentrate mixture and chemical analysis of ingredients are shown in Table (1). The concentrate mixture (CM) was offered for all groups in the order of 1.5% of average live body weight of lambs in two equal portions. Rice straw (RS, chopped to 1-2 inch length) was presented in the troughs and lambs had free access to added amounts along the day. Fresh drinking water was always available. Biweekly live body weight of lambs fasted for 16 hours were recorded.

The supplement is a product manufactured by ALLTECH Company and commercially known as Yea-Sacc^{1026} (YS). It is a product of specifically selected strains of *Saccharomyces cervisiae* 1026.

Rate of Yea-Sacc inclusion ranged between 2.5

Table (1): Chemical analysis of feed ingredients used and percentage composition and chemical analysis of the concentrate mixture (as fed).

Ingredient	%	DM	CF	CP	EE	NFE	Ash
Ground yellow corn	47	88.93	2.41	8.56	6.01	70.83	1.12
Wheat bran	40	89.46	11.67	11.90	8.44	52.02	5.40
Soyabean meal	10	90.38	6.95	43.86	2.22	32.14	5.21
Limestone	2	-	-	-	-	-	-
Common salt	1	-	-	-	-	-	-
Concentrate mixture	100	89.59	6.50	13.30	7.37	57.10	5.32
Rice straw	100	93.33	29.99	2.78	0.97	46.37	13.22
Yea-Sacc	--	86.57	16.25	23.67	5.08	34.08	7.49

- 6 gm kg^{-1} of CM while restricting, allowances over a total period of 20 wks (Table, 2). At later periods (over 24 wks) inclusion rate was maintained at 2 gm kg^{-1} CM.

Digestibility trials were carried out to determine digestibility coefficients of major nutrients when the concentrate allowances were 300, 550, 900 and 1100 gm/h/d, but the inclusion rate of YS was fixed to 2 gm kg^{-1} of CM.

Ruminal nutrients disappearance (In Sacco) was carried out in Ismailia Agricultural Research Station using two fistulated buffalo calves weighing about 450 kg on average to study degradability characteristics of the feed in the rumen. Calves were fed on a daily ration of 6 kg of commercial concentrate mixture and 6 kg of chopped rice staw. Incubation in the rumen was carried out 3wks after feeding the supplement (2 gm kg^{-1} CM). Data of the degradation (disapperance) constants was computed using NAWAY program based on the mathematical model developed by McDonald and Orskov (1979).

Results and Discussion

Over 20 wks of the feeding trial YS supplementation was tested at different levels of 2.5, 3, and 6 gm kg^{-1} CM over 6, 6 and 8 wk periods for these levels in respective order. Daily allowances of CM were restricted during these periods to 400 or 300 gm $head^{-1}$. At later periods of the feeding trial level of YS was maintained at 2 gm kg^{-1} of CM which was restricted to 600 gm and was raised to 900 gm $head^{-1}$ day^{-1} as lambs approached market or breeding live weights.

As shown in Table (2), supplementation of 2.5, 3, 6 and 2 gm YS kg^{-1} CM did not exert a statistically significant effect on ADG of male or female lambs.

Meanwhile, as a daily allowances of the CM were restricted $head^{-1}$ at every period (400, 300, 600 and 900 gm), the daily intake of RS was remarkably higher in male than female groups.

Roughage intake during period III expectedly reached a maximum compared to previous periods and tended to be higher in the un-supplemented groups. Over this period it may be worthy to observe that daily allowances of CM plus RS were just covering maintenance requirements for live body weights of 30 kg for male and 27 kg for female lambs.

ADG in YS groups (period IV) were seemingly higher than un-supplemented groups, but they were not significantly different within male or female groups. However, ADI of RS consumed was remarkably reduced due to higher allowances of CM fed.

Data at period V reveal that similar trends were maintained concerning ADG and differences due to YS lacked significance. Further reduction in roughage intake was observed in all groups.

The total live body weight gains over the whole 32 wks feeding trial were 18.4 and 15.3 kg for YS and un-supplemented female groups, while they were 18.2 and 20.3 kg for males in respective order. This means that YS supplemented females exceeded the un-supplemented by about 20% faster growth rate, but contrary to females, the un-supplemented group outgrew the YS supplemented group of males by 11% faster rate.

However, despite the divergent results within female or male groups differences are not attributed to YS supplementation.

On the other hand, increased DMI in many reports has been looked at as function of better microbial digestion in ruminants (Fenner and Archibald, 1967). However, differences between

Table (2): Effect of YS on Roughage intake and ADG of lambs.

Period	I				II				III				IV				V				VI	
Level YS	2.5 gm				3 gm				6 gm				2 gm				2 gm				2 gm	
Sex	male		female		male		Female		Male		Female		male		female		male		female		Male	
Treatment	S	US	S	US	S	US	S	US	S	US	S	US	S	US	S	US	S	US	S	US	S	US
No. of lambs	7	7	6	7	7	7	6	7	7	7	6	7	7	7	6	7	7	7	6	7	7	7
Duration, wk	6	6	6	6	6	6	6	6	8	8	8	8	6	6	6	6	6	6	6	6	12	12
ADI, gm																						
CM	400	400	400	400	300	300	300	300	300	300	300	300	600	600	600	600	900	900	900	900	900	900
RS	436	420	366	319	448	451	413	355	475	521	398	406	237	279	232	242	228	240	208	197	208	228
Initial wt., Kg	23.2	22.0.	18.8	19.7	26.8	26.7	23.6	24.3	29.2	30.5	26.2	26.6	30.9	31.3	27.5	27.6	34.5	35.6	32.0	31.2	41.4	42.3
Final Wt., Kg	26.6	26.1	22.6	23.1	29.2	30.5	26.2	26.6	29.4	30.9	27.1	27.4	34.0	34.1	30.2	29.5	41.4	42.3	37.2	35.0	51.6	52.6
ADG, gm	71.4	97.6	90.5	81.0	57.1	90.5	61.9	54.7	3.8	7.1	16.1	14.3	73.8	66.7	64.3	45.2	164.3	159.5	123.8	90.5	121.4	122.6

supplemented and un-supplemented groups in the present work were also too divergent to draw a conclusion for male or female lambs on the effect of YS on RS intake.

In the light of results obtained in this work it could be indicated that none of the supplementation levels of 2, 2.5, 3 and 6 gm YS kg^{-1} CM significantly affected ADG of male or female lambs. Differences due to YS supplementation are then thought of as too minor to affect gains. The very close or even higher values for ADI of RS in the un-supplemented groups specially when CM was limited might suggest that microbial digestion of the high fiber content in RS through cellolysis is not improved by YS supplementation contrary to the finding by El-Badawi *et al.* (1996) and Kamalamma and Krishnappa (1996).

supplementation were observed with feeding silage (Edwards *et al.,* 1991) to steers ,with feeding high energy starter to calves (Fallon and Harte, 1987) or with only high protein diets to goats (Deaville and Galbrath, 1992). On the other hand, Kamalamma and Krishnappa (1996) with feeding millet straw and Cabrera *et al.* (2000) with green forage found no effect on gains.

Increased DMI was reported by Phillips and Von Tunglein (1985), Angeles *et al.* (1998), Williams *et al.* (1991) and Cole *et al.* (1992) as YS was included in beef and dairy cattle diets. Yet, its supplementation did not affect DMI in sheep and goat Arambel and Kent (1990), Malcolm and Kiesling (1990), Gado *et al.* (1996), Garcia *et al.* (2000) and Jordan and Johnston (1990) reported that the addition of either 5 or 7.5 gm of yeast culture per lamb per day increased average DMI but differences were not statistically significant. Nevertheless, it was interesting to note that ADG at their minimal values on DMI of 712 and 755 gm h^{-1} d^{-1} in the supplemented and un-supplemenred male lambs (Table 3). Relevant values of RS were 443 and 486 gm, respectively. This might suggest that even feeding around the maintenance level (YS 1026) did not improve DMI. The same trend was also represented in data obtained on female lambs where no differences seemed to exist between DM or RS intake percent of live body weight or per unit of metabolic body weight.

Data presented in Table (4) show average daily intake (ADI) of rice straw (RS) and average digestibility coefficients of nutrients for YS supplemented and un-supplemented lambs given 300, 550, 900 and 1100 gm $head^{-1}$. Inclusion rate of YS was fixed to 2 gm kg^{-1} CM given to the supplemented lambs.

While differences were not statistically significant due to YS supplementation it could be observed that digestibility values for DM or OM tended to be higher as CM were raised in the third and fourth trials. In these trials ADI of RS constituted about 20% or a little bit higher of the total intake while it was about 50% or higher in the first two trials.

Likewise, while NFE digestibility tended to be higher as the CM level increased no significant differences existed between supplemented and un-supplemented lambs. Contrariwise, CF digestibility tended to be lower as the level of CM was raised and again none of the differences were significant due to YS supplementation.

Although, there were differences between CP digestibility values in the four digestibility trials, but statistical analysis indicated no significant differences that could be attributed to YS in any of these trials. The same trend was observed with digestibility of EE.

These findings provide additional evidence to those reported by Adams *et al.* (1981) concerning DM, OM, CP and ADF digestibility.

While little effect on the total tract digestion has been suggested by Williams *et al.* (1991), other

Table (3): Average daily DM, TDN and DCP intake/live body weight (LBW) and metabolic body weight ($W_{kg}^{0.75}$) taken at practically no gain.

	Males		Females	
Peroid (8 WK)	Suppl.	Un-suppl.	Suppl.	Un-suppl.
Average LBW (kg)	29.3	30.7	26.65	27.00
Metabiloc BW ($W_{kg}^{0.75}$)	12.59	13.05	11.73	11.85
Average intake g/h/d:				
Concentrate (g)	300	300	300	300
Roughage (g)	475	521	398	406
Total DM (g)	712	755	640	648
Average Daily Gain (g)	3.80	7.10	16.1	14.3
DMI/LBW (%)	2.40	2.50	2.40	2.40
DMI/ $W_{kg}^{0.75}$ unit (g)	56.60	57.90	54.60	54.7
Rough. DMI/ $W_{kg}^{0.75}$ unit (g)	35.20	37.30	31.70	32.00
TDN/ $W_{kg}^{0.75}$ unit (g)	28.30	28.00	27.90	27.30
DCP/ $W_{kg}^{0.75}$ unit (g)	2.80	2.70	2.80	2.80

Table (4): Average nutrient digestibility coefficients and feeding values for supplemented and un-supplemented diets

Concentrate Intake g/h/d		300		550		900		1100	
Treatment		S.	US.	S.	US.	S.	US.	S.	US.
No. of Animal		4	4	2	2	4	4	2	2
Rice straw Intake g/h/d		458	380	515	521	213	224	330	310
Digestibility, %									
	DM	68.98	65.76	68.59	64.88	75.95	72.94	72.81	75.32
	OM	74.44	73.89	78.12	69.66	78.46	76.16	75.84	78.13
	CF	67.06	67.44	62.65	61.96	52.26	55.60	56.61	59.46
	CP	72.17	71.71	60.61	58.45	77.99	75.82	69.17	75.36
	EE	70.74	67.79	50.12	51.69	67.49	72.53	75.54	75.36
	NFE	71.73	67.36	77.85	72.58	83.14	77.46	78.10	79.81
TDN	Gm	422	366	548	560	704	682	865	879
	%	60.7	58.7	61.3	58.4	70.0	67.20	66.8	68.9
DCP	Gm	34	33	46	45	88	86	97	105
	%	4.9	5.3	4.9	4.7	8.7	8.4	7.5	8.2

Table (5): Average DM, OM and CF disapperance (In- Sacco) for RS and CM fed with YS supplemental and un-supplemental.

Time	Treat	Rice straw			Concentrate mixture		
		DMD	OMD	CFD	DMD	OMD	CFD
12	S	27.85	30.39	19.07	55.47	50.20	45.00
	US	28.29	31.29	18.87	61.97 *	52.23 *	48.04 *
24	S	42.71	45.25	41.16	73.13	70.48	65.48
	US	42.07	46.25	36.57	79.90 *	67.46 *	63.86
48	S	53.44	56.70	50.82	87.95	87.10	72.51
	US	53.47	57.36	50.66	90.32 *	76.03 *	74.27
72	S	58.88	63.87	56.81	89.82	89.66	81.16
	US	58.95	63.01	56.69	91.89*	77.44 *	80.01
Potential degrad.	S	60.18	66.57	55.85	91.41	91.36	79.60
(A+B)	US	61.08 *	64.53	58.68	92.29	77.70 *	80.89 *
Rate of degrad.	S	0.0477	0.0395	0.0707	0.0588	0.0585	0.0634
(C)	US	0.0429	0.0463	0.0469	0.0748	0.0759 *	0.0502

findings indicated no effect on DM digestibility (Malcolm and Kiesling, 1990) or on DM and NDF digestibility (Garcia *et al.*, 2000).

Nevertheless, while positive effects at least on fiber digestion were pointed out by Gado *et al.* (1996) and on CP digestibility by several investigators (Arambel and Kent, 1990 and Martin and Nisbet, 1992) contrary results were reported by El-Badawi *et al.* (1996) on lower digestibilities observed in DM and all other major nutrients due to YS supplementation when raised to the level of 2 gm kg^{-1} concentrate mixture.

Such controversial results on nutrient digestibility might be attributed to differences between animal species and numbers included in the study. Different inclusion rate, roughage: concentration ratios and also may be duration of the experiment should all be considered as possible causes of variable findings.

Table (5) shows average In - Sacco dry matter disapperance (DMD), organic matter disappearance (OMD) and crude fiber disapperance (CFD) of rice straw and concentrate mixture in animals fed YS supplemented vs un-supplemented.

In this work, it might be pointed out that two animals may not be enough for In-Sacco disapperance studies. Added to this the incompatible results obtained on the In-Sacco disapperance of DM and CF of the CM in the supplemented animals might be attributed to differences in mixing the concentrate ingredients prepared for incubation.

However, Angeles *et al.* (1998) indicated that YS supplementation influenced initial rate or increased fiber digestion with little or no effect on total tract digestibility of DM, OM, NDF and ADF. Contrariwise , no effect was observed on DM , NDF or CP degradation rate of different fibrous feeds (Roav *et al.*, 1997).

Such discordant results in the variable data obtained on In-Sacco disapperance reveal a lack of unformed evidence for a constant positive effect due to YS supplementation

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استخدام إضافات الخميرة في علائق الأغنام

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قسم الإنتاج الحيوانى، كلية الزراعة، جامعة قناة السويس ٤١٥٢٢، الإسماعيلية، مصر

أجرى هذا العمل لدراسة تأثير إضافة Yea-Sacc1026 بمستويات (٢، ٢,٥، ٣، ٦ جم/ كجم مخلوط مركز) وتقدير متوسط الاستهلاك اليومي للأعلاف الخشنة (قش الأرز) ومتوسط الزيادة اليومية ومعاملات هضم المكونات الغذائية. كذلك تحضين المخلوط المركز وقش الأرز في كرش ٢ عجول جاموسي ذات فستيولا لقياس معدل اختفاء المادة الجافة، المادة العضوية، الألياف الخام. تتلخص النتائج فيما يلي:

*لم يكن هناك اختلاف معنوى في متوسط استهلاك القش أو متوسط النمو اليومي عند أي مستوى من مستويات الإضافة.

*أدي زيادة المأكول من المخلوط المركز من ٣٠٠- ٩٠٠ جم إلى انخفاض المأكول من القش من ٤٧٥ إلى ٢٠٨ جم، من ٥٢١ إلى ٢٢٨ جم / رأس في الذكور المعاملة وغير المعاملة ومن ٤١٣ إلى ٢٠٨ جم، ٤٠٦ إلى ١٩٧ جم / راس في الإناث المعاملة وغير المعاملة بالترتيب.

*في تجارب الهضم الأربعة التى أجريت لم تتأثر معاملات هضم المكونات الغذائية بالخميرة المضافة.

*كذلك في تجارب تحضين الأكياس النايلون لم تؤثر إضافة الخميرة على اختفاء المادة الجافة، المادة العضوية، والألياف الخام لقش الأرز بينما لم يكن هناك اتجاه ثابت لقيم المادة الجافة، المادة العضوية والألياف الخام.