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Original Research Article

Response of primiparous and multiparous buffaloes to yeast culture supplementation during early and mid-lactation

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ABSTRACT

Strains of live *Saccharomyces cerevisiae* yeast have exhibited probiotic effects in ruminants. This study investigated the effects of the dietary yeast supplement, *S. cerevisiae* (Yea-Sacc[1026]), on primiparous (PP) and multiparous (MP) Egyptian buffaloes in early to mid-lactation. Lactating buffaloes were fed either a basal total mixed ration (TMR, control; 4 PP and 8 MP) or the basal TMR plus 10 g Yea-Sacc[1026] per buffalo cow per day (yeast; 4 PP and 8 MP). The feeds were given from 15 days prepartum to 180 days postpartum. Feed intake, body weight, and milk yields (MY) were recorded, and milk and blood samples were collected for analyses. Feces were collected from days 45 to 47 during early lactation and from days 90 to 92 during mid-lactation to determine apparent digestibility of dry matter (DM), organic matter (OM), crude protein (CP) and crude fiber (CF). Energy corrected milk yield (ECM), feed conversion, and energy and nitrogen conversion efficiency were calculated. Yeast treated MP buffaloes consumed more DM ($P \leq 0.041$) and CP than the untreated control group. Apparent digestibility of DM and OM were significantly greater at mid-lactation for treated versus control group ($P = 0.001$). Crude fiber digestibility was greater in MP than PP buffaloes ($P = 0.049$), and yeast supplemented MP cows had a greater CF digestibility than control MP buffaloes at mid-lactation ($P = 0.010$). Total blood lipids decreased after yeast supplementation ($P = 0.029$). Milk yields, ECM, fat and protein yields increased for yeast treated MP buffaloes ($P \leq 0.039$). The study concluded that the response to yeast supplementation in buffalo cows is parity dependent. Multiparous buffaloes respond to yeast supplementation with an increased DM intake and CF digestibility without significant weight gains, allowing a greater ECM yield with less fat mobilization. Supplementing buffaloes with yeast culture may increase milk production in early lactation and results in a more persistent milk production during mid-lactation. Feed conversion and energy and nitrogen conversion efficiency may be increased with the use of yeast supplementation in Egyptian buffaloes.

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1. Introduction

High yielding dairy cows have difficulty in fully utilizing a nutritionally balanced ration because of physiological constraints in early lactation (McDonald et al., 2002). These problems may be overcome through yeast supplementation. It has been shown that yeast supplementation can increase conversion efficiency, stimulate rumen fiber digestion, stabilize ruminal pH, stimulate ruminal fermentation, increase feed intake and milk yields (MY) and reduce risks associated with abrupt dietary changes (Yoon and Stern, 1995; Denev et al., 2007).

Studies regarding use of *Saccharomyces cerevisiae* yeast based supplements date back to the 1950s (Newbold, 1996), and continue to be undertaken today. Positive effects of adding yeast culture to ruminant diets have been reported for growing cattle and lactating dairy cows (Dann et al., 2000; Desnoyers et al., 2009; Yuan et al., 2015). Recently, confirmation of positive effects of using yeast

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culture in lactating cow diets in the transition period and early lactation has been published (Schingoethe et al., 2004; Yuan et al., 2015; Zaworski et al., 2014).

There are only a limited number of studies on the effect of using live yeast supplementation on lactating buffaloes and only 4 relevant references were found between 2008 and 2013 (Campanile et al., 2008; Gaafar et al., 2009; Khattab et al., 2010). The fourth, and most recent publication, was by Degirmencioglu et al. (2013) about effect of *S. cerevisiae* supplementation in lactating Anatolian water buffaloes. This research reported increased dry matter intake (DMI) and total MY and fat corrected milk yield (FCM) in dairy cows after daily *S. cerevisiae* supplementation with 30 g per 500 kg BW. Furthermore, yeast supplementation can affect blood metabolites. A decreased urea N in blood plasma in dairy cows and an increased albumin in ewes were reported after yeast supplementation (Bruno et al., 2009; Helal and Abdel-Rahman, 2010). The responses to yeast culture supplementation, documented in published research, varies and may be due to differences such as the yeast type and strain, mode of action and level of application, as well as the animal type, diet, energy level, parity, lactation stage, and level of productivity. These differences make it difficult to compare published results and predict the usefulness of yeast supplementation for Egyptian buffaloes. Therefore, this study investigated effects of yeast supplementation to Egyptian buffaloes. Specifically, the following hypotheses were tested:

1) Yeast culture supplementation effects are similar in primiparous (PP) and multiparous (MP) lactating buffaloes.
2) Yeast culture supplementation effects are similar in early and mid-lactation buffaloes.
3) Yeast culture supplementation promotes energy and protein conversion efficiency.

2. Materials and methods

2.1. Animals, diets, feeding and experimental design

This study was conducted at the Experimental and Research Station, Shalkan, Faculty of Agriculture, Ain Shams University, Egypt and the laboratories of the Dairy Science Department, National Research Centre, Dokki, Giza, Egypt. Yea-Sacc^{1026} was used as a feed supplement. Yea-Sacc^{1026} is a yeast culture based on a proprietary strain of *S. cerevisiae*. The commercial product has a minimum concentration of 1×10^9 cfu/g, (Alltech Inc, Lexington, KY, USA).

Twenty-four lactating Egyptian buffaloes (8 PP and 16 MP) with a live weight of 520.4 ± 10.47 kg were randomly assigned to 2 groups of 12 buffaloes each, according to parity (4 PP and 8 MP). The animals were fed the experimental feed ration from approximately 15 days before parturition in order to adapt to the feed. All sampling started 15 days after parturition, approximately 30 days after introduction to the feed. The lactation trial lasted 180 days. The animals were housed in an insulated barn and fed individually. The animals were fed a total mixed ration (TMR, Table 1) without or with 10 g Yea-Sacc^{1026} per cow per day as the control and treatment group, respectively. The ration ingredients and chemical composition of the TMR are presented in Table 1. The ration contained 75% to 76% roughage (R) and 24% to 25% concentrate (C) on a fresh matter basis. The total ration was formulated to keep the neutral detergent fiber (NDF), non-fiber carbohydrate (NFC) and net energy for lactation (NE_L) levels according to NRC (2001) recommendations. The rations were formulated to provide the necessary energy and protein requirements according to Paul et al. (2002). Rice straw was available *ad libitum* in addition to the TMR. The ration was offered twice daily at 07:00 and 18:00 and the animals had continuous access to fresh water. Ten grams of the yeast supplement powder were added on top of a quarter of the morning TMR feed. The rest of the TMR and rice straw was given to the buffalo cows only after this feed and the live yeast culture was completely consumed. All experimental animals were cared for according to the Guide for the Care and Use of Agricultural Animals in Agricultural Research and Teaching (FASS, 2010). Data from 2 animals (1 PP and 1 MP) were eliminated from the control group due to illness not related to the experiment.

2.2. Sampling

The daily offered feeds (TMR and rice straw) and subsequent orts were recorded for each animal in order to calculate feed intake. Body weight, daily MY, milk fat and milk protein content were registered once every 15 days until 90 days post-partum and thereafter every 30 days until 180 days. The buffaloes were milked twice daily at 04:00 and 17:00 and MY of each buffalo was recorded by the DeLaval milk manager software attached to the milk set. The animals were weighed and milk samples taken at 15-day intervals (days 15, 30, 45, 60, and 75) and thereafter at monthly intervals (days 90, 120, 150 and 180). On the designated sample day, milk from the morning and evening milking of each buffalo cow was pooled and stored at 4 °C for subsequent analyses. The samples were pooled in quantities relative to the total amount of milk produced by the individual buffalo at the respective milking. In this way, one composite milk sample per animal per sampling day was analyzed. Milk samples were analyzed for total solids, fat, true protein and lactose by a Bentley 150 infrared milk analyzer (Bentley Instruments, Chaska, MN, USA). The Bentley instruments company calibrated the machine specifically for Egyptian buffalo milk.

Blood samples were taken from 3 PP and 4 MP control animals and 4 of each PP and MP yeast supplemented buffaloes at 15, 30, 60, 90, 120, 150 and 180 days in milk (DIM). A sample of 10 mL blood was drawn from the jugular vein of each animal. The blood samples were collected directly into clean, dry glass culture tubes at 3 h post morning feeding. The blood samples were centrifuged 2 h after collection at 1,430 × *g* for 15 min to collect serum. The serum was stored at −20 °C in clean, dry glass vials until subsequent analyses. The serum samples were analyzed using commercial kits (SPINREACT, A. A. Ctra. Santa Coloma, Girona, Spain). Total protein, albumin, urea, and creatinine concentrations were used as an indication of kidney function, while alanine aminotransferase (ALT) and aspartate aminotransferase (AST) were used as an indication of liver damage and total lipids as an indication of fat mobilization. Globulin concentration was calculated by subtraction of total serum protein and serum albumin. The albumin/globulin (A/G) ratio was calculated by dividing the value of albumin by the value of globulin in serum. These values are used to assess growth and general health.

Digestibility sampling was undertaken twice during the lactation trial. Fecal samples (approximately 150 g) were collected at 08:00 and 16:00 from the rectum for 3 consecutive days from days 45 to 47 and from days 90 to 92 and pooled by buffalo. These 2 sampling periods were considered to be representative of early and mid-lactation, respectively. A solution of 10% H_2SO_4 and formalin was added to the sample (Khattab et al., 2012). The samples were subsequently dried at 55 °C for 48 h, ground in Wiley mill to pass a 1 mm sieve, and thereafter subjected to chemical analysis. The acid insoluble ash (AIA) technique (Van Keulen and Young, 1977) was used as an internal marker for nutrient digestibility calculation as suggested by Sales and Janssens (2003).

2.3. Chemical analysis and calculations

Samples of the TMR and rice straw were collected, pooled weekly, completely dried at 55 °C and ground to pass a 1 mm screen

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