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Effect of Yeast Culture and/or Fibrolytic Enzymes Supplementation on Productive and Reproductive Performances of Dairy Egyptian Buffaloes

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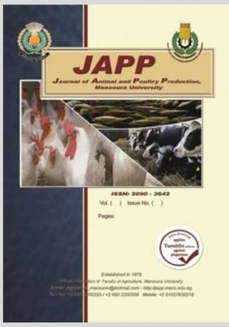

ABSTRACT

Twenty dairy buffaloes at late pregnancy and in 2-4 parties were divided into four groups fed control ration (G1), or the control ration with 10 g yeast (YC)/h/d (G2), 10 g/h/d fibrolytic enzyme (FENZ, G3) and 10 g YC+10 g FENZ/h/day (G4). The feeding period lasted from three months pre-partum up to 100 days postpartum. Results indicated that digestibility of DM, OM, CP, feeding values as TDN and DCP, actual and 7% FCM milk yield, percentages and components yield of milk and feed efficiency improved (P<0.05) by all treatments. Plasma total proteins, albumin, globulin and glucose increased (P<0.05) by FENZ. Ruminal pH value decreased insignificantly, while total volatile fatty acids and ammonia-N concentrations increased (P<0.05) with YC and FENZ. Supplementation with FENZ improved (P<0.05) calf birth weight (CBW), CBW/post-partum dam weight, weight at weaning, and daily and total gain. Reproductive traits improved by FENZ supplementation, in terms of decreasing (P<0.05) duration of placental drop and uterine involution, 1st heat incidence, days open and number of services per conception. Supplementation of YC and FENZ decreased (P<0.05) the cost of kg 7% FCM, and increased (P<0.05) income of 7% FCM, reflecting the highest economic feed efficiency.Pre- and post-partum diets supplemented with yeast culture and fibrolytic enzyme are beneficial to the digestibility, rumen fermentation, blood metabolites, milk production, feed conversion rate, economic feed efficiency, and postpartum reproductive performance of Egyptian buffaloes and growth performance of their offspring during suckling period.

Keywords: Buffaloes, yeast culture, fibrolytic enzyme, milk, digestibility, blood.

INTRODUCTION

Alternative strategies to enhance animal performance have explored of many livestock producers especially in buffaloes which considered the main milk producing animal in Egypt, they produce about 60% of the total milk production, and share with large portion in meat production. Fiber in forages is an essential component of ruminant diets and plays a significant role in ruminant production systems. Even though the fiber matrix and nutrients entrapped in fiber usually bypass digestion limiting the nutrient digestion and absorption the primary goal of improvements in feed utilization, animal production, health, and animal food safety (Sauvant *et al*., 2004). Cellulose, hemi-cellulose, starch, fructans and pectin form the major source of carbohydrates in ruminants. Cellulose is practically indigestible by the ordinary digestive enzymes produced by the gut alimentary tract.

Several feed additives have been used to improve animal performance, feed efficiency, carcass traits, some immune response parameters and economic efficiency of animals production (Salem *et al*., 2013). The enzymes, as well as the entire medium, are recovered complete with metabolites and fermentation substances. Although the sources of organisms are, in many cases, similar among enzyme products, the types and activity of enzymes produced can vary widely depending on the strain selected and the growth substrate and culture conditions used (Lee *et al*., 1998). Furthermore, the most available commercially ruminant feed additives enzyme are fermentation extracts of fungal (mostly *Trichoderma longibrachiatum*, *Aspergillus niger*, *A.oryzae*) and bacterial (mostly *Bacillus spp*.) origin or rumen bacteria (Cheeke, 2005). Exogenous fibrolytic enzymes products evaluated for ruminants are blends of various containing cellulase, β-glucanse, and xylanase that were originally produced and marketed for other uses in animal diets which contain low levels of starch and higher levels of fiber in the form of non-starch polysaccharides (Sauvant *et al*., 2004). Animals fed diets containing a direct-fed fibrolytic enzyme formulation had increased body weight gain, and improve manure nutrient excretion and milk production by 3.4%±4.7, but differed for early and late lactation in cows (Knowlton *et al*. 2002). Also, it can increase nutrient digestibility total tract thereby improving the productivity and feed conversion efficiency (Wang *et al*., 2012).

Animal performance increase can be improved by dietary addition with yeast culture (YC). This effect may be varied by change in level of addition, lactation stage, diet composition, and management (Elghandour *et al*., 2015). Count and activity of total and cellulolytic bacteria were stimulated by YC, resulting in higher rate of digestion of fiber, feed consumption, synthesis of microbial protein. Nevertheless, add yeast to diets increased dry matter intake (DMI) and milk yield and components (Robinson and Erasmus, 2008).

The aim of this work was to evaluation the supplementation of yeast culture (*Saccharomyces cerevisiae*) and fibrolytic enzymes or their combination

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effects on productive and reproductive performances of dairy buffaloes.

MATERIALS AND METHODS

This experiment was conducted at Buffalo Experimental Station, Mahallet Mousa, Kafer El-Sheikh Governorate, belonging to Animal Production Research Institute (APRI), Agricultural Research Centre, Ministry of Agriculture, Giza, Egypt, during year 2019.

Animal management and experimental design:

Twenty multiparous buffaloes in 2-4 parities were selected at late pregnancy (3 months before parturition) according to parity, LBW, and previous milk yield. The experimental period lasted from 90 days prepartm up to 100 days postpartum. Animals were divided randomly into four similar experimental groups (5 buffaloes in each group). All animals were fed a basal ration consisted of concentrate feed mixture (CFM), berseem hay (BH) and rice straw (RS) with roughage: concentrate ratio of 40:60. The 1st group was not supplemented (control), whereas, other groups were supplemented with 10 g YC/h/d (Biomate Yeast Plus®) for 2nd group, 10 g fibrolytic enzyme (FENZ) /h/d for 3rd group, or 10 g FENZ + 10 g YC/h/d for 4th group.

The live YC contained 5×10^9 cfu of *S. cerevisiae*/g, while the commercial fibrolytic enzymes (FENZ) contained: 110 U/g of protease, 9 U/g of lipase, and 110 U/g of a-amylase. All additives were well hand mixed at the time of feeding with the concentrate feed mixture. Chemical analysis of feedstuffs and basal diets of buffaloes are shown in Table 1. CFM composited of 32% undecorticated cotton seed cake, 24% wheat bran, 22% yellow corn, 12% rice bran, 5% linseed cake, 3% molasses, 1% limestone and 1% common salt.

Dairy buffaloes were individually fed to cover their recommended requirements allowance according to Kearl (1982). Rations were offered to animals in two equal meals daily at 9 a.m. and 3 p.m. and adjusted biweekly based on milk yield and body weight changes. Mineral blocks were available free choice for all animals. Animals were watered 3 times daily 7 a.m., 12 med-day and 7 p.m.

Table 1. Calculated chemical composition (on DM basis) and fiber fraction (%) of different feedstuffs and the basal ration.

Item	CFM	Berseem hay	Rice straw	Basal ration
Calculated chemical composition (%):				
DM	91.2	86.7	88.4	91.54
OM	93.98	88.42	87.36	88.92
CP	16.62	12.09	2.89	13.77
CF	13.04	28.63	38.83	19.51
EE	4.8	2.02	2.13	3.34
NFE	59.52	45.68	43.51	52.3
Ash	6.02	11.58	12.64	11.08
Fiber fraction (% of DM):				
NDF	37.49	47.73	54.43	41.74
ADF	19.93	26.25	35.43	17.76
AD L	5.67	7.45	5.38	6.21
Hemicellulose	17.56	21.48	19.01	23.98
Cellulose	14.26	18.8	30.05	11.55
NFC	35.07	26.58	27.90	30.07

***CFM; concentrate feed mix. Cellulose; hemicelluloses were calculated to Calsamiglia *et al.* (1995).**

Cows were kept in semi open pens transferred to the maternity unit at the delivery. Each group was placed in a shaded pen equipped with free stalls with free fresh water access. Cows were allowed to nurse their new borns after delivery for one week to fed colostrum. After that dams were mechanically milking twice daily at 7 a.m. and 5 p.m. Live body weight of cows was recorded pre- and post-calving. Also, calves were also weighed at birth, post-calving, then weekly until weaning during suckling period (100 days).

Digestibility trials

Three digestibility trials were conducted at the end of experimental period using three animals in each trial for determining nutrients digestibility coefficients and feeding values with acid insoluble ash (AIA) natural marker (Van Keulen and Young, 1977). Fecal samples were collected for 7 days as a collection period and composited for each animal. Representative samples of feedstuffs and feces were dried at 65ºC for 48 hours in a forced air oven, ground and chemically analysis (A.O.A.C, 1995). Wall contents (NDF, ADF, and ADL) were analyzed according to procedures of Van Soest *et al*. (1991). Composition of feedstuffs and basal ration are shown in Table 1.

Samples of rumen liquor:

Samples of rumen liquor were taken at 3 hours morning post-feeding by rumen stomach tube, then filtered with double layers of cheese cloth. The filtered sample was analyzed to estimate, pH value directly using digital pH meter (Microcomputer pH-vision Model 6007 (JENCO), Ammonia nitrogen concentration, as NH_3-N was estimated by saturated solution of magnesium oxide distillation (AOAC, 1995). The concentration of total volatile fatty acids (VFAs) concentration as meq/100 ml of rumen liquor was done using steam distillation method (Warner, 1964).

Reproductive traits:

During postpartum period, the uterine involution was done by rectal palpation once every two days complete uterine involution according to ElFadaly (1978). All experimental animals were detected for estrus twice/day. Animals in heat were naturally mated 12 h post the detection of estrus. Pregnancy was diagnosed 50 days post-mating by rectal palpation. Duration of placental drop and complete involution of the uterine was recorded. Also, the interval to 1st postpartum estrus, services number/conception, days open, pregnancy rate, gestation period, and calving interval were recorded.

Samples of blood

Samples of blood were taken at 3 hours post-feeding from the jugular vein into a clean dry test tubes containing anticoagulant (heparin). Blood samples under centrifugation of 4000 rpm for 20 min were performed to obtained plasma. Plasma samples were calorimetrically analyzed using commercial kits for determination total proteins (Henry, 1974), albumin (Doumas *et al.*, 1971), glucose and urea nitrogen (Patton and Crouch, 1977), and activity of plasma alanine transaminase (ALT) and aspartate transaminase (AST) were determined using AST and ALT kits according to Belfield and Goldberg (1971). Globulin level was calculated by difference.

Milk yield and sampling

Daily milk yield was recorded individually and the milk produced was corrected for 7% fat (FCM) according to Raafat and Saleh (1962) as follows: 7% FCM = 0.265 x milk yield (kg) + 10.5 x fat yield (kg). Samples of milk were taken from consecutive evening and morning milkings were taken biweekly and mixed by ratio of 1% of milk yield and analyzed for milk fat, protein, lactose, solids nonfat (SNF) and total solids (TS) using infrared method by Milko-Scan apparatus. Milk constituents yield were calculated by multiplying milk yield by its contents in milk.

Feed conversion

Feed conversion ratio expressed as the amounts of DM, TDN (kg), CP and DCP (g) required per each one kg of 7% FCM were calculated.

Economic efficiency

Economic feed efficiency (cost of daily feeding, 7% FCM price, and cost of feeding/kg 7% FCM). Price of one ton berseem hay, rice straw, and CFM was 3000, 700, and 6000 LE. The price of one kg from fibrolytic enzyme and yeast culture was 50 LE and price of 7% FCM was 10 L.E (marketing Egyptian prices of year 2019.

Statistical analysis:

The obtained data were statistically analyzed by system User's Guide (SAS, 1999) using one way-ANOVA. The significant differences were tested by Duncan's multiple range test (Duncan, 1955).

RESULTS AND DISCUSSION

Digestibility coefficients and nutritive values:

Nutrient digestibility coefficients of DM, OM, CF, EE and NFE and feeding values as TDN and DCP, and digestible energy were higher (P<0.05) in fibrolytic enzyme, yeast culture or yeast culture plus enzymes supplemented groups compared with control group. Group received FENZ recorded the highest values of nutrients digestibility and feeing values in comparing with the control. Crude protein digestibility was not significantly affected by enzyme or yeast supplementation (Table 2). These results are in collaboration with the outcome of Bassiouni *et al.* (2010) Salem *et al.* (2013) Malik and Bandla (2010). They found that OM, NDF and ADF digestibility were improved significantly when male buffalo calves were fed mixture of probiotics and enzyme. Rajamma *et al.* (2014) found that the FENZ supplementation in TMR fed to buffalo bulls improved (P<0.01) the digestion of CP, EE and CF. Yang *et al.* (2000) reported that the improvements of digestibility and dry matter disappearance caused by enzymatic treatment were related to increased microbial colonization. Beauchemin *et al.* (2000) revealed that exogenous fibrolytic enzymes may aid in exposing additional cell wall cites for bacterial attachment and thereby permitting more complete digestion of the diet. Likewise, in lactating buffaloes (Elghandour *et al*., 2015) and buffalo calves (Shahin *et al*., 2005) feeding yeast culture ration has an ability to promote rumen function and feed digestion by improve establishment rumen microbial ecosystem. Also, YC stimulates growth factors to ruminal bacteria (organic acids, vitamins B and amino acids) which increases rumen number and activity of proteolytic and cellulolytic bacteria on rumen. Yang *et al*. (2004) reported that yeast culture improves gut health, CP, CF digestibility through rumen maturity by beneficial activities of lactic acid bacteria in the gastrointestinal tract and alters microbial enzyme activities. In buffaloes, Abdel-Latif, (2005) reported that count of protozoa and microbes in the ruminal liquor were highr in animals fed Gustor nature (mixture of yeast and malate), however, the digestion, fiber fractions, DCP and TDN were not affected by TMR supplemented with FENZ and/or live YC in bulls (Ravikanth *et al.*, 2016).

Table 2. Effect of treatment on nutrient digestibility and nutritive values of the experimental rations.

Item	Control	YC	FENZ	YC+FENZ	SEM
Apparent digestibility, %					
DM	67.96 c	69.53 b	72.25 a	72.03 a	0.61
OM	60.81 c	63.51 b	65.30 a	63.94 b	0.53
CP	66.54	67.97	67.19	67.41	0.65
CF	64.34 c	69.79 a	68.50 a	66.82 b	0.67
EE	73.54c	75.44ab	76. 27a	74.42bc	0.62
NFE	72.58 c	74.83ab	75.31a	73.26 bc	0.81
Nutritive values, %					
TDN	65.43 c	67.18 b	69.76 a	68.48 a	0.73
DCP	8.26 c	8.57 b	8.92 a	8.78 b	0.19
DE (Mcal/kg DM)	2.885 c	2.962 b	3.076 a	3.019 b	0.04

a, b, c: Means within the same row with different superscripts differed significantly at P<0.05.

DE: The digestible energy = (Mcal/kg DM) = 0.04409*TDN% (NRC 2005).

Rumen parameters:

Results in Table 3 showed that the pH value of ruminal liquor decreased insignificantly (P>0.05), whereas, concentration of TVFA and NH_3-N was higher (P<0.05) with diets supplemented with YC and fibrolytic enzyme. Similarly, Salem *et al.* (2013), who reported an increase in rumen ammonia-N and total short chain fatty acids levels by enzyme addition. Rajamma *et al.* (2014) reported decreased (P<0.01) rumen pH value and increased (P<0.01) concentrations of TVFA, NH_3-N and N-fractions in rumen liquor of buffalo bulls fed TMRs with FENZ supplementation. Similarly, Abdel-Latif (2005) as a result of adding dietary yeast culture with Gustor properties (a mixture of yeast and malate) to buffalo, it was found that the ammonia-N value in the rumen was higher. Chaucheyras-Durand *et al.* (2008) It is mentioned that yeast stimulates rumen bacteria and increases the utilization of lactic acid and ammonia, leading to a moderate rumen pH and an increase in microbial population activity, which leads to an increase in rumen carbohydrate digestion and protein microbial synthesis.

Table 3. Ruminal parameters of buffalo cows as affected by the experimental rations.

Ruminal parameter	Control	YC	FENZ	YC+FENZ	SEM
pH value	6.23	6.05	6.10	6.13	0.12
TVFA's (meq/dl)	16.71c	18.63 a	18.32a	17.54 b	0.46
NH 3-N (mg/dl)	22.66c	25.25 a	25.11 a	24.45 b	0.63

a, b, c: Means bearing different superscripts in the same row are significantly different at P < 0.05.

Blood metabolites:

The effects of yeast and FENZ supplementation on some blood biochemicals are shown in Table 4. Adding yeast and FENZ to dairy buffalo ration showed significant (P<0.05) increase in blood total proteins, albumin, globulin and glucose concentrations, but did not affect blood plasma albumin, globulin, urea concentrations, beta-hydroxybutyrate (BHB), and hepatic enzymes (AST, ALT) activity as compared to the control ration. All blood parameters studied are within the normal physiological reference range (Kraft and Dürr, 2005), indicating normal liver function. These findings are in agreement with Bush (1991), who pointed out that the total serum protein concentration reflects the nutritional status of animals and is positively correlated with dietary protein levels. Also, El-Bordeny *et al.* (2015) found that the blood glucose and total protein concentrations of the FENZ group increased compared with the control group. This was due to the improvement of the metabolic process, especially the increase of the apparent nutrient digestibility, the flow of protein and organic matter in the rumen and the microbial protein in the rumen Caused by.

Table 4. Effect of treatments on some blood plasma biochemicals of lactating buffaloes

Item	Control	YC	FENZ	YC+FENZ	SEM
Total proteins (g8dL)	7.87 ^{c}	7.94 ^{b}	8.36 ^{a}	8.46 ^{a}	0.15
Albumin (g/dL)	3.69 ^{b}	3.59 ^{b}	4.01 ^{a}	3.97 ^{a}	0.08
Globulin (g/dL)	4.18 ^{c}	4.35 ^{b}	4.35 ^{b}	4.49 ^{a}	0.06
A/G ratio	0.88	0.83	0.92	0.88	0.04
Glucose (mg/dL)	63.42 ^{c}	67.24 ^{b}	69.89 ^{a}	66.15 ^{b}	1.23
ALT (IU/L)	52.75	52.64	54.13	53.11	0.64
AST (IU/L)	42.75	43.09	41.63	42.78	0.37
Urea-N (mg/dL)	45.37	42.67	44.13	43.91	0.23
Beta-hydroxybutyrate (BHB), mmol/L	0.67	0.59	0.56	0.60	0.03

a, b and c: Means with different superscripts within the same row differed significantly at P < 0.05.

Feed consumption:

Yeast culture or fibrolytic enzyme supplementation did not significantly alter feed intake as DMI, TDN, and DCP (Table 5). The results of our study agreed with other studies (Salem *et al.* 2013; Peters *et al*., 2015; El-Bordeny *et al.*, 2015), They confirmed that adding enzymes had no effects on dairy cows or DM intake at different stages of lactation. Morrison *et al.* (2001) YC culture was fed from 14 days before delivery to 14 days after delivery, and it had no effect on prenatal DMI. On the other side, Gado *et al.* (2009) found that the DMI obtained by adding FENZ to dairy cows has increased, these cows have received total rations, or added forage before mixing with other ingredients or in TMR or concentrated diets (El-Bordeny *et al*., 2015). Finally, FENZ in the Bermuda grass-based TMR increases the intake of DM in dairy cows (Romero *et al.,* 2016). Also, Yang *et al.* (2004), reported that DMI increased after adding YST culture to the diet of lactating cows.

Table 5. Feed intake as DM, TDN, and DCP of buffaloes from the experimental rations.

Item	Treatment				SEM
	Control	YC	FENZ	YC+FENZ	
Feed intake (kg/head/day) on DM basis:					
CFM	7.35	7.35	7.35	7.35	0.09
BH	2.81	2.70	2.75	2.86	0.06
RS	2.2	2.1	1.8	1.9	0.02
Total DMI	12.36	12.15	11.9	12.11	0.21
Total TDNI	8.09	8.16	8.30	8.29	0.07
Total DCPI	1.02	1.04	1.06	1.06	0.02

Milk yield

Data in Table 6 showed that actual and 7% FCM yields were higher (P<0.05) for buffaloes received yeast and enzyme treatment supplementation than the control. The rate of increase in 7% fat corrected milk increased by 9.52, 15.48 and 13.10% for yeast, enzyme and mixed groups than the control group, respectively. The increase in milk yield was numerically higher in early than late lactation. This was attributed to the negative energy balance of the animal at the beginning of lactation and balanced at the mid-lactation. Feeding FENZ improves the available energy by increasing the content of nutrients required for breast milk synthesis and is beneficial to the body Reserves, especially during the transition period (Guerra *et al*., 2007). Positive effect of fibrolytic enzyme additive was clear in improved lactation performance of early and mid-lactation in Holstein Friesian cows as indication of increased available degradation nutrients and more efficient conversion of feed without the need to mobilize the body's fat stores during the milk production period (Bowman *et al*., 2002). The current study is in line with those found by Beauchemin and Holtshausen (2010). Gado *et al*., (2009) indicates that FENZ had a considerable positive effect on milk production in early lactating cows, an increase of approximately 23%. Holtshausen *et al.* (2011) pointed out that adding dietary fibrinolytic enzymes in feed or feed can increase milk production from 5-16%.Bassiouni *et al.* (2010) observed that the supplementation of corn silage or berseem hay with cellulase increased the digestibility of nutrients and thus increased milk production. HeidariKhormizi *et al.* (2010) according to reports, in Holstein Holstein cows, feeding direct-fed microorganisms and feeding enzymes or both significantly improved milk production. Feeding FENZ in the Bermuda grass-based TMR increased milk production of dairy cows (Romero *et al.*, 2016) due to improving the digestion of dietary fiber, adding a mixture of cellulase and xylanase at the amount of 1.5 g/kg DM TMR can significantly increase the average daily milk production and FCM production of Murrah buffalo (Chandra Sekhar *et al.*, 2010).

Milk contents:

Data in Table 6 revealed that fat, protein, lactose, SNF and TS contents in milk of buffalo cow was significantly (P<0.05) the highest in group fed enzyme treatment followed by the other supplemented groups, while the lowest content was in control group. However, fibrolytic enzyme and yeast supplementation did not revealed any significant effect on the percentage of ash in milk. Meantime, the production of all milk components (fat, protein, lactose, total solids and solids instead of fat) supplemented with plasmin and yeast was significantly increased (P<0.05). Due to the addition of enzymes, the increase in protein production may be due to the increase in microbial protein synthesis observed by Zheng *et al*. (2000). Compared with the control group, milk fat production FENZ increased significantly (P <0.05) (El-Bordeny *et al.*, 2015). Supplementing exogenous plasmin in dairy cow diets can increase fiber digestibility, thereby increasing the proportion of acetic acid, thereby increasing the synthesis of milk fat (Giraldo *et al*., 2008). In addition, Stokes (1992) speculates that the increase in fat content may be due to the increase in available energy and fatty acids for fat synthesis when plasmin is added. Yang *et al.* (2000) Obtained increased total tract NDF digestibility and rumen VFA ratio, which affected milk fat synthesis by adding enzymes. Gado *et al.* (2009) concluded that cows fed with ZADO® supplemental diets (0.57%) increased milk protein production in brown Swiss cows compared to cows fed with a control diet of 0.45 kg/h/day (P <0.05). On the other hand, Beauchemin *et al.* (2000) showed that adding enzymes in dairy cow diets has a beneficial effect on milk protein and casein, but has no effect on milk fat or solids instead of fat percentage. Ortiz-Rodea *et al*. (2013) It was observed that adding enzymes had no effect on milk yield, fat content, lactose or protein increase. Peters *et al*. (2015) found that the addition of FENZ does not have a significant effect on milk fat and protein, which may be related to the improvement of fiber digestibility in the rumen fermentation mode and the lack of energy content in the diet. In lactating cows, Erasmus *et al*. (1992) proved that supplementing YC has no beneficial effect on improving milk yield and composition. Mansour (2009) found that the increase in milk fat percentage when plasmin is added may be due to the increase in available energy and fatty acid synthesis. However, Klingerman *et al*. (2009) reported that in the enzyme supplement group, milk production without changing milk fat and milk protein increased significantly. Bowman *et al*. (2002) found that depending on the specific FENZ application mode, the percentage of milk lactose decreased.

Table 6. Effect of dietary treatments on milk production and composition of lactating buffaloes.

Item	Treatment				SEM
	Control	YC	FENZ	YC+FENZ	
Milk yield (kg/head/day):					
Actual	8.4^{c}	9.2^{b}	9.7^{a}	9.5^{b}	0.13
7% FCM	7.91^{c}	8.51^{b}	9.40^{a}	9.16^{b}	0.26
Milk composition, %:					
Fat	6.44^{b}	6.29^{c}	6.71^{a}	6.66^{a}	0.23
Protein	4.2^{c}1	4.54^{ab}	4.62^{a}	4.47^{b}	0.24
Lactose	4.62^{c}	5.04^{b}	5.32^{a}	5.00^{b}	0.32
Solids not fat	9.54^{c}	10.26^{b}	10.61^{a}	10.13^{b}	0.41
Total solids	15.98^{c}	16.55^{b}	17.32^{a}	16.79^{b}	0.57
Ash	0.72	0.69	0.67	0.66	0.04
Milk content yield (kg/head/day):					
Fat	0.54^{c}	0.58^{c}	0.65^{a}	0.63^{b}	0.02
Protein	0.35^{c}	0.42^{b}	0.45^{a}	0.42^{b}	0.03
Lactose	0.39^{c}	0.46^{b}	0.52^{a}	0.48^{b}	0.04
Solids not fat	0.80^{c}	0.94^{b}	1.03^{a}	0.96^{b}	0.11
Total solids	1.34^{c}	1.52^{b}	1.68^{a}	1.59^{b}	0.03
Milk energy (Kcal / kg milk)	1031.94^{c}	1014.64^{c}	1063.07^{a}	1057.31^{b}	52.34

a, b and c: Means in the same row with different superscripts differed significantly at P < 0.05.

Dams and offspring body weights:

Results in Table 7 revealed that body weight of dams pre and post-parturition and fetal fluid showed insignificantly differences among groups. Whereas, calf birth weight (CBW) and CBW/ dam, weaning weight of calves, total and daily weight gain and colostrum yield were significantly (P<0.05) higher with dietary yeast culture or exogenous fibrolytic enzyme supplementation. Rate of loss in body weights of cows after calving was 10.30, 10.51, 10.85 and 10.91% for control, YST, FENZ and YST+FENZ groups, respectively. The newly born calves of treated dams showed higher weights than control, but fibrolytic enzyme treatment achieved better vitality and heavier calves. Calves birth weight, weaning weight, calves daily and total weight gain in comparison with the other groups. Improvement in percentage daily gain of calves was 10.42, 12.50 and 16.60 % for YST, FENZ and YST+FENZ as camper with the control group, respectively. The supplementation has improved the metabolism by increasing the digestion protein, TDN, milk protein and milk lactose during calving and weaning period, leading to an increase of calf weight at birth and weaning. The higher birth weight gives advantage for calves to grow and to have a good body weight at weaning. Also, the difference in calf weight gain reflects difference in milk production between supplemented and control females (Hammadi *et al*., 1998). Weight losses at parturition are evaluated to 13 and 11% of the pre-calving weight for cows was reported by Marston *et al.* (1995). Adding yeast culture tends to decline the risk gastrointestinal infections and subsequent diarrhea and dehydration account for the majority of health disorders in the young calf matures during the preweaning period (Davis and Drackley, 1998). In this respect, Magalha *et al*. (2008) indicated potential benefits to animal health, minimized frequency of health treatments, and reduced risk of morbidity and mortality accompanied by improvements in growth performance in dairy calves fed yeast culture which might reflect to increased feed intake, improved energy status, and enhanced immune function, or reduced incidence of diseases.

Table 7. Effect of YST, FENZ and YST+FENZ added to diets of buffalo cows on their body weights and weight of their calves.

Item	Treatment				SEM
	Control	YC	FENZ	YC+ FENZ	
Pre-partum dam weight (kg)	496	498	494	495.23	4.58
Post-partum dam weight (kg)	445	443	438	441	3.90
Calf birth weight (CBW), kg	39.83^{c}	40.53^{b}	41.49^{a}	41.25^{b}	0.60
Fetal fluid, kg	11.24	11.80	12.13	12.79	0.25
CBW / Dam post-partum (%)	8.95^{c}	9.15^{b}	9.47^{a}	9.35^{a}	0.38
Weight of calves at weaning (kg)	88.12^{c}	93.50^{b}	95.16^{ab}	97.25^{a}	1.40
Total gain of calves (kg)	48.29^{c}	52.97^{b}	53.67^{ab}	56^{a}	0.69
Daily weight gain of calves (g/day)	0.48^{c}	0.53^{b}	0.54^{ab}	0.56^{a}	0.07
Colostrum yield, kg	4.41^{c}	4.63^{a}	4.50^{b}	4.55^{b}	0.12

a, b and c: Means differed in superscripts within the same row are significantly different at P < 0.05.

Feed conversion

Feed conversion as DMI, TDN and DCP required for production of 7% FCM is presented in Table 8. Compared with other groups, the feed conversion rate with plasmin supplementation was significantly decreased (P<0.05) because the amount of DMI, TDN and DCP/kg FCM was significantly decreased (P<0.05). Feed efficiency is related to higher actual milk production and FCM production. Compared with no feed supplement, there is no difference in feed intake in the supplemented buffalo group. This may also be attributed to the higher digestibility of NDF in the rumen, indicating nutrients Higher utilization rate (Holtshausen *et al*., 2011). The similar trend was concluded by Salem *et al.* (2013), he confirmed that compared with untreated dairy cows, the addition of enzymes to dairy cows' diets in early lactation did not cause any significant changes in dry matter intake, but increased average daily weight gain, overall weight increase and Feed efficiency. In addition, Malik and Bandla (2010) conducted in vitro experiments on the performance of male buffalo calves and found that ADG and feed were more efficient after adding a mixture of probiotics and enzymes. Bowman *et al.* (2002) reported that compared with the early stage of lactation, the cows fed with fibrinolytic enzyme showed a better nutrient conversion trend per kilogram of milk compared with the control group, which was mainly due to higher milk production. Arriola *et al.* (2011) reported a decrease in DMI values and an increase in milk production in early lactating cows, resulting in a significant increase in total feed efficiency (kg FCM / kg DMI).

Table 8. Effect of the experimental diets on feed conversion and economic efficiency of lactating buffaloes.

Item	Treatment				
	Control	YC	FENZ	YC+ FENZ	SEM
Feed conversion:					
DMI kg/kg FCM	1.57 ^{a}	1.43 ^{b}	1.27 ^{c}	1.33 ^{b}	0.03
TDN kg/kg FCM	1.03^{a}	1.05^{a}	0.89^{b}	0.91^{b}	0.02
DCP g/kg FCM	130.0^{a}	130.0^{a}	120.0^{b}	120.0^{b}	5.86
Economic efficiency:					
Daily feed cost (LE)	54.07	53.67	53.61	54.01	0.94
Feed cost (LE)/kg FCM	6.84 ^{a}	6.31 ^{b}	5.70 ^{c}	5.90 ^{b}	0.13
Output of FCM (LE)	79.1 ^{c}	85.1 ^{b}	94.0 ^{a}	91.6$^{a b}$	2 .11
Economic feed efficiency (EF)	1.46 ^{c}	1.59 ^{b}	1.75 ^{a}	1.70 ^{a}	0.03
Economic improvement %	00^{c}	8.39^{b}	19.86^{a}	15.93^{a}	0.15

a, b, c: Means in the same row for each item with different superscripts differ significantly at 5% level

Economic efficiency

The economic efficiency results in Table 8 show that the cost of daily feeding was not affected by fibrozyme and dietary YC addition. The cost of each kg 7% FCM reduced (P <0.05) by addition of fibrozyme and yeast. Adding exogenous fibrozyme, yeast culture and adding YST + FENZ to the diet of lactating cows can improve economic feed efficiency and achieve daily net profit. The daily income of the yeast culture, fibrozyme and YST + FENZ supplement group increased by 8.39%, 19.86% and 15.93% compared with the control group during the whole period. In agreement with the present results, Gaafar *et al.* (2009) found increase in daily feed cost, but after supplementing with baker's yeast, 7% FCM output and economic benefits have been significantly improved. In addition, Gaafar *et al.* (2010) reported that the feed cost per kilogram of 7% FCM in the feed was significantly reduced, but after the addition of fibrolytic enzyme, the output and economic benefits of 7% FCM were significantly improved.

Reproductive traits:

Results presented in Table 9 cleared improvement in most reproductive measurements by dietary FENZ addition, in terms of decreasing the duration of placental drop, complete involution of the uterine, incidence of the 1st estrus, days open length and number of service per conception when compared with other groups. However, the differences in gestation period among groups were not significant. These results indicated that dietary supplementation of FENZ showed a positive impact on buffalo reproduction by achieved the lowest days open and consequently the lowest calving interval followed by groups FENZ+YST, yeast and control respectively. Canfield and Butler (1990) found a strong correlation between negative energy balance in early lactation and resumption of ovulation with activity LH which probably induced follicle growth and oocyte maturation in cattle. Furthermore, El-Barody *et al*., (2001) indicated that improving feed utilization and energy mobilization is the major limiting key element dictating an early ovulation in dairy buffaloes during the first few weeks after calving by enhanced nutrient availability which stimulate the ovary or other parts of the hypothalamic-pituitary-ovarian axis and may avoid stimulation of gonadotropin secretion. In this respect, AbdelKhalek (2003) recorded improvement in days to first breeding, day open, service period and number of services per conception, but the differences were not significant of multiparous Friesian cows fed diets with Yea-Sacc as YC. Roque *et al*., (2019) reported that the number of insemination services tended to be lower in cows fed diets supplemented with exogenous enzyme which could help to reduce instances of systemic inflammation and decrease fat mobilization in lactating Holstein cows. Williams, (1988) found an improvement in the reproductive traits in dairy cows fed diets supplemented with YC, and this was related to highly concentrated yeast cells of Zn. On the other hand, reproductive traits were not affected by Yea-Sacc1026 addition to the diet of Rahmani sheep (Mousa *et al*., 2012). However, Magdalena *et al* (2011) indicated that the use of the enzyme and/or yeast preparations in the periparturient and early lactation periods has no effect on changes in body weight and body condition or reproductive. Krzystof, *et al*., (2009) reported has no effect on changes in body weight and body condition or fertility indices of the cows fed enzyme preparation in the periparturient and early lactation periods. Also, the interval to 1st service was 74.9 d by feeding YC diets (Dann *et al*., 2000).

Table 9. Postpartum reproductive traits of buffaloes in different experimental groups.

Item	Treatment				
	Control	YC	FENZ	YC+FENZ	SEM
Placental drop (h)	9.73^{a}	8.75^{b}	6.42^{c}	8.91^{b}	1.4
Uterine involution (days)	53.7 ^{a}	49.2^{a}	37.2^{c}	43.5^{b}	8.13
Onset of 1st heat (days)	51.7 ^{a}	50.6^{a}	43.6^{c}	46.1^{b}	7.85
No. services / conception	2.31^{a}	1.55^{b}	1.09^{c}	1.42^{b}	0.53
Days open	90.2 ^{a}	88.6^{b}	76.3^{c}	83.8^{b}	17.25
Gestation period (days)	327.1	321.3	305.0	318.7	11.16
Calving interval (days)	417.3^{a}	409.9^{a}	381.3^{b}	402.5^{a}	25.18

Means bearing different superscripts in the same row are significantly different at P < 0.05.

Estrus and pregnancy rates:

Table 10 showed that estrus rate was the highest in FENZ (100%), moderate in YC and YC+FENZ (80%), and the lowest in control (60%). However, pregnancy rates based on inseminated animals and total animals were 100% in FENZ group, followed 100 and 80% in YC+FENZ group, while the lowset in in YC group (75 and 60%) and control group (100 and 60%), respectively. These results are in agreement with those obtained by Łopuszańska-Rusek and Bilik (2011) demonstrated a higher pregnancy rate and shorter calving to conception interval with fibrolytic enzymes and yeast culture for dairy cows compared to control group.

Table 10. Estrus and pregnancy rate of buffaloes in the experimental groups.

Teatment	Estrus rate	Pregnancy rate*	Pregnancy rate**
Control	3/5 (60)	3/3 (100)	3/5 (60)
YC	4/5 (80)	3/4 (75)	3/5 (60)
FENZ	5/5 (100)	5/5 (100)	5/5 (100)
YC+FENZ	4/5 (80)	4/4 (100	4/5 (80)

CONCLUSION

Pre- and post-partum diets supplemented with yeast culture and fibrolytic enzyme are beneficial to the digestibility of buffalo, rumen fermentation, blood metabolites, milk production, feed conversion rate, economic efficiency and postpartum reproductive performance and growth performance of their offspring during suckling period.

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تأثير اضافة الخميرة مع/أو الأنزيمات المحللة للألياف على الأداء الانتاجى والتناسلى للجاموس الحلاب

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تمت الدراسة على عدد 20 بقرة جاموسى فى أخر الحمل و فى الموسم الثانى إلى الرابع و تم تقسيمها الى اربعة مجاميع غذيت على نفس العليقة وكانت المحموعة الأولى كنترول بينما تم اضافة 10جم/راس/يوم من الخميرة الجافة في المجموعة الثانية، 10جم/ راس/يوم من الانزيمات المحللة للالياف فى المجموعة الثالثة و10جم/ راس/يوم من الانزيمات المحللة للالياف +10جم/ راس/يوم من الخميرة الجافة في المجموعة الرابعة. امتدت فترة التغذية من 3 شهور قبل الولادة حتى 100 يوم بعد الولادة. اظهرت النتائج زيادة معنوية فى معاملات هضم المادة الجافة و المادة العضوية والبروتين الخام والقيم الغذائية وإنتاجية اللبن الفعلى والمعدل 7% دهن ونسب وانتاجية مكونات اللبن وزيادة معدل التحويل الغذائي للمعاملات. كذلك زيادة معنوية في تركيز البروتين الكلى والألبيومين والجلوبيولين والجلوكوز بالدم فى مجموعة الإنزيمات. حدث انخفاض غير معنوى فى درجة حموضة الكرش بينما لوحظ ارتفاع معنوي في تركيز الاحماض الدهنية الطيارة الكلية والامونيا فى سائل الكرش فى مجموعة الخميرة و الإنزيمات. كما اظهرت العجول المولودة للحيوانات المعاملة فى مجموعة الانزيمات تحسن معنوى في أوزان الميلاد والفطام والزيادة الكلية واليومية في وزن الجسم ونسبة وزن الميلاد لوزن الام بعد الولادة. كذلك حدث تحسن ملحوظ في صفات التناسل مثل قصر فترة نزول المشيمة، وعودة الرحم، أول شياع والفترة من الولادة حتى التلقيح المخصب ونقص عدد التلقيحات اللازمة للإخصاب وزيادة معدل الاخصاب مع اضافة الأنزيمات. كما حدث تحسن فى الكفاءة الاقتصادية لإنتاج اللبن مقارنة بالمعاملات الأخرى. نستخلص من هذه الدراسة أن اضافة الخميرة مع/أو الانزيمات المحللة للألياف له تأثير إيجابي على الاداء الإنتاجي والتناسلي والكفاءة الاقتصادية للجاموس الحلاب .