PRODUCTIVE PERFORMANCE OF LACTATING BUFFALOES FED BIO-YEAST DURING SUMMER SEASON

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ABSTRACT

Thirty lactating buffaloes weighing 543 ± 19.83 kg in their third and fourth lactation seasons, after their peak of lactation curve, were used in this study during summer season. Buffaloes were randomly assigned to one of three dietary treatment groups of 10 animals each. Each group of animals was fed on one of the following experimental treatments: T1, concentrate feed mixture (control treatment). T2, control treatment plus 10 g bio-yeast / head / day. T3, control treatment plus 20 g bio-yeast / head / day. The control concentrate mixture contained 33 % yellow corn, 33 % wheat bran, 20 % rice bran, 11 % decorticated cottonseed meal, 2 % calcium carbonate and 1 % sodium chloride. Rice straw was offered ad lib as a roughage source in this study. Bio-yeast supplementation (T2 and T3) had significantly (P< 0.05) higher values of total dry matter intake (TDMI) by 7.90 and 8.71 % as milk yield was increased by 8.04 and 17.14 % leading to increased requirements, therefore the quantity of feed offered was increased. Fat corrected milk (FCM 7 %) yield was increased by 17.86 and 20 %, and daily return was enhanced by 30.99 and 27.30 %, respectively for buffaloes fed experimental rations T2 and T3 compared with those fed the control ration T1. However, milk fat, protein, lactose, ash, total solids and solids-not-fat percentages were not significantly affected by adding bio-yeast to buffaloes' ration during the summer season. Studies of Bio-yeast and its effect on digestibility and rumen activity were also undertaken

Key words:- Milk production, Bio-yeast ,Lactating Buffaloes, .

INTRODUCTION

High temperature and humidity combine to decrease dry matter intake (DMI) in dairy cows as a physiological means of regulating internal body temperature. This is accomplished by decreasing rumen fermentation and metabolic rates (Moody *et al.* 1971). A reduction in DMI decreases nutrients available for milk synthesis. Thus milk production declines and several lactation parameters are affected (Smith *et al.* 1993). Heat stress and health factors may impose constraints for buffaloes in the tropics (Nangia and Garg, 1992) and decrease feed intake and milk yield (El-Masry and Marai, 1991).

Yeast and yeast cultures have been added to diets of dry and lactating dairy cattle with varied responses under moderate ambient temperature. In some studies, yeast cultures improved DMI (Williams *et al.* 1991; Dann *et al.* 2000) and milk production (Wang *et al.* 2001; Kholif *et al.* 2005), whereas other studies (Arambel and Kent, 1990; Soder and Holden, 1999) found no response to yeast cultures. Some field reports indicated higher DMI and milk production when yeast was fed during periods of heat stress (Huber, 1998).

Improvements in feed efficiency can positively affect herd profitability even when changes in production or feed intake or both are slight (Casper *et al.* 2003). If feeding Bio-Yeast (BY) can cause even modest improvements in ruminal fermentation and digestibility, and minimize heat stress, improvements in feed efficiency may occur.

The objective of this study was to evaluate the use of BY in diets of lactating buffaloes, especially during times of heat stress.

MATERIALS AND METHODS

1-Animals and experimental design:

This study was conducted at the Animal Production Department Experimental Farm, Faculty of Agriculture, South Valley University from June to August 2007. Thirty lactating buffaloes weighing 543 ± 19.83 kg in their third and fourth lactations after the peak of their lactation curve (averaged 5.18 kg milk / d) were used in this study. Buffaloes were randomly assigned to one of three dietary treatment groups of 10 animals each. The control ration consisted of concentrate feed mixture (CFM) and rice straw. The CFM contained 33 % yellow corn, 33 % wheat bran, 20 % rice bran, 11 % decorticated cottonseed meal, 2 % calcium carbonate and 1 % sodium chloride. Each group of animals was fed on one of the following experimental treatments: I- concentrate feed mixture (control treatment, T1). II- control treatment plus 10 g BY/ head / day, Kanzy Medipharm Company, Canada, (T2). III- control treatment plus 20 g BY/ head/ day (T3). Rice straw was offered *ad lib* as a roughage source and the amount consumed was calculated for each animals. Mineralized salts licking blocks were available throughout the experiment. The chemical composition of CFM, RS and BY is presented in Table (1).

2- Feeding and management:

The animals were kept outdoors under shade day and night. Data from the South Valley University Weather Station were used to evaluate the monthly variations of air temperature and relative humidity during the experimental periods (Table 2).

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Nutrient requirements were individually calculated according to body weight, daily milk yield and milk fat test according to Ghoneim allowance (1966). The feed for each buffalo cow was weighed separately and BY was handly mixed with the concentrate diet just before feeding to ensure that each animal had consumed its own supplement for a period of three months. Animals were consumed its own requirements without any residual. Animals were milked twice daily at 4 am and 4 pm, while they were fed the CFM at 8 am and 6 pm. Lactating buffalo cows were adapted gradually to the diet during the first 10 days.

3-Sampling and laboratory analysis:

A fixed portion of diets were collected daily in the last week of each month and composite samples were formed, dried at 70 °C for 48 h, ground and kept in closely tight jars for laboratory analysis. Feeds were analysed for dry matter (DM), organic matter (OM), crude protein (CP), crude fiber (CF), ether extract (EE) and ash according to AOAC (1995).

Table (1): Proximate analysis of concentrate feed mixture (CFM), rice straw (RS) and Bio-Yeast (BY) consumed by lactating buffaloes.

Nutrients (%)	Feeds		
	CFM[1]	RS	BY
DM	90.40	93.40	92.16
On DM basis:			
OM	88.39	85.33	91.71
CP	15.60	4.40	47.84
EE	2.20	1.80	1.25
CF	11.35	41.24	4.45
NFE	59.24	37.89	38.17
Ash	11.61	14.67	8.29

[1]CFM = Concentrate feed mixture, is composed from 33 % yellow corn, 33 % wheat bran, 20 % rice bran, 11 % decorticated cottonseed meal, 2 % calcium carbonate and 1 % sodium chloride.

Milk yield was recorded daily for each animal and composite milk samples from morning and subsequent evening milkings were collected daily and analysed individually for total solids, total nitrogen and ash according to AOAC (1995). Milk fat was determined using Gerber units (British Standards Institution, 1962).

At the last week of each month throughout the study, rectal temperature was recorded twice daily at 9 am and 3 pm. The values were averaged. Rectal temperature was measured using a clinical mercury thermometer inserted into the rectum for two minutes.

4-Statistical analysis:

The obtained results were statistically analysed using the GLM of SAS (1992) for a complete randomized design

$$Y_{ij} = \mu + T_i + E_{ij},$$

Where, μ is the overall mean, T the effect of dietary treatments (i= 1, ...3) and E is the experimental error.

RESULTS AND DISCUSSION

Environmental values are listed in Table (2). The outdoor air temperatures in the shaded area where the animals were kept (AT, °C) ranged from 25.8 to 41.1°C. The mean of minimum AT was 25.9 °C, while the mean of maximum AT was 40.97°C. The relative humidity (RH, %) ranged from 6.8 to 43.5 % with a daily mean of 12.53 % (low) and 38.57 % (high). Data presented in Table (5), showed the effect of bio-yeast supplementation on rectal temperature (RT, °C) of lactating buffaloes under hot summer conditions. Results revealed that RT was decreased significantly ($P< 0.05$) by 0.71 and 1.73 % for buffaloes fed T2 and T3 rations, respectively compared to those fed the control ration T1. These results are in agreement with those observed in lactating cows by Huber *et al.* (1989) and Higginbotham *et al.* (1994) who reported that supplementation of yeast to hyperthermic animals reduced body temperature. Similarly, Yousef *et al.* (1996) concluded that supplementation of yeast to the basal ration of buffaloes caused a significant ($P< 0.05$) decline in their rectal temperature relative to non supplemented buffaloes under hot summer conditions.

The calculated nutrients content of rations consumed in this experiment are presented in Table (3). The composition of all treatments were almost similar except that the crude protein content of bio-yeast treatments (T2 and T3) are slightly higher compared with the control (T1) treatment (12.26 and 12.29 % vs. 12.06 %, respectively).

Table (2): Monthly variations in air temperature (AT, °C) and relative humidity (RH, %) in the area of South Valley Experimental Animal Farm during the period of study.

Months	AT, °C			RH, %		
	Min.	Max.	Mean	Min.	Max.	Mean
June	26	40.9	33.45	16.6	41.9	29.25
July	25.9	40.9	33.40	6.8	30.3	18.55
August	25.8	41.1	33.45	14.2	43.5	28.85
Average	25.90	40.97	33.43	12.53	38.57	25.55

Table (3): Calculated nutrient content and feeding values (%) of rations consumed by lactating buffaloes on dry matter basis.

Treatments Nutrients (%)	T1	T2	T3
DM	91.35	91.30	91.31
OM	87.42	87.47	87.48
CP	12.06	12.26	12.29
EE	2.07	2.08	2.08
CF	20.80	20.32	20.32
NFE	52.49	52.81	52.79
ASH	12.58	12.53	12.52
Feeding value[1]:			
SV	56.33	57.03	57.02
DP	7.05	7.22	7.24

Nutrients contents calculated according to quantities consumed from concentrate feed mixture and rice straw (RS).T1 = Control, T1 plus 10 g / d bio-yeast (BY, T2) and T1 plus 20 g / d BY (T3).
[1]Feeding value was calculated according to the tabulated values (ARC, 1997) of each ingredient.

During summer season conditions, TDMI tended to be greater for buffaloes that received bio-yeast treatments compared with those receiving the control treatment (Table 4). Increasing level of bio-yeast supplementation from 0 to 10 and 20 g /d increased TDMI by 7.90 and 8.71 %, respectively. The concentrate roughage ratio was nearly similar. It was (2.17 : 1), (2.33 : 1) and (2.32 : 1) for T1, T2 and T3, respectively.

Table (4): Mean values of live body weight (LBW, kg) and dry matter intake (DMI, kg/h/d) of lactating buffaloes fed diets supplemented with Bio-Yeast.

Items	Treatments			Mean SE	Sig.
	T1	T2	T3		
LBW, kg	543	545	542	19.83	NS
CFM intake	7.62	8.40	8.45	......	......
RS	3.52	3.61	3.64	0.384	NS
BY	......	0.01	0.02	......	......
TDMI	11.14	12.02	12.11	0.121	NS
TDMI % of LBW	2.05	2.21	2.23	......	......
C : R ratio	2.17 : 1	2.33 : 1	2.32 : 1	......	......

T1 = Control. T2 = T1 plus 10 g / d Bio-yeast. T3 = T1 plus 20 g /d Bio-Yeast. TDMI = Total dry matter intake. C : R = Concentrate Roughage ratio. Sig. = Significant ($P < 0.05$). NS = Not significant.

Similar increases in DMI were recorded by Dann *et al.* (2000), El-Ashry *et al.* (2001) and Kholif *et al.* (2005) They reported significant improvements in DMI when yeast culture was given to lactating animals. Arambel and Kent (1990) suggested that yeast cultures might be best utilized by animals under stress. Callaway and Martin (1997) suggested that yeast cultures provide soluble growth factors that stimulate growth of cellulolytic bacteria and cellulose digestion. However, the mechanism for improved DMI with yeast culture supplementation has not been clearly defined.

Researchers have suggested that yeast culture may cause some changes in the rumen, including increased pH, altered VFA concentration (Williams *et al.* 1991), increased counts of cellulolytic bacteria (Wiedmeier *et al.* 1987), and increased rate or extent of rumial fiber digestion (Callaway and Martin, 1997).

On the basis of these previous studies, it may be suggested that bio-yeast may increase fiber digestion, which could increase rate of passage and therefore improve DMI. As digestibility was enhanced, more nutrients were absorbed and were available for milk and milk constituent synthesis. Accordingly the milk yield was increased and the feed requirement was greater, therefore more feed was delivered.

The climate conditions (ambient temperature and relative humidity) in this experiment may caused a reduction in buffaloes productivity. Data from table 5 showed that buffaloes produce about 5.8 kg /d. These results are in agreement with those obtained by El-Masry and Marai, (1991).

The present data (Table 5) clearly show that buffaloes fed rations supplemented with bio-yeast (T2 and T3) had significantly ($P< 0.05$) higher values of milk yield by 8.0 and 17.1 %, respectively than those fed the control ration (T1). These results are in agreement with those obtained by El-Ashry et al. (2001), Salem et al. (2002), Kholif and Khorshed (2006). The addition of yeast to the rations of ruminants increases the quantities of volatile fatty acids formed to provide metabolisable energy and to stimulate protein synthesis in the rumen in order to improve the supply of amino acids and nutrients to the mammary gland (Huber et al. 1989) which lead to an increase in milk yield and its composition.

Similarly, 7 % FCM yield was significantly ($P< 0.05$) higher in yeasts supplemented treatments (T2 and T3) (Table 5) representing increases of 17.9 and 20.0 %, respectively than buffaloes receiving the control treatment (T1). These results are in accordance with those reported by Abo El-Nor and Kholif (1998).

Feed efficiency, as indicated by FCM production per kilogram feed DM consumed, was increased significantly ($P< 0.05$) when bio-yeast was fed (Table 5). These results tended to support field reports and results of (Huber, 1998; Yoon et al. 2003; Schingoethe et al. 2004; Cooke et al. 2007) that indicated tendencies for improved response of lactating cattle fed yeast culture. The mode of action by which the feeding of yeast may improve feed efficiency of heat-stressed buffaloes is not fully known. Improved appetite by yeast feeding during heat stress has been proposed (Huber, 1998) and is substantiated by the present data. Improved ration digestibility (El-Ashry et al. 2001; Salem et al. 2002; Kholif and Khorshed 2006) is another possible explanation, but diet digestibility was not undertaken in the present study.

Table (5): Effect of Bio-Yeast supplementation on Rectal temperature (RT,°C), milk yield and it's composition of lactating buffaloes fed the experimental rations.

Items	Treatments			Mean SE	Sig.
	T1	T2	T3		
RT, °C	38.22^{a}	37.95^{b}	37.57^{b}	0.129	*
Milk Yield (kg/h/d)	5.25^{b}	6.05^{a}	6.15^{a}	0.223	*
7 % FCM (kg/h/d)[1]	5.60^{b}	6.60^{a}	6.72^{a}	0.180	*
FCM/TDMI	0.50^{b}	0.55^{a}	0.56^{a}	0.009	*
Milk composition (%):					
Fat	7.64	7.86	7.91	0.046	NS
Protein	4.15	4.17	4.18	0.007	NS
Lactose	4.18	4.18	4.20	0.010	NS
Ash	0.76	0.77	0.79	0.0001	NS
Total Solids	16.73	16.98	17.08	0.021	NS
Solids not fat	9.09	9.32	9.37	0.049	NS
Yield of milk constituents:					
Fat (kg/d)	0.401^{b}	0.476^{a}	0.487^{a}	0.001	*
Protein (kg/d)	0.218^{b}	0.252^{a}	0.257^{a}	0.0001	*
Lactose (kg/d)	0.220^{b}	0.252^{a}	0.253^{a}	0.0001	*

Sig. = Significant ($P< 0.05$). NS = Not significant. a, b and c Means in the same raw having different superscripts are significantly different ($P< 0.05$).

[1] = 7 % FCM = 0.265 milk yield + 10.5 fat yield (Raafat and Saleh, 1962).

Data of milk fat, protein, lactose, ash, total solids and solids–not-fat percentages (Table 5) were not significantly affected by adding bio-yeast to buffaloes'ration, but showed a tendency to be increased. These results are in agreement with those obtained by Soder and Holden (1999), Dann et al. (2000), Schinegothe et al. (2004) and Cooke et al. (2007).

Milk fat, protein and lactose yields were significantly ($P< 0.05$) increased as bio-yeast was added at levels of 10 and 20 g / h/ d to buffaloes'ration. These results are in agreement with those of El-Ashry et al. (2001) and Salem et al. (2002), who reported that milk component yields were increased when lactating animals were fed yeast cultures.

Data of Table (6) indicated that adding bio-yeast at levels of 10 and 20 g / h /d to buffaloes'rations increased daily return by 31.0 and 27.3 %, respectively compared with the control ration.

It could be concluded that supplementing bio-yeast in the ration of heat-stressed buffaloes at rates of 10 g / h / d improved milk yield, feed efficiency and increased economic return.

Table (6): Feeding cost, price of FCM produced and profitability of bio-yeast supplementation in buffaloes' ration.

Items	Treatments		
	T1	T2	T3
Feeding cost (FC/d, L.E)[1]	10.83	11.98	12.56
FCM yield (kg/h/d)	5.60	6.60	6.72
Selling price of FCM produced (L.E)[2]	16.80	19.80	20.16
Daily return (DR, L.E)	5.97	7.82	7.60
% Superiority	100	130.99	127.30

[1]The price of one ton decorticated cottonseed meal is 1750 L.E, one ton wheat bran is 1000 L.E, one ton yellow corn is 1570 L.E, one ton rice bran is 1000 L.E, one ton sodium chloride is 200 L.E., one ton of calcium carbonate is 40 L.E. and the price of one ton rice straw is 352 L.E.
[2]The price of one kg 7 % FCM is 3 L.E at the experimental time.

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الملخص العربي

الأداء الإنتاجي للجاموس الحلاب المغذى على البيويست خلال فصل الصيف

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إستخدم في هذه الدراسة ٣٠ جاموسة حلابة بمتوسط وزن ٥٤٣ ± ١٩,٨٣ كجم بعد وصولها إلى نقطة إنحدار منحنى اللبن وذلك خلال فصل الصيف حيث كانت درجة الحرارة الصغرى ٢٥,٩ °م والكبرى ٤٠,٩٧ °م بينما كانت الرطوبة النسبية ١٢,٥٣ ، ٣٨,٥٧ % على التوالي. وقد وزعت هذه الحيوانات عشوائياً إلى ثلاث معاملات (بكل منها ١٠ حيوانات). إحتوت المعاملة الأولى (المقارنة) على ٣٣% ذرة صفراء ، ٣٣ % ردة ، ٢٠ % رجيع كون ، ١١ % كسب قطن غير مقشور ، ٢ % كربونات كالسيوم ، ١ % كلوريد صوديوم ، بينما تم تكوين المعاملتين الثانية والثالثة بإضافة ١٠ ، ٢٠ جم بيويست / رأس / يوم على التوالي لمخلوط العلف المركز (المقارنة) كما تم تقديم قش الأرز كمادة مالئة لحيوانات التجربة تبعاً لحد الشبع.

وقد أظهرت النتائج أن إضافة البيويست في عليقة الجاموس الحلاب أدت إلى زيادة الكمية الكلية المأكولة من المادة الجافة زيادة معنوية بمقدار ٧,٩ ، ٨,٧١ % كنتيجة لزيادة إنتاج اللبن بمقدار ٨,٠٤ ، ١٧,١٤ % مما زاد من الإحتياجات الغذائية فكان لابد من زيادة الكمية المقدمة من الغذاء والتي إستهلكها الحيوان دون ترك أي متبقيات ، وكذلك زاد محصول اللبن المعدل لنسبة دهن ٧ % بمقدار ١٧,٨٦ ، ٢٠ %. كما أدت إضافة البيويست إلى زيادة العائد الإقتصادي بمقدار ٣٠,٩٩ ، ٢٧,٣٠ % وذلك للحيوانات التي تغذت على المعاملتين الثانية والثالثة على التوالي مقارنة بالمعاملة الأولى (المقارنة). بينما لم يكن لإضافة البيويست في عليقة الجاموس الحلاب تأثير معنوي على تركيب اللبن (نسبة الدهن ، البروتين ،اللاكتوز ، الرماد ، الجوامد الصلبة الكلية وكذلك الجوامد اللادهنية).