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# Effect of Supplementation Dry Yeast or Bentonite and their Combination as Feed Additives on Productive Performance of Lactating Buffalos.

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## ABSTRACT

The objective of this experiment was to investigate the influence of addition active dry yeast, bentonite or their mixture to lactating buffalos' rations on digestibility, milk yield, milk constituents, some blood metabolites, feed efficiency and economic efficiency. Eight lactating buffalos were used in double 4×4 Latin square design where their live body weight was (612.5±41.19 kg on average) and previous milk yield recorded (8.92±0.47 kg/day on average). Animals were fed individually according to Kearl requirements (1982) requirements, as follows: 40% of their energy requirement as total digestible nutrients (TDN) was covered from concentrate feed mixture (CFM), while the other 60% of energy requirement was covered from Egyptian berseem (Br), with an extra amount of rice straw (RS) was offered at 0.5% of animal's body weight T1 (control ration), while the tested rations were included the control ration plus 10 g/h/d yeast (T2) or 20g bentonite /kg DM intake (T3) or the combination of the two additives (T4). Results showed that positive significant effects respecting most nutrient digestibilities for all supplemented rations based on those control ration, being the better values were mostly occurred with T4. The feeding values as TDN was significantly ($p<0.05$) increased with supplemented rations compared with that of control one. Similar trend between experimental rations regarding DCP values were observed with the best value was also associated with (T4). The average daily actual milk yield (AMY) was significantly higher ($p<0.05$) when animals fed the supplemented rations (T2, T3 and T4) in comparison with those fed the free from additives ration (T1). The fat corrected milk (7% -FCM) was behaved the same trend of (AMY), but there were no significant differences among the experimental rations. There were no significant differences between the experimental diets regarding milk composition. The total dry matter intake and TDN intake showed no significant differences among the experimental rations, while, the values of DCP intake was significantly ($P< 0.05$) better when animals fed T4 ration than those fed the control one. There were no significant differences among experimental rations regarding the measured blood metabolites. The best economic efficiency was occurred with T3 and T4 rations. Generally, from the obtained results, it could be concluded that supplementation of dry yeast or bentonite or both of them to rations of lactating buffaloes had, favorability significant effects on digestibility, feeding value, milk production and composition and economic efficiency.

**Keywords:** Lactating buffalo, yeast, bentonite, nutrients digestibility, milk production, and economic efficiency.

## INTRODUCTION

In Egypt, buffalos are the main productive farm animal (3.9 million animals), which contributing the national economy annually by around (50-55%) and (30-35%) from the total milk and red meat, respectively (FAO, 2005). Milk production in Egypt did not yet reach acceptable self-sufficiency level. Efforts are continuing in spite of the limited national feed resources, to increase the production through the utilization of some additive that reduce the passage rate of the digesta through the digestion tracts in order to improve the efficiency of digestion and consequently improving feed utilization. Bentonite primarily consist of a mineral called montmorillonite, which has an articulated layered structure with a net negative charge balanced by cations within the interlayer space. Montmorillonite has an attraction for mono-and divalent ions that bind proteins and nitrogenous compounds to bypass the rumen (Adamis and Williams, 2005; Trckova *et al*., 2004; and Wester 2002). Bentonite recognized as safe additive for feeding livestock (EFSA, 2016), where 20 mg/kg of complete feed was safe for all animal species (EFSA FEEDAP Panel, 2012a). Bentonite is one of the common natural clays used in animal diets to improve feed intake, digestibility of nutrients and daily gain (Saleh *et al*., 1999 and Salem *et al*., 2001). Mesgaran (2005) indicted that addition of sodium bentonite (350 g/cow/d) to the low forage diet slightly enhanced milk yield of Holstein cows. Katsoulos *et al*. (2006) found that when cows were fed on concentrate ration supplemented with 1.25% clinoptilolite could be produced higher total milk yield than the unsupplemented ones. Also, Abd El-Baki *et al*. (2009) and Helal and Abd El- Rahman (2010) found the same trend with lactating buffalos and sheep, respectively. More recently, Sulzberger *et al*. (2016) found that when dairy cows fed on TMR with high grain challenge supplemented with clay (0.5, 1and 2% of diet DM) tended to yield more milk than those without clay supplementation.

Active dry yeast products (Saccharomyces cerevisiae being one of the most common feed additives) are well accepted as having beneficial effects in livestock production (Chaucheyras-Durand *et al*., 2008). Rumen specific yeasts are also used to stimulate microbial activity in the rumen. The inclusion of probiotics in ruminant feed is designed to encourage certain strains of microbes for growth in the gut at the expense of undesirable ones. The main effects of live yeasts are to improve the rumen maturity, scavenging oxygen and maintaining the anaerobic conditions to sustaining microbial establishment (McDonald *et al*., 2002). Also, stabilizing the of ruminal pH and consequently reducing the risk of acidosis by competing with lactic acid producing bacteria, increasing fiber degradation and interactions with plant cell-wall degrading micro-organisms (Chaucheyras-Durand *et al*., 2008). Moreover, rumen specific live yeasts may therefore aid in fasting adaptation and development of the rumen (Pinos-Rodriguez *et al*., 2008). Bertin and Andrieu, (2005), demonstrated that Yea-Sacc®1026 significantly improved milk production of high-producing dairy cows. Yeast supplementation can stimulate rumen fiber digestion, stabilize ruminal pH, stimulate ruminal fermentation, increases feed intake, milk yields, feed conversion efficiency and reduce risks associated with abrupt dietary changes (Yoon and Stern, 1996 and Denve *et al*. 2007). Azzaz H.H. *et al*., (2015) concluded that lactating buffalo's rations supplemented with yeast (Saccharomyces cerevisiae) showed significant improvement in nutrients digestibility, milk yield and composition. Supplementing buffaloes with yeast culture may increase milk yield during early lactation up to the peak point that in turn led to and a more persistent milk production during mid-lactation period. In ruminants the beneficial effects of yeast as microbial feed additive on the performance of animals were summarized as better ruminal digestion, improved nutrient utilization and milk production (Alsaied Alnaimy and Mostafa Habeeb, 2017). Due to the complexity of the ruminal ecosystem in terms of structure of microbial populations and activities, optimization of its function could be achieved by combinations of live yeast products and other additives to exert synergistic effects. Over many years of research and experience, feed additives are very important in feeding animals, which became clear a good device for maximizing nutritional efficiency. Nowadays, probiotics in general, especially dry yeast, as well as clay minerals are extremely beneficial for feeding ruminants.

The objective of this work was to investigate the effect of addition active dry yeast or bentonite or their mixture to lactating buffalo rations on digestibility, milk yield, milk constituents, some blood metabolites and feed efficiency.

## MATERIALS AND METHODS

**The experimental procedures:**

This study was carried out at El-Gemmaiza Animal Production Research Station belonging to Animal Production Research Institute, Agricultural Research Centre, Egypt. Eight lactating buffalos in their $3^h$ or $4^{th}$ lactation seasons were employed after first month of lactation to conduct this work. Animals were random distributed according to their live body weight (612.5±41.19 kg in average) and milk yield (8.92±0.47 kg /day in average) into four similar groups using duplicated 4*4 Latin squares designs. Two buffalos were fed each ration during a period of 28 days. The first 21 days was used as preliminary period followed by 7 days as collection period. Animals in all groups were fed individually according to Kearl requirements (1982) as follows: Control ration (T1): 40% concentrate feed mixture (CFM) plus 60% Egyptian berseem (Br) based on total digestible nutrients (TDN) requirements in additions of 0.5% of animal's body weight from rice straw (R bentonite (20 g/kg DM) and yeast (10g / animal /day). Bentonite S). While, ration T2 received control ration plus yeast (10 g/animal/day), ration T3 received control ration plus bentonite (20g/kg DM), and ration T4 received control ration plus the combination of and yeast (Dox-al, DX Thepax100R(strain GSH351) containing $5x10^9$ cells/ g (European patent n.0111202 - European patent n.98116181.3) were offered after mixed with concentrate feed mixture. The CFM was offered twice daily, while berseem and rice straw portions were offered once daily. Animals were hand milked twice at 7 am and at 3 pm every day. Milk yield was recorded individually throughout the collection period and milk samples were collected twice daily over 7 - d collection period. Representative samples of milk (morning and evening samples) were proportionally mixed and analyzed for fat, protein, lactose, solids non-fat and total solids using Milk scan apparatus (model/30 series type 10900 FOSS), while ash was calculated by difference. Energy of milk was calculated using the formula of Overman and Sanmann (1926) (Kcal=115.3(2.51+fat %). The formula of Raafat and Saleh (1962) (7% - FCM = 0.265 milk yield +10.5 fat yield) was used to switch the actual milk yield to 7% - FCM. Feed conversion was calculated and expressed in terms of Kg DM, TDN or DCP required for producing one kg 7% - FCM. Economic efficiency for milk production was expressed as the ratio between the price of daily milk 7% - FCM produced and the cost of daily feeds consumed. The feed cost, based on the current price (LE/ton) as CFM, BR and RS were 3900, 300, and 350 L.E., respectively. While, bentonite was priced 0.25 L.E./kg, yeast 100 L.E./kg, and the price of milk was = 8 LE.

**Digestibility trials:**

At the end of each period, all animals from each group were used for digestibility trails to evaluate the nutrient digestion coefficients and nutritive values of rations, Acid Insoluble Ash (AIA) procedure was used as a natural marker according to Van Keulen and Young (1977). Fecal grab samples of nearly 500g were taken from the rectum three times daily for five days as collection period. Blood samples were taken at 8 am prior to morning feeding and drinking. Samples were withdraw from the jugular vein of experimental animals into clean heparinized glass tubes. Blood samples were centrifuged at 4000 rpm per 20 min. to separate the serum. Blood serum was stored in at -200c for subsequent specific chemical analysis.

**Analytical procedure:**

Proximate analysis of feed consumed and feces excreted samples were determined according to the official methods (A.O.A.C., 2000). Blood serum was separated from the whole blood to determine the total protein according to the method of Peters (1968), albumin was analysed according to Doumas (1971) and globulin was calculated by subtracting the albumin value from total protein one, and urea according to (Patton and Grouch, 1997). Milk samples were analyzed using a Milkoscan system (Foss Electric Hillerod, 133B Milkoscan, Denmark) for lactose, fat, protein, total solid (TS) and solid non-fat (SNF) concentrations.

**Statistical analyses**:

The data were statistical analysis by General Linear Model procedures (GLM) described in SAS User's Guide (SAS, 2003). The Duncan's new multiple-range test (Duncan, 1955) was used to test the significant between means.

## RESULTS AND DISCUSSION

**Proximate analysis of rations:**

Data in Table (1) showed that proximate analysis of BR and RS are extremely comparable to those recorded in the literature. The values of CP (15.30%), CF (13.17%) and EE (3.46%) of CFM were also within the normal range of the currently manufactured concentrates in Egypt, which usually used for milk production. In general, the present results of the chemical composition values of CFM, BR and RS (Tables 1) are within the normal ranges that reported in Egypt by several workers (Helal and Abdel-Rahman, 2010, Abd El-Ghani , 2012 and Ghoniem *et al*., 2017). The control of CP and CF and the other nutrients are greatly similar among the experimental rations, where the additional additives did not changing its composition, being the CP and CF contents are too suitable for lactating buffaloes.

**Table 1. Chemical analysis of feed stuff and calculated composition of the experimental diets (on DM basis %).**

| Items | DM | OM | CP | CF | EE | NFE | Ash |
|---|---|---|---|---|---|---|---|
| CFM* | 92.15 | 86.24 | 15.30 | 13.17 | 3.46 | 54.31 | 13.76 |
| BR | 15.93 | 82.25 | 10.53 | 28.36 | 0.83 | 42.53 | 17.75 |
| R.S. | 91.95 | 77.62 | 4.45 | 36.29 | 0.63 | 36.25 | 22.38 |
| Calculated composition of experimental rations : | | | | | | | |
| T1 (control) | 64.63 | 82.96 | 11.26 | 23.59 | 1.91 | 46.20 | 17.04 |
| T2 | 66.20 | 83.18 | 11.54 | 22.90 | 2.01 | 46.73 | 16.82 |
| T3 | 67.56 | 81.79 | 11.26 | 22.80 | 1.97 | 45.76 | 18.21 |
| T4 | 65.27 | 81.60 | 11.01 | 23.49 | 1.86 | 45.24 | 18.40 |

***CFM; contained of 32% yellow corn , 30% undecorticated cotton seed meal , 20% wheat bran, 6 % rice bran, 5% soybean meal, 3% molasses, 3% limestone, 1% common salt.**

**Nutrient digestibility and feeding values:**

Data presented in Table (2) indicated that the daily dry matter intake (DMI) expressed either as kg/100kg B.W or g/kg w $^{0.75}$ were insignificantly higher with the three tested rations (T2, T3 and T4) than those of control one. The enhanced intake is most likely due to an improvement of the rate of breakdown of feedstuffs in the rumen. These results are in agreement with those obtained by Abou Ella (2007) and Helal and Abdel-Rahman (2010) who found that DMI of lactating ewes was significant increased with rations supplemented with dried yeast and/or bentonite compared to the control ration that free from both supplements. Also, similar results were observed by Degirmencioglu *et al*. (2013) with Anatolian water buffaloes. Similarly, Desnoyers *et al*. (2009) reported that yeast supplementation increased DMI by 0.275 kg/h/d of lactating buffalos. The obviously increasing the alfalfa DM consumption could be correlate with the optimizing ruminal pH and cellulolytic activity due to the stabilization of the ruminal environment by yeast application (Miller-Webster *et al*., 2002). Yeast added to the rations provides stimulatory actors to rumen cellulolytic bacteria as reported by Williams *et al*., 1991; Harrison *et al*., 1988 and Erasmus *et al*., 1992. In contrast, Soren *et al*., (2013) demonstrated that addition of Saccharomyces cerevisiae alone or in combination with Lactobacillus sporogenes for rations' lambs did not affect on feed intake. Otherwise, Saleh *et al*. (1999) indicated that DM intake by lactating buffaloes slightly decreased in bentonite addition groups. Concerning the digestibility findings, positive significant effects respecting most nutrient digestibilities of the all supplemented rations (T2, T3 and T4) were observed compared with unsupplemented one (T1), being the better values were mostly occurred with (T4). Similar effect was detected by Azzaz *et al*. (2015) who showed significant (p<0.05) increases of all nutrient digestibilities by lactating buffaloes fed rations supplemented with yeast culture (Saccharomyces cerevisiae) compared with those fed the control ration. Similarly, Hanne H. Hansen *et al*. (2017) reported that multiparous buffalo cows had respond to yeast supplementation through increases DM, OM and CF digestibility. Also, Mohsen Kazemi *et al*. (2017) indicated that treatment containing sodium bentonite had significantly higher (P< 0.05) DM and OM digestibility compared the control group. With sheep, El-Ashry *et al*. (2003) noticed that yeast addition to lamb diets had improved the digestibility of DM, CP, CF and hemicellulose which in turn led to an increases in protein degradability and the flow microbial nitrogen rate to post ruminal. Moreover, Olson *et al*. (1992) reported that the addition of yeast culture can increase rumen OM digestibility and resulted in greater microbial efficiency. Considerably, yeasts may stimulate growth and enzymatic activity of cellulolytic bacteria, as well as improve microbial protein synthesis and fiber degradation (Yoon and Stern, 1996 and Bomba *et al*., 2002). These positive effects of dietary treatments may be attributed to the positive action of yeast culture in the rumen environment in which optimizing the ruminal pH that in turn stimulate proteolytic bacteria that causing CP digestion to be better than that the diet free from yeast (Williams *et al*., 1991). Reverse results were obtained by Tripathi *et al*. (2008), Tripathi and Karim (2010) and Soren *et al*. (2013) who studied the effect of probiotic addition to goats' rations on nutrients digestibility. They found that digestibility of DM, OM, CP and NDF did not affect by probiotic supplementation. Nevertheless, it caused significantly (P< 0.01) higher ADF digestibility than that of unsupplementation one. Obviously, the present results revealed that the combination of the two feed additives have an advantage over the use of each one alone. The improvement of digestibility coefficients of the tested rations supplemented with clay (bentonite) may be attributed to the role and benefit of clays as Improving feed utilization by slowing feed passage time throughout the digestive tract which reflected favorably on digestibility (Quiscnberry and Bradley, 1964, Almquist *et al*., 1967 and Ousterhout, 1967). Improvement the digestibility might be incident due to increasing the reactive surface areas of nutrients to the rumen microorganism enzymes (Pulatov *et al*., 1983). Regarding the feeding values of the experimental rations respecting TDN which was significantly (p<0.05) increased with all supplemented rations compared with control group, being the better values were associated with the mixture of two additives (T4). Similar, trend among dietary treatments in respect of DCP values were observed with the best value was also occurred with (T4). Improvement of nutritive values was reported by Allam *et al*. (2001) who found that TDN and DCP values increased from 73.73 to 81.88 and from 13.19 to 15.32, respectively, when yeast (2.5 g/h/day) was added to dairy cows. Also, the same results was archived by Helal and Abdel-Rahman (2010) with ewes and Abd El-Ghani (2012) with lactating buffalos.

**Milk Yield and composition:**

The results of Milk yield and composition of lactating buffalo fed the experimental rations are shown in Table 3. The daily actual milk yield (AMY) was significantly higher (p<0.05) when animals fed supplemented rations (T2, T3 and T4) compared to unsupplemented ration (T1), with no significant differences among the three tested rations. Daily actual milk yield was increased by 6.49, 8.50 and 11.63 % for T2, T3 and T4 respectively, based on control yield. The 7% - FCM yield took the same trend of AMY while, there were no significant differences among the experimental rations. The yield of 7% - FCM was increased by 9.01, 9.24 and 15.32 % for T2, T3 and T4 rations, respectively compared to control one. In the current study, improving the digestion coefficients and the feeding values of T4 could be reflect on the highest AMY or 7% - FCM produced with this ration. The positive response of yeast or bentonite or their mixture on milk yield is most likely due to the increased feed intake and improved digestibility of nutrients.

**Table 2. Feed intake, nutrient digestibility and feeding values of experimental rations fed to lactating buffalos**

| Items | Treatments | | | |
|---|---|---|---|---|
| | T1 | T2 | T3 | T4 |
| DM intake : | | | | |
| Kg/100 kg B.W | 2.15±0.19 | 2.38±0.22 | 2.27±0.19 | 2.33±0.36 |
| g /Kg $W^{0.75}$ | 106.52±7.00 | 117.58±7.80 | 112.37±7.32 | 113.18±8.73 |
| Digestion coefficients % : | | | | |
| DM | 62.04d±0.32 | 67.10b±0.40 | 65.59c±0.44 | 68.36a±0.22 |
| OM | 64.60c±0.20 | 68.63a±0.43 | 66.43b±0.42 | 68.94a±0.26 |
| CP | 61.33d±0.05 | 64.24b±0.41 | 63.46c±0.23 | 66.85a±0.16 |
| CF | 64.56c±0.23 | 67.42a±0.21 | 66.71b±0.24 | 67.51a±0.10 |
| EE | 77.81b±0.14 | 79.03a±0.30 | 77.92b±0.17 | 78.35b±0.13 |
| NFE | 69.64c±0.21 | 70.61b±0.18 | 71.17a±0.07 | 70.65b±0.16 |
| Feeding values (%, DM basis) : | | | | |
| TDN | 66.50c±0.26 | 67.76b±0.40 | 68.45ab±0.42 | 69.05a±0.45 |
| DCP | 7.72d±0.07 | 8.02c±0.02 | 8.33b±0.15 | 8.86a±0.07 |

**a ,b ,c and d : means in the same row with different superscripts differ ($P<0.05$).**

**(Control)T1= 40% CFM+60% BR+ R.S., T2=40% CFM+60% BR+ R.S. + Yeast, T3=40% CFM+60% BR+ R.S. +Bentonite and T4= 40% CFM+60% BR+ R.S. + Yeast + Bentonite.**

Also, stimulatory factors for rumen bacteria such as B - Vitamins, amino acids and organic acids are involved in yeast culture where they have a potential role in stimulating the ruminal bioprocesses. Due to the complexity of the ruminal ecosystem in terms of structure of microbial populations and its activities, optimization of its function could be achieved by combinations of live yeast products and other additives to display the synergistic effects on the whole biomass degradation. Perhaps this is what happened when the combination of bentonite and yeast were added into the diets of lactating buffaloes in the present trial. Bentonite may have enhancing role to stimulated yeast to play a better role in rumen. Milk composition as T.S, SNF, fat, protein, lactose and ash showed no significant differences among the dietary treatments, being slightly increased in these constituents toward the dietary treatments T3 and T4 (Table 3). Also, milk energy was insignificantly higher when animals fed all tested rations (T2, T3 and T4) than those fed control one. Clay can acts to slow down rate of passage through the rumen and thereby affect rumen microbes, which resulted in, increase rumen acetate and decrease rumen propionate production (Rindsing *et al*., 1969). Similar findings were reported by Desnoyers *et al.* (2009) who found that yeast products affect the rumen microbial population, causing changes in ruminal VFA production that led to in an increasing milk production as well as increasing in milk fat and milk protein yields from dairy cows. Increased percentage and yield of milk protein might indicate that changes in rumen fermentation as a result of supplementing YC that therefore increased the supply of glucogenic and aminogenic substrates. Our results are supported by the results of many researchers; Azzaz H.H. *et al*. (2015), Sulzberger *et al*. (2016), Hanne. H. Hansen *et al*. (2017) and Bakr *et al*. (2015) who observed that milk production and milk fat of dairy cows fed a basal diet plus supplementation of yeast were higher than those fed unsupplemented diet. Moreover, Saccharomyces cerevisiae supplementation had been associated with increased the flow of microbial protein leaving the rumen and enhanced supply of amino acids entering the small intestine for more efficiently enzymatic digestion of diets protein (Paryad and Rashidi, 2009). The present results are agreement with those reported by Dembinski *et al*. (1985) who showed that milk yield and fat content were increased when dairy cows fed diet supplemented with bentonite. However, El-Ashry *et al*. (1996) found that milk yield and 7%-FCM slightly increased, but fat, TS, SNF, ash and lactose contents not affect when bentonite added 3% to lactating buffalo diets. While, Abdelmawla *et al*. (1998) found that milk yield and lactose content increased significantly, but TS, SNF, fat, protein and ash contents unaffected when bentonite was added to lactating goat rations at levels 6 and 12 g/h/d. likewise, Saleh *et al*. (1999) demonstrated that milk fat and lactose percentage were significant higher by supplementing 3% or 6% of concentrate of bentonite, but milk protein, casein, TS, SNF and ash contents were not significant affect, compared with those of unsupplemented ration (control). Similarly, Alsaied Alnaimy and Mostafa Habeeb (2017) reported that when cows received clay (0.5, 1or 2%) during a grain challenge tended to yield more milk and had higher 3.5% FCM than those in control (without bentonite) and there was a positive effect on milk fat and fat yield. Recently, Cangiruyarlar *et al*. (2018) found that cows produced higher milk when administrated yeast with clinoptilolite than those of control which received water administration orally to perform same stress conditions.

**Feed intake and feed efficiency:**

The results of total DM, TDN and DCP intake of the experimental rations are presented in Table 4. The results of total DMI and (TDN) intake showed no significant differences among all experimental rations. The highest values of DMI and TDN intake were obtained with T4 ration, while the lowest values were observed with control ration. However, the values of DCP intake was significantly ($P< 0.05$) increased when animals fed T4 ration compared to those fed control one, with no significant differences among control and other tested rations (T2 and T3). The results of feed efficiency that expressed as amount of 7% - FCM produced from one kg DM intake or one kg TDN intake appeared that there were slight improvement of feed efficiency with T2 and T4 rations compared with T1 and T3 rations, with no significant differences among all rations. Unlike the previous trend, the highest value of DCP efficiency was recorded with T2 and control rations (T1), while there were no significant differences among all rations. Our results are consistent with the findings of Schingoethe *et al*. (2004) who reported that yeast supplementation to cows diets in mid-lactation had improved feed efficiency compared with the unsupplementation one under heat stress conditions. Desnoyers *et al*. (2009) and Yuan *et al*. (2015) suggested that yeast supplementation increases OM digestibility in ruminants, thereby increasing energy harvest from the diet. Furthermore, Kholif and Khorshed, (2006) found that yeast supplementation in the diets of Egyptian lactativng buffaloes improved significantly the nutrients digestibility coefficient and increased milk yield, 4% FCM yield, milk protein and solids not fat contents as well as fed efficiency compared with the unsupplementation group (control). Generally, studies in dairy cows indicated that supplementation with YC may increase DMI and milk production and improve milk composition. However, several factors could be affect the response of dairy cows to YC supplementation, such as stage of lactation, type of forage given, feeding system as total mixed ration (TMR) or forage and concentrate given separately and forage: concentrate ratio. Regarding bentonite addition, El- Tahan *et al.* (2005) concluded that feeding rations containing maize silage with 2% or 4% tafla improved rumen fermentation of sheep and improved daily body gain, feed conversion and economic efficiency of calves.

**Table 3. Effect of feeding the experimental rations on milk yield and composition with lactating buffalos.**

| Items | Treatments | | | |
|---|---|---|---|---|
| | T1 | T2 | T3 | T4 |
| Actual milk yield (AMY), kg / day | 8.94$^{b}$±0.13 | 9.52$^{a}$±0.22 | 9.70$^{a}$±0.21 | 9.98$^{a}$±0.18 |
| Improvement of AMY % | - | 6.49 | 8.50 | 11.63 |
| 7% -FCM ( kg / day) | 8.55±0.62 | 9.32±0.63 | 9.34±0.69 | 9.86±0.46 |
| Improvement of 7% -FCM | - | 9.01 | 9.24 | 15.32 |
| Milk constituents (%) : | | | | |
| Total solids (T.S) | 15.18±0.54 | 15.36±0.55 | 15.29±0.70 | 15.76±0.38 |
| Solids nonfat (SNF) | 8.60±0.25 | 8.55±0.08 | 8.64±0.22 | 8.88±0.21 |
| Fat | 6.58±0.43 | 6.80±0.42 | 6.65±0.46 | 6.88±0.27 |
| Protein | 3.46±0.13 | 3.46±0.08 | 3.47±0.17 | 3.70±0.16 |
| Lactose | 4.46±0.11 | 4.41±0.06 | 4.47±0.10 | 4.49±0.07 |
| Ash | 0.68±0.07 | 0.68±0.01 | 0.70±0.01 | 0.69±0.01 |
| Milk energy (Kcal / Kg milk)* | 1048±81.18 | 1073±67.6 | 1056±93.59 | 1082±48.08 |

**a and b: means in the same row with different superscripts differ (P<0.05).**
**(Control) T1= 40% CFM+60% BR+ R.S., T2=40% CFM+60% BR+ R.S. + Yeast, T3=40% CFM+60% BR+ R.S. +Bentonite and T4= 40% CFM+60% BR+ R.S. + Yeast + Bentonite.**
***Milk energy (Kcal / Kg milk) = 115.3 (2.51 +fat %).Overman and Sanmann (1926)**

**Table 4. Effect of feeding the experimental rations on feed intake and efficiency of lactating buffalos.**

| Items | Treatments | | | |
|---|---|---|---|---|
| | T1 | T2 | T3 | T4 |
| Initial body weight (kg) | 619.38±36.11 | 612.63±36.23 | 627.53±36.4 | 623.47±35.41 |
| Daily DM intake (kg/h): | | | | |
| CFM | 3.66±0. | 3.85±0. | 3.86±0. | 3.99±0. |
| Br | 6.15±0. | 6.47±0. | 6.48±0. | 6.69±0. |
| RS | 2.82±0.40 | 2.83±0.30 | 2.76±0.19 | 2.92±0.26 |
| Yeast | - | 0.01 | - | .01 |
| Bentonite | - | - | 0.28±0.00 | 0.28±0.00 |
| Total DM intake (kg/h/d) | 12.63±0.31 | 13.16±0.24 | 13.38±0.25 | 13.88±0.35 |
| Total TDN intake (kg/h/d) | 8.40±0.18 | 8.92±0.11 | 9.16±0.19 | 9.58±0.18 |
| Total DCP intake (kg/h/d) | 0.98b±0.03 | 1.06ab±0.02 | 1.12ab±0.03 | 1.23a±0.03 |
| Daily 7%FCM yield (kg | 9.86 | 9.34 | 9.32 | 8.55 |
| Feed efficiency : | | | | |
| FCM / kg DMI | 0.68±0.05 | 0.71±0.05 | 0.70±0.04 | 0.71±0.04 |
| FCM / kg TDNI | 1.02±0.08 | 1.04±0.07 | 1.02±0.09 | 1.03±0.07 |
| FCM / kg DCPI | 8.72±0.58 | 8.79±0.58 | 8.34±0.53 | 8.02±0.53 |

**a ,b ,c and d: means in the same row with different superscripts differ (P<0.05).**
**(Control)T1= 40% CFM+60% BR+ R.S., T2=40% CFM+60% BR+ R.S. + Yeast, T3=40% CFM+60% BR+ R.S. +Bentonite and T4= 40% CFM+60% BR+ R.S. + Yeast + Bentonite.**

### Some blood Parameter:

Data in Table (5) illustrated the effect of feeding experimental rations on some blood constituents of lactating buffalo. Results of serum total protein indicated that significant (P<0.05) lower value with T3 ration than that of the other tested rations T1 and T4 rations. The mean values of serum albumin and globulin did not significantly (P<0.05) affected by experimental rations used in this period. The mean values of albumin/ globulin ratio showed significant(P<0.05) higher value with T3 ration than that of T1 ration (control) but insignificant higher than that of the other tested rations (T3 and T4) . The results of serum urea concentration showed insignificant (P<0.05) lower value with control ration (T1) than that of other tested rations. These results are similar with those found by El-Ashry *et al*. (2001) who reported that addition of 10 g/h/day Baker's yeast (containing 109 CFUS per gram) to rations of lactating buffaloes insignificantly increased serum total protein, albumin and globulin than those of control group. Salem *et al*. (2002) reported that addition of yea-sacc to rations of lactating buffaloes increased serum total protein and albumin (P<0.05) than that of control group. Similarly this trend was reported by Soren *et al*. (2013) revealed that there were no significant difference in concentrations of serum albumin, globulin, and urea of lambs consumed rations supplemented with Saccharomyces cerevisiae alone or in combination with Lactobacillus sporogenes based on unsupplemented diet. Also, Azzaz *et al*. (2015) and Cangiruyarlar *et al*. (2018) found that blood urea concentration showed higher value with cows which administrated yeast with clinoptilolite than that of control ones, while, values for total protein, albumin, globulin, A/G ratio, creatinine, enzyme activities of ALT and AST were not altered by yeast culture supplementation. Hanne

.H. Hansen *et al.* (2017) found that blood urea concentration showed higher level in Primiparous lactating buffalo cows supplemented with yeast than that of control group.

**Table 5. Effect of feeding the experimental rations on some blood serum constituents of lactating buffaloes.**

| Item | Treatments | | | |
|---|---|---|---|---|
| | T1 | T2 | T3 | T4 |
| Total protein (g/dl) | 6.41a±0.12 | 6.36ab±0.14 | 5.73b±0.20 | 6.40a±0.31 |
| Albumin (g/dl) | 3.52±0.07 | 3.57±0.05 | 3.43±0.05 | 3.61±0.09 |
| Globulin (g/dl) | 2.89±0.07 | 2.79±0.10 | 2.29±0.21 | 2.80±0.28 |
| Albumin/globulin | 1.22b±0.03 | 1.29ab±0.03 | 1.53a±0.13 | 1.33ab±0.13 |
| Urea-N (mg/dl) | 54.13±2.63 | 54.87±2.38 | 56.20±3.19 | 56.73±2.63 |

**a ,b ,c and d: means in the same row with different superscripts differ (P<0.05).**

**(Control)T1= 40% CFM+60% BR+ R.S., T2=40% CFM+60% BR+ R.S. + Yeast, T3=40% CFM+60% BR+ R.S. +Bentonite and T4= 40% CFM+60% BR+ R.S. + Yeast + Bentonite.**

**Economic efficiency:**

Results of economic efficiency are summarized in Table 6. The daily profit above feeding cost was 40.26, 44.04, 45.04 and 47.19 L.E for T1, T2, T3 and T4 respectively and also the economic efficiency were 2.43, 2.44, 2.52 and 2.49 or T1, T2, T3 and T4 rations, respectively. While feeding cost per kg FCM produced was 3.29, 3.27, 3.18 and 3.21 for T1, T2, T3 and T4 rations, respectively. Better economic efficiency was obtained with T4 ration. These results are in harmony with those obtained by El-Ashry *et al*., (2001) who reported that yeast supplementation to lactating buffalo rations decreased the cost of feed used to produce one kg 7% - FCM compared with unsupplementation one. With fattening lambs, El-Ashry *et al*. (2003) found that feed cost per kg gain was the least for supplemented lamb rations with flavomycin and with yeast than that of control group. Kravale *et al*. (2005) demonstrated that economic efficiency of the dairy herd was improved in the Yea-Sacc®1026 supplementation than that of unsupplemented one (control). Also, Britt *et al*. (2005) indicated that there was a $1.00 economical advantage per cow per day with yeast supplementation over than the unsupplementation group in Jersey and Holstein cows. Likewise economical efficiency increased by 12.7 and 15.6%, but feed cost decreased by 16.15 and 17.47 % when bentonite was added to buffaloes rations at level 3 and 6%, respectively (Saleh *et al*., 1999). Also, El-Tahan *et al*. (2005) concluded that feed rations containing maize silage with 2 or 4% tafla clay improved feed conversion and economical efficiency of Friesian calves. From these results, it could be concluded that adding bentonite and /or yeast to rations of lactating buffalos were more effective in decreasing the feed cost to produce 1kg milk.

**Table 6. Effect of feeding the experimental rations on economical efficiency of lactating buffalos.**

| Items | Treatments | | | |
|---|---|---|---|---|
| | T1 | T2 | T3 | T4 |
| Daily feed intake,(kg/h) as fed: | | | | |
| CFM | 3.97 | 4.18 | 4.19 | 4.33 |
| Berseem | 38.60 | 40.46 | 40.69 | 42.02 |
| Rice straw | 3.07 | 3.08 | 3.00 | 3.18 |
| Bentonite | 00 | 00 | 0.30 | 0.30 |
| Yeast | 00 | 0.01 | 00 | 0.01 |
| Total feed cost (LE/h/d): | 28.14 | 30.52 | 29.68 | 31.69 |
| 7% - FCM yield (kg/h/d) | 8.55 | 9.32 | 9.34 | 9.86 |
| Price of 7% FCM yield (L.E./d) | 68.40 | 74.56 | 74.72 | 78.88 |
| Profit above feeding cost (L.E) | 40.26 | 44.04 | 45.04 | 47.19 |
| Feeding cost / kg 7% FCM (L.E./d) | 3.29 | 3.27 | 3.18 | 3.21 |
| Economic efficiency* | 2.43 | 2.44 | 2.52 | 2.49 |

**(Control)T1= 40% CFM+60% BR+ R.S., T2=40% CFM+60% BR+ R.S. + Yeast, T3=40% CFM+60% BR+ R.S. +Bentonite and T4= 40% CFM+60% BR+ R.S. + Yeast + Bentonite.**

**Calculation based on the following price in Egyptian pound (L.E) per kg, CFM = 3.9 L.E. /kg, R.S=0.35 L.E. /kg, Berseem =0.30 L.E. /kg, bentonite = 0.25 L.E. /kg, yeast=100 L.E. /kg, and kg of milk of buffaloes was = 8 LE.. *Economic efficiency = Price of daily FCM yield (LE) / Total feed cost (LE).**

# CONCLUSION

In conclusion, the supplementation of dry yeast or bentonite or their mixture to rations of lactating buffaloes had positive impacts on nutrients digestibility, nutritive value, milk production and composition and economic efficiency. The combination of bentonite with yeast are not clear enough. So, further researches are needed to clearly describe this synergetic effect between yeast and bentonite, with different doses for being potentially effective on animal performance both yeast and bentonite and with different methods and strategies for animal nutrition.

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## تأثير إضافة كل من الخميرة الجافة أو البنتونيت أو مخلوطهما كإضافات غذائية على أداء الجاموس الحلاب

**عبدالغنى حسانين غنيم ، عزت عرفة البلتاجى و على احمد عبده على**
**معهد بحوث الإنتاج الحيوانى – مركز البحوث الزراعية – الدقى – الجيزة – مصر**

أجرى هذه البحث لدراسة تأثير إضافة الخميرة الجافة النشطة والبنتونيت أومخلوطها الى علائق الجاموس الحلاب على معاملات الهضم ،وإنتاج ومكونات اللبن، بعض مكونات الدم والكفاءة التحويلية للغذاء وكذلك الكفاءة الإقتصادية. تم استخدام ثمانية جاموسات حلابة في تصميم المربع اللاتينى (4 × 4) ،وكان وزن الجسم الحي (612.5 ± 41.19 كيلوجرام في المتوسط) وسجلات الحليب السابقة (8.92 ± 0.47 كجم / يوم في المتوسط). تم تغذية الحيوانات بشكل فردي وفقا لمقررات كيرل (1982)، غذيت المجموعة الأولى (المقارنة): 40% علف مركز+60% برسيم (على أساس الطاقة) بالإضافة الى كمية من قش الأرز تقدر 0.5% من وزن الحيوان , بينما المعاملة الثانية: عليقة المقارنة +10جرام خميرة /رأس/ يوم, المعاملة الثالثة: عليقة المقارنة +20جرام من البنتونيت / كجم عليقة اساسية, أما حيوانات المعاملة الرابعة: فقد غُذيت على العليقة المقارنة + الخميرة (10 جم / حيوان / يوم) + (20 جرام / كجم من الكمية الكلية من العليقة.وأظهرت النتائج أن الجاموس الحلاب المغذاة على العلائق المختبرة كانت اعلى فى معاملات هضم معظم العناصر الغذائية عن مجموعة المقارنة، حيث كانت أفضل القيم مع الجاموس الحلاب المغذاة على T4. وايضا كانت القيم الغذائية (TDN) و (DCP) تقريبا أخذت نفس اتجاه معاملات هضم المواد الغذائية حيث كانت اعلى قيمة مع الجاموس الحلاب المغذاة على (T4). وكان متوسط الإنتاج اليومي الفعلي للحليب (AMY) أعلى (P<0.05) مع الحيوانات المغذاة على العلائق المختبرة ( T2،T3وT4) عن مجموعة المقارنة. بينما أخذ اللبن المعدل ٧% دهن نفس إتجاه متوسط الإنتاج اليومي الفعلي للحليب (AMY)غير أنه لا توجد فروق معنوية بين جميع المعاملات. كما لم تظهر فروق ذات دلالة إحصائية فيما يتعلق بمكونات اللبن. كما لم توجد فروق معنوية بين جميع العلائق التجريبية فى كمية المادة الجافة المأكولة فى صورة (DMI) أو (TDNI) ،في حين زاد المأكول من DCPI بشكل معنوي ( P <0.05) مع المعاملة T4 عن تلك الحيوانات التى غذيت على مجموعة المقارنة. كما لم تكن هناك فروق ذات دلالة إحصائية بين المعاملات التجريبية في ما يتعلق ببعض مقاييس الدم. وكانت الكفاءة الأقتصادية أفضل مع المعاملات T3 وT4. بشكل عام،من النتائج التي تم الحصول عليها، يمكن أن نستنتج أن اضافة الخميرة الجافة أوالبنتونيت أومخلوطهما لعلائق الجاموس الحلاب كان لها تأثير كبيرعلى معاملات الهضم والقيم الغذائية وإنتاج الحليب والكفاءة الاقتصادية.