Egyptian J. Anim. Prod.,45 Suppl. Issue, Dec. (2008):537-547

EFFECT OF USING NATURAL FEED ADDITIVES ON PERFORMANCE OF DAIRY FRIESIAN COWS

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SUMMARY

Twenty eight lactating Friesian cows averaged 520 kg live body weight were assign to evaluate the effect of supplementation of lactating Friesian cows with yeast culture and Enzyme on milk production efficiency. Cows were divided into four experimental groups and fed the same basal ration but differed in feed additives. Cows in the 1st group (T1) were fed a basal ration containing concentrate feed mixture, berseem hay, rice straw and corn silage (control). Cows in the 2nd (T2) and 3rd (T3) were fed the basal ration supplemented with 10 g enzyme(Fibrozyme containing 100XU/g xylanase) and 10 g yeast culture (Yea-Sacc containing 10^8 cells of Saccharomyces cerevesiae/g), respectively. While, those in the 4th group (T4) were fed the basal ration supplemented with 5g yeast + 5g Enzyme. Feeding period lasted for 16 weeks. Four digestibility trials using 12 lactating Friesian cows, three in each trial were conducted to determine nutrient digestibility coefficients and feeding values in experimental groups. Rumen and blood parameters, feed utilization and economic efficiency were also studied. Results showed that cows fed rations supplemented with both 10g yeast , 10g Enzyme and 5g yeast plus 5g Enzyme improved (P<0.05) most nutrient digestabilities and feeding values as TDN and DCP compared with control ration , as well as rumen and blood parameters. Milk yield as actual milk yield and 4% fat corrected milk, total yields of fat and protein in milk and economic efficiency were the highest (P<0.05) for cows in T4 and T3.

In the light of the present results cows with yeast culture, mixture yeast plus enzyme and enzyme tended to have greater beneficial effects in the performance and had improved the economic efficiency of milk production, especially those treated with 10 g yeast /h/d.

Keywords: Friesian cows, yeast culture, Enzyme , digestibility, milk yield, blood

INTRODUCTION

An enzyme is a naturally occurring protein that catalyzes chemical reactions in biological systems. Enzymes promote the breakdown of complex feed molecules into smaller chemical fractions such as glucose or amino acids that are digestible by the ruminant animal. An example, the enzyme cellulase initiates the breakdown of cellulose (fiber) into sugars. Common enzyme additives contain cellulases, hemicellulases, xylanases, amylases, and pectinases. Cellulases, hemicellulases, and pectinases are enzymes that degrade the fiber portion of forages. Amylase breaks

down starch (amylose) therefore its use would be directed towards starch containing silages such as corn silage.

Research data also suggests that hemicellulases and pectinases are more effective than cellulases at reducing fiber content. Unfortunately,hemicellulases and pectinases break down fiberfractions (hemicellulose, pectin) that are more easily digested by ruminants. Consequently, these enzymes reduce the concentration of digestible NDF fractionsrather than the indigestible NDF fraction cellulose. Interestingly, current trends in enzyme technology involve incorporating enzymes directly into total mixed rations (TMR's) or silages prior to feeding. Initial research has observed some positive effects using this method. The economics of this practice have yet to be determined.

Fungal supplements (*Aspergillus oryzae* and *Saccharomycescerevisiae*) have improved DMI, milk production, milk composition, and Body weight gain of dairy cows (Besong *et al*. (1993), Dawson, *et al*. (1990), Fuller (1989) and Piva,*et al*. (1993)). Improvements in performance have been attributed to increased numbers of ruminalcellulolytic bacteria, improvements in ruminal fiber degradation, and changes in ruminal VFA (Arambel *et al*. (1987), Martin and Nisbet (1990) and Wiedmeier, (1987)). Yeast may also provide growth factors, such as malate,to bacteria that utilize lactate that in turn maymoderate changes in ruminal pH (Nisbet, and Martin. 1991). Yeast cultures also have been shown to stimulate utilization of hydrogen by ruminal acetogenic bacteria Chaucheyras, *et al*. (1995). However, supplemental yeast has not always altered ruminal metabolism (Adams *et al*., 1981), Judkins and Stobart (1988) and Kim *et al*. (1993) or improved animal performance (Harris *et al*., 1992) and Swartz *et al*. (1994).

Yeast cultures prepared from active cultures of *Saccharomyces cerevisiae* have been used in animal feeds for over six decades. The response to yeast cultures by lactating dairy cows has been variable.In some studies, yeast cultures have improved DMI (Fallon and Harte. 1987), Malcolm and Kiesling. (1986) and Williams *et al*. (1991), milk yield (Kellems, *et al*. (1990), Piva *et al*. (1993), Williams *et al*. (1991) and Wohlt *et al*. (1991)), and milk composition (Williams *et al*. (1991) and Wohlt *et al*. (1991); other studies, (Arambel and Kent, 1990, Erdman and Sharma, 1989 and Quinonez *et al*. (1988) found no response to yeast cultures. Piva *et al*. (1993) suggested that several factors, including stage of lactation, type of forage fed, feeding strategy, and forage to concentrate ratio, are likely to affect the response to yeast cultures in dairy cows. Kellems *et al*. (1990) reported that microbial additives such as yeast cultures had the greatest effect on cowsin early lactation, increasing milk yield over that of control cows. Williams *et al*. (1991) found that yeast cultures had the greatest effect when diets contained 60% concentrate and 40% forage.

The objective of these experiment was to determine the effects of a live yeast and enzyme supplement on some rumen and blood parameters and on the performance of lactating cows.

MATERIALS AND METHODS

The presented study was conducted at Dina Farm (Cairo-Alexandria desert rode km.86). Twenty eight lactating Friesian Cows (in 3^{rd} -5^{th} lactating season) were taken one week post- partum and were randomly distributed according to lactation season and milk yield into four similar groups (7 animal each) to evaluate the effect

of feeding concentrate feed mixture, berseem hay, rice straw and corn silage with or without enzyme (Fibrozyme containing 100XU/g xylanase), yeast (Yea-Sacc containing 10^8 cells of Saccharomyces cerevesiae/g) and mixture from enzyme plus yeast on animal performance .

Experimental rations:

Animal in all groups were fed according to NRC (1989) as follows: The first group was fed concentrate feed mixture (CFM), berseem hay (BH), corn silage (CS) and rice straw (RS) and was considered as a control (T1). Cows in the 2nd group were fed control ration plus 10 g enzyme (T2), 3 rd group were fed control ration plus 10 g yeast (T3) and 4th group were fed control ration plus 5 g. enzyme + 5 g. yeast (T4) .

Cows and feeding :

Cows were fed individually twice daily at 8.00 a.m. and 4.00 p.m. All daily feed residuals were recorded and so daily feed consumption were determined .

Cows were milked twice daily at 7.00 a.m. and 5.00 p.m. Daily milk yields were individually recorded during the experimental period. Actual milk yield was corrected to 4 % FCM according to the formula of Gaines (1923). Samples of milk were collected weekly at the morning and the evening milking . Composite milk samples (relative to the quantity of milk production) were taken and frozen for chemical analysis. Milk analysis was determined by milko Scan . Total nitrogen content (TN) was determined using semi-micro Kjeldahl method, meanwhile total solids (TS) and ash contents were measured according to Ling (1963).

Digestibilty trial :

At the end of the feeding experimental that lasted 90 days, three cows were randomly chosen from each group to evaluate the feeding values of experimental rations. Grab sample method and silica as internal marker were applied for the digestibility determination according to Van Keulen and young (1977). Feces samples were collected twice daily at 12.00 hrs . intervals for three successive days from each cow. Solution of 10% H_2So_4 was added to the representative samples before drying in oven at 60 °C for 24.00 hrs. Dried samples were ground and kept for chemical analysis according to A.O.A.C. (1995) .

Rumen liquor samples :

At the end of each digestibility trial, rumen liquor samples were collected from three cows of each group by stomach tube at 4.00 hrs post morning feeding . Samples were directly strained through four folds of gauze and divided into two portion. One for the immediately estimation of pH and ammonia nitrogen (NH_3-N) while the other was stored in the deep freezer after added toluene and paraffin oil for total volatile fatty acid concentration (TVFA's) determination. Samples were tested for pH value digital pH meter. Ammonia-N concentration was determined according to Conway (1957). TVFA's was determined according to Warner,(1964).

Blood serum constituents :

One blood samples were collected from the jugular vein of three animal from each group at the end of feeding trial. The collected blood samples were centrifuged

at 4000 r.p.m for 20 min. . Blood serum was tested for total protein , albumin , GOT, GPT and creatinin using commercial kits.

The chemical composition of the **f**eedstuffs are illustrated in Table (1). Chemical analysis using methods of A. O. A. C. (1995) was performed on representative samples from all experimental feedstuffs.

Efficiency of feed utilization was calculated as the amount of 4% FCM produced by 1kg DM, TDN and DCP consumed . The economical efficiency for milk production expressed as the ratio between the price of milk produced and the cost of feeds consumed was estimated on the basis of the following price in Egyptian pounds per kg. for milk , LE. 1.78, concentrate feed mixture LE. 1244, berseem hay LE. 500, corn silage LE. 150, rice straw LE. 75, yeast LE. 35 and Enzyme LE. 60.

Statistical analysis was carried out using general linear procedure of SAS user's guide, (1996) .Group mean differences were tested using least significant differences (Duncan, 1955).

Table 1. Chemical composition of the ingredients

Items	Composition on DM% bases						
	DM	**OM**	**CP**	**EE**	**CF**	**NFE**	**Ash**
***Concentrate feed mixture**	91.61	92.59	16.8	3.1	12.4	60.29	7.41
Berseem hay	93.98	87.2	14.42	2.75	23.62	46.41	12.8
Corn silage	34.9	92.37	9.4	2.5	24.88	55.59	7.63
Rice straw	93.33	84.6	3	1.87	34.91	44.82	15.4

*Concentrate feed mixture consists of : 25% yellow maize, 27% undecorticated cotton seed meal, 20% rice bran, 15% wheat bran, 5%soybean meal, 5% molasses, 2% limestone, 1% common salt.

RESULTS AND DISCUSSION

Nutrient digestibility and Nutritive values:

Data in Table (2) indicate that supplementation of yeast culture and enzyme in rations in the T2, T3 and T4 resp. showed the significantly effect on digestibility of DM, OM, CP, CF and NFE compared with control ($P<0.05$) in EE there is no significantly difference between control and other treatments. This results agreement with those reported by Harrison, *et al*. (1988). Wohlt *et al*. (1998) found that CP digestibility tended to be improved by cows fed a diet supplemented with yeast culture.

On the other hand, Mohi-Eldin *et al*. (2008) indicated that the supplementation of different yeast culture in calf's ration did not any effect on DM, OM, EE and CP digestibility .

The nutritive value as TDN% and DCP% in Table (2) showed that TDN% ranged between 60.44 and 66.36%, the lowest value was recorded for T1 (control), while, T3, T4 and T2 rations had the higher values. The differences were significant among treatments. This results are in agreement with Ibrahim *et al*. (2006) and Mohi-Eldin, *et al*. (2008).

The DCP values in Table (2) were significant ($P<0.05$) increased for supplementation with yeast culture and enzyme compared to control ration.

On other hand, Ibrahim *et al*., (2006) found that the yeast culture additive into lamb ration had no significant effect on the nutritive values estimated as TDN and DCP.

Table 2. Digestion coefficients and nutritive value of experimental rations (on DM basis)

	Experimental rations			
Items	**T1**	**T2**	**T3**	**T4**
Digestibility coefficients %				
DM	62.55[b]	66.67[a]	66.56[a]	66.58[a]
OM	64.14[c]	67.92[b]	70.16[a]	69.74[ab]
CP	66.13[b]	74.32[a]	73.76[a]	72.70[a]
EE	69.92[a]	71.43[a]	72.81[a]	72.09[a]
CF	64.69[b]	70.21[a]	69.18[a]	69.70[a]
NFE	63.18[b]	65.37[b]	69.54[a]	68.94[a]
Nutritive values				
TDN	60.44[c]	64.25[b]	66.36[a]	66.01[ab]
DCP	8.17[b]	9.37[a]	9.46[a]	9.28[b]

a, b and c : Means followed by different letters in the same row are significantly different (P<0.05)

Ruminal Activity

The parameters rumen liquers for group animals fed different with Enzyme resulted in significantly (P<0.05) higher in pH value while supplemented ration with yeast culture did not significantly affect . Morever, the animals fed tested rations (T2, T3 and T4) appeared to lower significant in NH3-N concentration compared to those of fed control ration. However, the significant (P<0.05) differences between T2 and T3 were found (Table 3) . The variation in NH3-N concentration among different treatment might be attributed to reduced ammonia-N absorption by rumen epithelium or increase/ decrease efficiency of microbial protein Synthesis (Smith *et al.*, 1980). The higher concentration of NH3-N might be due to the degradation of protein and hydrolysis of NPN substances (Reddy *et al.*, 1989). Results revealed that the significant increase of ruminal VFA's concentration were recorded with animals feed tested ration, being 15.00, 15.65 and 15.50 meq / 100ml for T2, T3 and T4 , respectively . So ration supplemented with enzyme or/ and yeast culthur tended to have get higher VFA's concentration.

Blood parameters:

Results obtained in Table (3) indicated that animal groups fed supplemented rations (T2, T3 and T4) had a significantly (P<0.05) higher concentration of serum protein fraction such as total protein, Albumen and globulin compared with those fed control ration. Higher significant differences in serum protein fraction concentration might be attributed to synthesis liver function and higher digestibility of CP and OM of tested rations, which indicated better utilization of dietary protein owing to supplemented rations with feed additives . These results were agreement with those reported by Abd ElKhalek *et al*. (2000). They found that serum albumin

concentration was significantly higher with rate of 6.5% in calves fed supplemented ration with yeast. However, total protein in this study was within the normal range. On the other hand, all values of serum urea-N and creatinin concentrations were significantly (P<0.05) lower with supplemented rations (T2, T3 and T4)compared to the control ration (T1). Concentration of serum urea-N and creatinin might be attributed to efficiency of N utilization in ruminat (Lewis *et al*., 1957). The results were agreement with those reported by Fayed (1995). In general, from these results, it could be noticed that the supplemented rations with either enzymes or yeast culture as feed additives tended to significantly (P<0.05) affected in some blood parameters.

Table 3. Some rumen liquer and blood parameters of lactating cows fed on experimental rations

	Experimental rations			
Items	**T1**	**T2**	**T3**	**T4**
Rumen liquer:				
pH	6.25[b]	6.40[a]	6.22[b]	6.31[ab]
NH3-N mg/100ml	24.92[a]	22.92[b]	21.47[c]	22.08[c]
TVFA's meq./100ml	12.36[b]	15.00[a]	15.65[a]	15.50[a]
Blood parameters:				
Total protein g/100ml	6.86[b]	7.55[a]	7.49[a]	7.51[a]
Albumen g/100ml	3.65[b]	4.23[a]	4.04[a]	4.14[a]
Glubulin g/100ml	3.21[a]	3.32[a]	3.45[a]	3.37[a]
Urea-N mg/100ml	26.60[a]	24.56[b]	24.40[b]	24.45[b]
Creatinin	1.59[a]	1.39[b]	1.33[b]	1.34[b]
GOT IU/L	38.02[a]	36.65[b]	36.89[b]	36.75[b]
GPT IU/L	24.12[a]	23.61[a]	23.71[a]	23.64[a]

a, b and c : Means followed by different letters in the same row are significantly different (P<0.05)

Milk Production, its composition and feed utilization efficiency:

The average daily milk and 4% FCM yield are presented in Table (4). It could be noticed that both milk yield and 4% FCM were significantly (P<0.05) increased with different treatments (T2, T3 and T4) compared to control (T1).

Cows received rations supplements with both enzyme and yeast (T4) recorded the highest value of daily 4% FCM (15.22 kg), followed by those supplemented with yeast culture (15.05 kg) and those supplemented with enzyme (14.63 kg). Results obtained revealed that the daily 4% FCM yield were improved and increased by 15.74, 19.07 and 20.41% for animals fed rations supplemented with enzyme (T2), yeast culture (T3) and enzyme plus yeast culture (T4), respectively. These results were agreement with those reported by Besong *et al*. (1993), Dawson, *et al*. (1990), Fuller (1989) and Piva, (1993) who found that enzyme and yeast additives enhanced milk production in lactating cows .

The improvements in performance of cows might be attributed to increase numbers of ruminal celluloytic bacteria, improvements in ruminal fiber degradation

and changes in ruminal VFA according to Arambel *et al*. (1987), Martin and Nisbet (1990) and Wiedmeier (1987).

In addition, the fat, protein, lactose, total solids and solids not-fat of milk were influenced significantly ($p>0.05$) by yeast or enzyme addition. This improvement in milk composition may be due to the range of effects in rumen, including in pH, altered VFA concentrations, decreased methane production, increased number of cellulolytic bacteria and increased rate and extend of rumen fiber digestion (Dawson and Newman (1987), Harrison, *et al*. (1988), Wiedmeier, *et al*. (1987) and Williams, *et al*. (1991).

Table 4. Total intak, average daily milk yield and its composition and feed utilization efficiency of lactating cows

	Experimental rations			
Items	**T1**	**T2**	**T3**	**T4**
Daily total intake, kg				
DM	15.13^{b}	15.54^{a}	15.74^{a}	15.60^{a}
TDN	9.14^{c}	9.98^{b}	10.45^{a}	10.30^{a}
DCP	1.24^{c}	1.46^{ab}	1.49^{a}	1.45^{b}
Daily milk yield, kg	13.94^{b}	16.13^{a}	16.58^{a}	16.35^{a}
Daily 4% FCM,kg	12.64^{b}	14.63^{a}	15.05^{a}	15.22^{a}
Milk composition,%				
Milk fat	3.38^{c}	3.52^{b}	3.68^{a}	3.62^{a}
Milk protein	3.24^{b}	3.41^{a}	3.44^{a}	3.4^{a}
Milk lactose	4.45^{b}	4.84^{a}	4.89^{a}	4.82^{a}
Milk T.S.	11.08^{d}	11.68^{c}	12.02^{a}	11.84^{b}
Milk S.N.F.	7.70^{d}	8.15^{c}	8.34^{a}	8.22^{b}
4% FCM production efficiency				
FCM kg/kg DM	0.835	0.941	0.956	0.975
FCM kg/kg TDN	1.383	1.466	1.440	1.477
FCM kg/kg DCP	10.19	10.02	10.10	10.50

a, b,c and d : Means followed by different letters in the same row are significantly different ($P<0.05$)

Feed conversion and production efficiency:

Data presented in Table (4) showed that the production efficiency expressed as kg 4% FCM/kg DM, TDN or DCP for cows fed supplemented ration with enzyme and yeast culture (T4) were 0.975, 1.477 and 10.50 kg, respectively .

Improvement in production efficiency as kg 4% FCM/kg TDN ranged between 4.12-6.80%. From these data, it could be concluded that cows fed supplemented ration with enzyme or/and yeast culture appeared to improve production efficiency and feed conversion with no adverse effects.

Economic efficiency:

Concerning the feed cost, results in Table (5) revealed that the feed cost /head/day was 0.905, 0.850, 0.832 and 0.787 LE. With cows fed T1,T2, T3 and T4, respectively

showing the highest economic with T4. Average daily feed cost/head was reduced as aresults to supplement of ration with feed additives such as enzyme or/ and yeast culture. So, the highest economical efficiency was related to the lowest feed cost and highest 4% FCM yield which appeared with cows fed rations supplemented with enzyme plus yeast culture (T4).

Table 5. Economic efficiency of lactating cows

Items	Experimental rations			
	T1	T2	T3	T4
Input costs (LE)	11.44	12.44	12.52	12.55
output (LE)	22.50	26.04	27.59	28.39
Economic efficiency	1.97	2.09	2.20	2.26
Feed cost/kg 4% FCM (LE)	0.905	0.85	0.832	0.787
Milk production as % of the control group				
Actual milk yield	100	115.71	118.94	117.29
4%FCM	100	115.74	119.07	120.41

CONCLUSION

Cows fed ration supplemented with feed additives such as enzyme or/and yeast culture tended to increase in nutrient digestibility, nutritive value, with no adverse effects on rumen and blood serum parameters. Moreover, these supplementation showed increase in milk yield and economical efficiency.

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تأثير إستخدام الإضافات الطبيعية على الآداء الإنتاجى للأبقار الفريزيان الحلابة

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أجريت الدراسة بإستخدام ٢٨ بقرة فريزيان حلاب متوسط أوزانها الحى ٥٢٠ كجم وذلك لدراسة تأثير اضافة بعض الاضافات الطبيعية مثل الانزيم (Fibrozyme containing 100XU/g xylanase) والخميرة,(Yea-Sacc containing 10^8 cells of Saccharomyces cerevesiae/g) على كفاءة انتاج اللبن. وقسمت الحيوانات الى أربعة مجاميع متماثلة فى الوزن الحى وموسم الحليب فى كل مجموعة ٧ حيوانات، وغذيت المجاميع على النحو التالى: مجموعة الأولى (الكنترول) غذيت على عليقة مكونة من (علف مركز، دريس برسيم، قش أرز وسيلاج) بدون إضافات . والمجموعة الثانية غذيت على عليقة مثل الكنترول مضاف اليها ١٠ جم انزيم والمجموعة الثالثة غذيت على عليقة مثل الكنترول مضافا" اليها ١٠ جم خميرة والمجموعة الرابعة غذيت على عليقة مثل الكنترول مضافا" اليها ٥جم انزيم + ٥ جم خميرة .

واجريت تجارب الهضم لتقدير القيمة الغذائية ومعاملات الهضم بإستخدام ١٢ بقرة من المجاميع السابقة (٣ حيوانات فى كل مجموعة) لدراسة المقاييس المختلفة لسائل الكرش .

ومن النتائج التى تم الحصول عليها من هذه الدراسة أن الابقار التى غذيت على عليقة الكنترول مضاف اليها كلاً من الانزيم والخميرة ومخلوط من الانزيم والخميرة أدى الى تحسين فى المعاملات هضم المركبات الغذائية وكذلك القيمة الغذائية للمركبات الكلية المهضومة والبروتين المهضوم مقارنة بعليقة الكنترول وكذلك أدت استخدام الاضافات الى زيادة معنوية لمحصول اللبن ومكوناته.

ونستخلص من هذه الدراسة:

أن استخدام الخميرة منفردة أو مخلوط مع الانزيم (بنسبة ٥ جم لكل منها) أدت إلى تحسين معاملات الهضم والقيمة الغذائية وYانتاج اللبن الأبقار الحلابة.