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INFLUENCE OF YEAST CULTURE SUPPLEMENTATION ON FEED DIGESTIBILITY, BLOOD CONSTITUENTS AND THE PERFORMANCE OF FINISHED CULLED FEMALE BUFFALOES

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ABSTRACT

Twenty-four culled female buffaloes {12 heifers (H) and 12 adult (A)} were used to evaluate the effects of two types of commercial yeast culture {More yeast (1) and CenMose (2)/ trade name} on nutrient digestibility, nutritive value, average daily gain, feed conversion and blood constituents compared to control (C) groups with no supplement . Each group of animals were divided into three similar subgroups (4 each) on the basis of initial age and initial body weight as follows:

Experimental groups	Heifers			Adult buffaloes		
Averages	HC	H1	H2	AC	A1	A2
Age , months	26.0±1 0	30.0 ± 5.0	26.5±2.50	51.0±1.4	43.5±5.5	36.0±1.0
Body weight, kg	379.5±47.5	346.5 ± 56.5	347.5±29.5	450.5±33.5	463 0±37.0	485 5±28.5

H1 and A1 = More yeast supplement, H2 and A2 = CenMose supplement and HC & AC control groups.

Yeast cultures were top-dressed on the morning concentrate diet at one level of 10 g / head / day. Subgroups H1 and A1 were given More yeast while subgroups H2 and A2 were given CenMose. The subgroups of HC and AC were used as control. All animals were fed for 90 days on a traditional diet comprising of concentrate mixture and wheat straw. Neither nutrients digestibility nor nutritive values were affected by yeast cultures in both heifers and buffalo cows. Yeast cultures increased the average daily gain (ADG) and decreased daily feed intake resulted in an improvement of feed efficiency in heifers. While, CenMose improved the ADG with a slight increase in daily feed intake and gave higher feed efficiency compared to Moreyeast and control one. A2 and H2 showed the best ones in feed conversion (5.33 and 5.09 TDN / Gain, resp.) and the ADG were (1.294 and 1.139 Kg, resp.). More yeast did not affect in the performance of buffaloes while sensible improvement was shown in heifers. Blood analysis showed no significant differences among all groups in total protein, total cholesterol and total lipids.

Addition of yeast culture including its growth medium in concentrate diet of culled female buffaloes improve the average daily gain and feed conversion during a 90-day finishing period.

Keywords: Yeast -digestibility – blood – performance -female buffaloes

INTRODUCTION

Feed additives have been used to improve the utilization of feed nutrients (Joseph *et al.*, 1957; Adams *et al* , 1981; Drennan, 1990; Singla *et al.*, 2000 and Mazen, 2003). The yeast (*Saccharomyces cerevisiae*) culture is the most popular feed additives used for manipulation of the rumen fermentation principally to improve the nutrition of ruminants (Singla *et al.*, 2000; Wang *et al* ., 2001 and Mazen, 2003).

The composition of microbial products and diets used in many of the previous studies were quite variable, thus leading to variable response of animal performance.

Increased rate of body weight gain, better feed efficiency, increased dry matter intake and improved digestibility in cattle fed yeast culture were observed by Dawson *et al.* (1990); Putnam *et al.* (1997); Wang *et al.* (2001) and Mazen (2003). However, yeast culture showed no beneficial response as observed by Quionez *et al.* (1988); Mustvangwa *et al.* (1992) and Swartz *et al.* (1994).

It is still unclear how the yeast as additives exerts its effect. In general, beneficial effects of these supplements have been associated with their ability to alter rumen function. Since yeast culture may increase the concentrations of anaerobic and cellulolytic bacteria (Weidmeier *et al.*, 1987; Harrison *et al.*, 1988 and Dawson *et al.*, 1990) and the total number of rumen bacteria (Singla *et al.*, 2000); thus, altering of digestion (Fiems *et al.*, 1993).

To our knowledge, the effect of yeast culture plus growth medium on the performance of finished female buffaloes has not been investigated. For this reason, the aims of the current study were to evaluate the effects of yeast culture on nutrients digestibility, nutritive value, average daily gain, feed conversion and some blood constituents of culled heifers and adult buffaloes during a 90-day finishing period.

MATERIALS AND METHODS

A field trial was conducted at Mehallet Moussa Research Station, Animal Production Research Institute, Agriculture Research Center, Ministry of Agriculture.

Twenty four culled female buffaloes by adding two types of commercial yeast culture (More yeast or CenMose / Trade name) in their concentrate diet for three months.

More yeast consists of *Saccharomyces cerevisae* including its growth medium, which were originally prepared from yellow corn, corn gluten, wheat bran, barley, corn flour and molasses. Each gram contained 14.8×10^6 cfu. The constituents of CenMose are *Saccharomyces cerevisae* (min. 1,000 Billion cfu), *Bacillus subtilis* fermentation product (min. 5 million cfu), β 1, 3 - β 1, 6D-glucan, mannan based oligosaccharide, cellulose, protease, amylase and fermentation soluble. Each gram contained 11.6×10^6 cfu. These two yeast cultures are produced in USA. Total viable cell counts on the culture were reported by the manufacturer and were estimated using the standard method of Collins and Patricia (1976). Also, yeast cultures samples were chemically analyzed according to the method of A. O. A. C. (2000).

Experimental Groups:

The experimental animals consisted of two groups, heifers and adult buffaloes. Each group was subdivided into three subgroups (H1, H2 and HC for heifers and A1, A2 and AC, for adult buffaloes). Each subgroup had four animals, based on their initial age and initial body weight (Table 1).

Table (1): The averages of initial age and initial body weight of. the experimental animals.

Experimental groups	Heifers			Adult buffaloes		
	HC	H1	H2	AC	A1	A2
Age , months	26.0± 1.0	30.0 ± 5.0	26.5± 2.50	51.0± 1.4	43.5± 5.5	36.0± 1.0
Body weight, kg	379.5± 47.5	346.5 ± 56.5	347.5± 29.5	450.5± 33.5	463.0± 37.0	485.5± 28.5

H1 and A1 = More yeast supplement, H2 and A2 = CenMose supplement and HC & AC control groups.

Feeding regime:

All animals were kept individually in semi-open sheds and were fed according to Ranjhan (1999). The concentrate diet was offered twice a day at 8.00 am and 14.0 p.m. while, rice straw was given once a day. The ratio of concentrate to roughage was about 3:1. Only the morning concentrate diet was Top-dressed with the yeast culture at one level of 10 g / head / day. Subgroups H1 and A1 were given More yeast while subgroups H2 and A2 were given CenMose; HC and AC subgroups were used as control. Fresh water was available twice daily and mineral blocks were freely available. All animals were injected by vitamin A and D once a day throughout the experiment. Food refusals were measured; feed intake and weight of animals were recorded biweekly.

Digestibility trial:

At the end of the feeding experiment, three animals from each treatment were used for the digestibility trial. Grap sample method was used and the acid insoluble ash as the internal marker was carried out to estimate the nutrient digestibility as reported by Van Keulen and Young (1977). Feces samples were collected four successive days from each animal for chemical analysis according to A. O. A. C. (2000).

Sampling and analysis:

Concentrate and rice straw were sampled throughout the experiment and bulked for chemical composition analysis (A. O. A. C. , 2000). The chemical composition of concentrate, rice straw and both of yeast cultures is shown in Table (2).

Blood sampling:

Before morning feeding, Blood samples were taken monthly from the Jugular vein of all animals. Then, centrifuged at 3000 rpm for 10 minutes then, plasma samples were stored at -20 ^{0}C for later determination of total protein (Gornall *et al.*,1949 and Henry *et al.*,1974); Total lipids (Zollner and Kirsch ,1962) and total cholesterol (Allain *et al.*, 1974 and Trinder, 1969).

Statistical analysis:

Comparisons among treatments were carried out for each of the two main groups separately, namely heifers and buffaloes. Data analysis was carried out by the Least Squares methods, using the General Linear Model of SAS (2000).

Table (2). Chemical composition of used feeds and yeast cultures (% DM basis)

Items	Concentrate Mixture*	Rice straw	More yeast	CenMose
Dry matter	91.56	92.68	89.37	94.17
Organic matter	92.55	84.55	94.43	89.74
Crude protein	17.61	4.90	30.64	27.67
Ether extract	3.78	1.10	4.60	2.45
Crude fiber	14.65	33.83	5.50	15.20
N-free extract	56.51	44.72	53.69	44.42
Ash	7.45	15.45	5.57	10.26

* Containing: 25 % Yellow corn, 28 % undecorticated cottonseed meal, 37 % wheat bran, 7 % molasses 2 % limstone and 1 %common salt.

RESULTS AND DISCUSSION

I. Nutrient Digestibility and Nutritive value:

Least squares means of nutrient digestibilities and nutritive value of the diet with or without a supplement of both yeast cultures (More yeast and CenMose) for heifers and buffalo cows are presented in Table (3). Nutrient digestibilities of CP, EE, CF, NFE and DM were not affected by yeast cultures in both heifers and adult buffaloes. In our experiment, it was found out that the diet digestibilities were not altered by the supplement of yeast culture. Such findings might be due to that non of the markers was ideally efficient in the quantitative and qualitative estimation (Kotb and Luckey, 1972). Even though, the use of natural markers, e.g. acid insoluble ash (AIA) in digestibility studies offer the advantages of cheapness and convenience, the recovery of silica in the feces is not really quantitative in different condition due to some main reasons. The first is due to the absorption and excretion of the silica in the urine. The second main reason is the contamination of the feed with dust. Our findings are in agreement with those of Harrison *et al.* (1988) and Mutsvangwa *et al.* (1992) in Holstein cows and Crossbred bulls and Khalil (2000). However, Weidmeier *et al.* (1987); Gomez-Alarcon *et al.* (1990) and Mazen (2003) recorded a significant improvement in the diet digestibilities when yeast cultures were included in the diet. Moreover, our findings are in agreement with those of Khalil (2000) who reported that nutritive value of the diet measured in buffalo heifers was not affected by the yeast culture.

II. Animal performance:

Although, no significant differences were detected among all groups, both of the yeast cultures increased the average daily gain (ADG) and improved feed conversion (Table 4). The best ADG and feed conversion for buffalo heifers were recorded for H2 (CenMose). The improvements in ADG and feed efficiency were about 22.8 % and 27.0 % for H1 (More yeast), while they reached 36.6 % and 39.2 % for H2 (CenMose). Current results are in full agreement with those of Khalil (2000) and Mazen (2003) in buffaloes. They attributed the improvement of ADG and feed efficiency to the stimulation and

Table (3): Least squares means (× ± SE) of nutrient digestiblities and nutritive value in culled female buffaloes.

Items	HC (× ± SE)	H1 (× ± SE)	H2 (× ± SE)	AC (× ± SE)	A1 (× ± SE)	A2 (× ± SE)
Nutrient Digestiblities, %						
CP	73.38 ± 1.63	68.73 ± 1.63	71.14 ± 1.63	76.95 ± 4.22	77.51 ± 4.23	76.89 ± 4.22
EE	87.68± 60.79	80.74 ± 6.78	79.50 ± 6.79	89.93 ± 4.61	88.27 ± 4 61	92.01 ± 4.60
CF	59.71 ± 3.25	58.16 ± 3.24	51.72 ± 3.24	62.82 ± 2 74	68.73 ± 2.74	60.57 ± 2.74
NFE	79.22 ± 2.77	75.92 ± 2.76	79.79 ± 2.77	81.20 ± 2.83	81.27 ± 2 83	79.93 ± 2.83
DM	71.96 ± 2.33	66.92 ± 2 33	69.85 ± 2.33	74.53 ± 3.14	76.16 ± 3.15	73.82 ± 3.14
Nutritive value, %						
TDN	70.83 ± 2.88	69.90 ± 2.87	68.68 ± 2.88	72.98 ± 3.12	74.95 ± 3.12	72.77 ± 3.12
DCP	11.29 ± 0.31	10.40 ± 0.31	10.90 ± 0.31	11.70 ± 0.83	12.20 ± 0.83	12.09 ± 0.83

Comparisons among treatments were carried out for each of the two main groups separately.
No significant differences were detected among groups.
H1 and B1 = More yeast supplement, H2 and B2 = CenMose supplement and HC & BC control groups.

Table (4): Least squares means (× ± SE) of final body weight, gain in weight, average daily gain, daily feed intake, feed conversion and blood constituents of culled female buffaloes

Items	HC (× ± SE)	H1 (× ± SE)	H2 (× ± SE)	AC (× ± SE)	A1 (× ± SE)	A2 (× ± SE)
Initial age , month	26.0 ± 1.0	30.0 ± 5.0	26.5 ± 2.50	51.0 ± 14.0	43.50 ± 5.50	36.0 ±1.0
Initial body weight , kg	379.5 ± 47.50	346.5 ± 56.5	347.5 ± 29.5	450.5 ± 33.50	463.0 ± 37.0	485.5 ± 98.50
Final body weight , kg	454.6 ± 19.95	438.68 ± 19.33	449.97 ± 19.94	576.34 ± 15.88	561.10 15.88	615.06 ± 15.87
Body weight gain , Kg	75.10 ± 15.59	92.18 ± 22.91	102.47 ± 22.34	77.84 ± 15.88	62.60 ± 15.91	116.56 ± 15.87
Average daily gain , Kg	0.834 ± 0.18	1.024 ± 0.25	1.139 ± 0.25	0.864 ± 0.18	0.697 ± 0.18	1.294 ± 0.18
Daily feed intake as :						
TDN	6.13 ± 0.20	5.82 ± 0.20	5.80 ± 0.20	6.65 ± 0.40	6.92 ± 0.40	6.90 ± 0.40
DCP	0.98^{a} ± 0.03	0.87^{b} ± 0.03	0.92^{ab} ± 0.03	0.98 ± 0.08	1.13 ± 0.09	1.15 ± 0.08
DM	8.62 ± 0.29	8.34 ± 0.29	8.46 ± 0.29	9.09 ± 0.53	9.26 ± 0.23	9 48 ± 0.53
Feed conversion :						
TDN / gain	7.35 ± 2.06	5.68 ± 1.10	5.09 ± 1.55	7.70 ± 1.86	9.93 ± 2042	5.33 ± 2.92
DCP / gain	1.18 ± 0.21	0.85 ± 0.18	0.81 ± 0.24	1.13 ± 0.29	1.62 ± 0.40	0.88 ± 0.49
DM / gain	10.34 ± 2.93	8.14 ± 1.64	7.43 ± 2.22	10.52 ± 2.53	13.29 ± 3.27	7.26 ± 3.93
Blood constituents:						
Total Protein (g/dl)	8.18 ± 0.09	8.15 ± 0.34	8.19 ± 0.4	8.14 ± 0.34	8.32 ± 0.40	7.75 ± 0.29
Total cholesterol (mg/dl)	85.73 ± 5.83	92.11 ± 6.19	101.44 ± 6.61	87.34 ± 6.25	85.10 ± 4.32	109.59 ± 6.44
Total lipids (g/dl)	0.318 ± 0.02	0.328 ± 0.03	0.416 ± 0.03	0.313 ± 0.03	0.310 ± 0.02	0.328 ± 0.03

In each row, means not followed by the same letter differ significantly at 5 % level. Comparisons among treatments were carried out for each of the two main groups separately.

H1 and B1 = More yeast supplement, H2 and B2 = CenMose supplement and HC & BC control groups.

regulation of the digestion process, which was reflected on the increase of body weight gain.

Concerning adult buffaloes, CenMose treatment (A2) improved the ADG with a slight increase in daily feed intake. It gives more efficient feed utilization when compared to More yeast treatment (A1) and control one as shown in Table (4) These results are in agreement with the results of Mustvangwa *et al.* (1992), with feedlot steers Also, Drennan (1990), observed an improvement in live-weight gain and food conversion accompanied by higher dry matter intake (DMI) when yeast culture was included in a grass-silage based diet given to Continental cross bulls over a 205 day period.

It is worth noting that the result of the present study and the findings of Weidmeier *et al.* (1987) and Harrison *et al.* (1988) indicated no major effect on the DM digestibility of the diet. This may be due to the influence of the changes in bacterial numbers on rate of fiber digestion and hence, intake. However, diet digestibility is more related to the physiochemical and structure of the forage and ruminal retention time (Hovell *et al*, 1986). In addition, the presence of yeast culture might alter ruminal fermentation patterns and ruminal pH (Williams *et al.*, 1991). Moreover, DMI was significantly increased by the addition of yeast culture during the experimental period of 28 weeks (Mustvangwa *et al.*, 1992).

III. Blood Constituents:

Yeast culture supplement had no effect on plasma total protein (g / dl), total cholesterol (m / dl) and total lipids (g / dl) in heifers and adult buffaloes during finishing period (Table 4).

Blood protein pattern often reflects the physiological and chemical status of the animal (Abou Akkada *et al.*, 1971 and Kumar *et al.*, 1980). Values of plasma total protein were almost similar in all groups ranged from 7.75 to 8.32 g / dl in adult buffaloes and 8.15 to 8.19 g / dl in heifers. Values of total cholesterol and total lipids were higher in H1 and H2 (in heifers) and A2 (in adult buffaloes). These results could be attributed to the increased bacterial lipid content caused by yeast cultures. Results of the present study are closely agreed with results of O`Kelly and Spiers (1988). They indicated an increase in plasma cholesterol and fatty acids contained in cholesterol esters when monensin was supplemented to the diet of beef cattle. This increase was presumably an effect of increased bacterial lipid synthesis, which increased the amount of lipids available for absorption. In contrast, Duff *et al.* (1994) reported that diets containing ionphores did not increase serum cholesterol or triglycerides compared to a control diet. Pordomingo and Galyean (1990) observed a greater bacterial lipid content of Lasalocid compared with monensin *in vitro*, which might increase serum lipids of Lasalocid. In the present study, a remarkable decrease in serum cholesterol concentration occurred with More yeast culture supplement in buffaloes (A2). The reasons for this failure to observe increased cholesterol and total lipids were not clear.

IMPLICATIONS

Addition of yeast culture including its growth medium in concentrate diet of culled female buffaloes improve the average daily gain and feed conversion

during a 90-day finishing period. Furthermore, potential effects of yeast cultures supplement on the performance of such animals need further investigation particularly, with respect to its effect on body composition and carcass traits.

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تأثير إضافة الخميرة على معاملات الهضم ومكونات الدم والأداء الإنتاجي لإناث الجاموس المستبعدة

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أجريت هذه الدراسة للاستفادة من إناث الجاموس المستبعدة كمصدر للحوم الحمراء وذلك بتسمينها باستخدام بعض الإضافات الطبيعية مثل الخمائر حيث استخدم نوعين من الخمائر التجاريـــــــة (More yeast و CenMose) .

تم استخدام عدد ٢٤ أنثى جاموس مستبعدة (١٢ عجلة ، ١٢ جاموسة) بمتوسط وزن ٣٥٨ كجم و ٤٦٦ كجم ، ومتوسط عمر ٢٨ شهر و ٤٤ شهر لكل من العجلات و الجاموس على التوالى . غذيت جميع الحيوانات لمدة ٩٠يوم، قسمت العجلات والجاموس إلى ثلاثة مجاميع كل مجموعة تحتوى على أربعة حيوانات لكل منهما. تمت التغذية على النحو التالى:

١- مجموعة كنترول غذيت على (علف مركز + قش ارز) .
٢- مجموعة مختبرة غذيت على (علف مركز + قش ارز) + ١٠ جرام خميرة More yeast للحيوان فى اليوم.
٣ -مجموعة مختبرة غذيت على (علف مركز + قش ارز) + ١٠ جرام خميرة CenMose للحيوان فى اليوم.

وفى نهاية فترة التغذية تم إجراء تجربة هضم وذلك لتقييم تأثير إضافة الخمائر على معاملات الهضم والقيمة الغذائية ومعدلات الزيادة اليومية وكفاءة التحويل وبعض مكونات الدم . فكانت النتائج كالتالى :-

- لم تتأثر معاملات الهضم والقيمة الغذائية بإضافة الخميرة لكل من العجلات والجاموس ، بينما إضافة خميرة More yeast أدت إلى تحسن معنوى فى الكفاءة التحويلية ومتوسط الزيادة اليومية فى الوزن -
- أما بالنسبة لخميرة CenMose فلقد أدت إلى تحسن متوسط الزيادة اليومية مع زيادة طفيفة فى المأكول وزيادة الكفاءة التحويلية للغذاء مقارنة بالخميرة من نوع More yeast وكذلك مجموعة الكنترول . حققت إضافة الخميرة CenMose فى كلا من الجاموس و العجلات أعلى زيادة يوميه فى الوزن (١,٢٩٤كجم و ١,١٣٩ كجم) و أعلى كفاءه تحويلية (TDN/gain ٥,٣٣ و TDN/gain ٥,٠٩) على التوالى .كما أظهرت النتائج عدم تأثر مكونات الدم بإضافة الخميرة .

ومما سبق يمكن أن نستخلص أن إضافة الخميرة مع بيئة مزرعة النمو إلى العليقه المركزة لإناث الجاموس المستبعدة حسنت من الزيادة الوزنية اليومية وكذلك كفاءة التحويل خلال فترة التسمين (٩٠ يوم)