Productive Performance of Lactating Buffaloes Fed Rations Containing some Feed Additives under Summer Season in Egypt.

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ABSTRACT

This study was conducted to compare the effect of supplementing yeast combined with chromium methionine (Cr-Met) or niacin or their mixture into rations of lactating buffaloes on their productive performance over 120 days of an experimental period under summer season conditions. Twelve lactating buffaloes with an average 550 Kg live body weight and in their 4th or 5th seasons at mid-lactation, were divided randomly into four similar groups (three buffaloes per group) according to their live body weight and milk yield. Dietary treatments (on DM) were as follows: (T1) control ration that free from feed additives, T2: control ration plus 10g yeast + 5g Cr-Met, T3: control ration plus 10g yeast + 5g niacin and T4: control ration plus 10g yeast + 5g Cr-Met + 5g niacin. The experimental rations were formulated to cover maintenance and production allowance according to Kearn (1982) for dairy cattle. Results indicated that supplementing lactating buffalo rations with different feed additives (T2, T3 and T4) improved the digestibility of most nutrients and feeding values as TDN and DCP than those of control one (T1). No significant differences were found respecting most blood serum constituents among all groups of lactating buffaloes, except globulin concentration was significantly ($P<0.05$) lower with those fed tested rations compared with that of control group. The 7% - FCM yield was significantly ($P<0.05$) higher for all tested rations (T2, T3 and T4) than that of control one (T1). Also, 7% - FCM yield of both tested rations (T3 and T4) was significantly ($P<0.05$) higher than that in tested one (T2), being the highest value was recorded with T4 ration that supplemented with the mixture of additives (yeast - Cr-Met - niacin). The daily 7% - FCM yield was increased by (11.18%) for T2, (15.91%) for T3 and (18.43%) for T4 supplemented rations compared with unsupplemented ration (T1). Milk composition was not affected by any treatments except lactose percentage which was significantly ($P<0.05$) decreased with those fed T2 - ration compared with those fed other experimental rations (T1, T3 and T4). Likewise, feed conversion was significantly ($P<0.05$) improved with all animals fed tested rations (containing feed additives) being the best improvement was occurred with mixture of supplements (yeast plus Cr-Met and niacin). Meanwhile, relative economic efficiency was 5.3, 6.5 and 7.8 % for tested rations T2, T3 and T4, respectively being better than that of control one (T1). Generally, from the obtained results indicated that the supplementation of different feed additives to lactating buffalo rations had positive effects on digestibility, feeding value, some blood serum parameter, milk yield and economic efficiency.

Keywords: lactating Buffaloes, chromium methionine, niacin, yeast, digestibility, blood parameters, milk production, economical efficiency.

INTRODUCTION

Buffaloes are the major source of producing meat and milk in Egypt, and their productive performance is greatly affected by many physiological and environments factors. Heat stress and humidity are considering an environmental two main factors responsible for the reduction in animal production economically during summer season (Pierre *et al.*, 2003). Such dysconditions could be led to decrease milk yield between 10 to 35% in mid-lactating dairy cows (Rhoads *et al.*, 2009), and 14% in early lactation period (Lacetera *et al.*, 1996), as well as affect worsely on milk composition (El-Khashab, 2010). The adverse impact of heat stress on milk production by reduction dry matter intake and decrease the nutrients uptake (McGuire *et al.* 1989) led to a negative energy balance as well as increase the maintenance requirements (Collier *et al.*, 2005). Moreover, such stress also adversely affect rumen health and its functions (Baumgard and Rhoads 2012). Furthermore, under heat stress conditions Smith and Teeter (1987) indicated that the increasing mineral excretion led to healthy problems, therefore, cause serious economic losses (Pierre *et al.*, 2003). Commonly, some reports indicated that the suitable temperature for milk production of dairy cattle is between - 0.5° and 25°C (West, 2003). On the other hand, buffaloes are more susceptible to heat stress as compared to other farm animals (Das *et al.*, 1999) because the dark body color and rarely distributed sweat glands. For these reasons, it's important to reduce the heat stress in order to maintain good health status and high productive efficiency. Ultimately, one of the key management factors of reducing the effectiveness of heat stress on animals performance is the nutritional strategies that can potentially help to maintain animal health and productive efficiency (Collier

et al., 2006). Some nutritional strategies that can be effectively reduce the damage of heat stress could be induced by reducing the ratio of roughage to concentrate that may led to an increases in dry matter intake yet, the studies indicated that dairy cows fed high concentrate (energy) and low fiber diets during heat stress could be improve DMI and milk yield. Moreover, addition of feed additives for instance, yeast that have been effectively alleviate the heat stress conditions and also to stabilize rumen health and its functions to be in maximal modulation favorably for rumen microorganism. It also altered microbial protein activities in the rumen and total bacterial number particularly the cellulolytic one that increasing the rate of fiber digestion (Offer and Cruick, 1991). On the other hand, many studies with dairy cows (Bruno *et al.* 2009 and Shwartz *et al.*, 2009) reported that yeast culture addition increased feed intake during heat stress and milk production. Moreover, niacin supplementation led to increase microbial protein synthesis in the rumen and protozoa numbers as well (Erickson *et al.*, 1990), propionate production (Riddell *et al.*, 1980), cellulose digestion (Horner *et al.*, 1988a) and improve energy utilization (Zimbelman *et al.*, 2010). In some studies, improvement of milk production and persistency in dairy cows were found with rations supplemented with niacin (Madison-Anderson *et al.*, 1997), and also increased milk protein percentage (Minor *et al.*, 1998). likewise, chromium is an essential element for potentiates insulin action (NRC, 2001), and thus play a vital role in carbohydrates, lipids and proteins metabolism (Vincent, 1999). Chromium supplementation has shown to be effective for alleviating the negative effects of environmental stresses and thereby improving productive performance of farm animals (Amata, 2013), improving

immunity (Spears, 2000), increase growth performance in growing and finishing ruminant animals (Amata, 2013), with growing heifers (Spears *et al.*, 2012), mature dairy cows (Leiva *et al.*, 2014), and lastly increased DMI, and milk yield of dairy cows (McNamara and Valdez 2005). It can also improve metabolic rate by improving thyroid hormones (Burton, 1995). Furthermore, during stress periods, the chromium excretion in the urine usually led to increases the chromium requirements. Therefore, important recommendation with supplemental dietary chromium for animals undergoing environmental stress was recorded by (NRC, 1997).

Therefore, the objectives of this study were to evaluate the effects of supplementing yeast mixed with chromium methionine, or niacin or their mixture into rations of lactating buffaloes on feed intake, nutrients digestibility, milk production and composition, some blood serum parameters status and economic efficiency under summer season conditions.

MATERIALS AND METHODS

This study was conducted at Rewinh buffalo production farm belongs to the Agricultural production sector, Agriculture Research Center, Ministry of Agriculture, Kafr El Shiekh Governorate, Egypt, to evaluate the effect of feeding lactating buffaloes on diets supplemented with yeast mixed with chromium methionine or niacin or its mixture on their productive performance.

Animals and rations:

This study was carried out during summer season (June till September 2017) and lasted for 120 days. Twelve lactating buffaloes in their 4th or 5th seasons at mid-lactation and weighed in average 550 kg were divided randomly into four similar groups (three buffaloes per group) according to their live body weight and milk yield. Dietary treatments (on DM basis) were as follows: (T1) control ration that unsupplemented with feed additives, T2: control ration plus 10g yeast (Dox-al,DXThepax100R (strain GSH351) containing 5×10^9 cells/g (European patent n.0111202-European patent n.98116181.3) + 5g chromium methionine (Cr-Met), consisting of Cr-Met complex 3.4% (consists of 0.1% chromium and 0.7% methionine), calcium carbonate 95.1% and mineral oil 1.5%, T3: control ration plus 10g yeast + 5g niacin and T4: control ration plus 10g yeast + 5g Cr-Met + 5g niacin. Feed additives (yeast, Cr-Met and niacin) were mixed with a CFM just before feeding in the morning along the experimental period. Control rations consisted of approximately 60% concentrate feed mixture (CFM) + 20% corn silage (CS) + 20% rice straw (RS) on dry matter basis. The CFM in mash form and consist of 40% corn yellow, 30% wheat bran, 8% soyabean meal, 19% sunflower meal, 1.8% limestone 1% common salt and 0.2% mineral and vitamins premixes and chemical composition of the ingredients are present in Table (1). The experimental rations were formulated to cover maintenance and milk production allowance according to Kearn (1982) for dairy cattle. In addition, diets were offered twice daily and fresh water was allowed freely. All animals were vaccinated and treated in accordance of the established routine of the livestock and they injected with vitamins AD₃E to cover

their requirements. Buffaloes were hand milked twice at 7 am and at 3 pm every day. Feed intake and daily milk yield of each buffalo were recorded daily along the experimental period. Milk samples were collected every two weeks (from consecutive the evening and morning milking in the same day) during the experimental period from each buffalo. The formula that given by Raafat and Saleh (1962) was used to convert the actual milk yield in 7% fat corrected milk as following :

$$7\% - \text{FCM} = 0.265 \times \text{milk yield} + 10.5 \times \text{fat yield}$$

Feed conversion was calculated for the experimental rations as the amount of DM and TDN in kg required to produced one kg of 7% - FCM . Economic efficiency of milk production were expressed as the ratio between the price of daily FCM produced and the cost of daily feed consumed .

Digestibility trials:

Four digestibility trials were conducted to determine the digestibility and feeding values of experimental rations, using Acid insoluble Ash (AIA) as a natural marker as described by (Van Keulen and Young, 1977). Fecal grab samples of about 300g were collected from the rectum at the end of the feeding trial twice daily over 5- days period. Blood samples were collected from all animals at the end of digestibility trials before morning feeding from the jugular vein and after collection these samples were immediately centrifuged at 4000 rpm for 20 minutes and serum was separated and stored at -25°C until analysis.

Laboratorial Analysis:

The chemical analysis of representative samples of feed and feces were analyzed according to (AOAC, 2000). Blood serum was separated from the whole blood to determine some blood serum parameters using commercial kits of Bio-Merieux, lab, France, following the same steps described by manufactories as the total protein, according to Armstrong and Carr (1964), albumin was analysed according to Doumas (1971) and globulin was calculated by subtracting the albumin value from total protein one. The activities of aspartate aminotransferase (AST) and alanine aminotransferase (ALT) were analysed according to Reitman and Frankal, (1957). Milk samples were analyzed for milk lactose, fat, protein, total solid (TS) and solid non-fat (SNF) concentrations by the Milkoscan system (Foss Electric Hillerod, 133B Milkoscan, Denmark).

Statistical analysis

Statistical analysis was carried out by General Linear Model procedures (GLM) described in SAS User's Guide (SAS, Institute 2003). Differences among treatment means were separated by Duncan's new multiple-range test (Duncan, 1955).

RESULTS AND DISCUSSION

Chemical composition of feedstuffs and experimental rations are presented in Table 1. Results showed that chemical composition of CFM, CS, RS and calculated composition of experimental rations are within the normal ranges which earlier reported in PSAN (1997), and by several other workers (Mostafa *et al.*, 2015 and Abou Elenin *et al.*, 2016).

Digestion coefficients and feeding values:

Data of digestion coefficients and feeding values of experimental rations are presented in Table 2. Data indicated

that most nutrient digestibilities were significantly ($P<0.05$) higher with all tested rations than that in control one, being the differences among the tested rations did not significant differ in respect of most nutrient digestibilities excepted with OM and NFE digestibilities. The results of the present study could be emphasised on the potential beneficial effect of using the experimental feed additives for improving the rations digestibility of lactating buffaloes particularly under the heat stress condition of summer season in Egypt. Results here are similar with those reported by Mostafa *et al.* (2015) who noticed that addition two level of niacin to the rations of Friesian calves had increased the digestibility of dry matter of the consumed diets. Similarly, Kumar and Dass (2005) stated that niacin supplementation in diet of buffaloes had improved the rumen fermentation by decreasing ammonia-N concentration and increasing protein synthesis. On the other hand, the positive effect of supplementation of Cr-Met plus yeast are confirmed by the findings of Deka *et al.* (2015) who revealed that all nutrient digestibilities tended to increased with increasing the level of organic Cr from zero tell 1.5 mg/kg DM with lactating buffaloes. Moreover,

Moawd *et al.* (2008) revealed that digestibility of most nutrients of the diets of lambs were significantly ($P<0.05$) higher with supplementation of organic chromium than those of unsupplemented one.

Table 1. Chemical composition of feed ingredients and calculated composition of the experimental rations.

Items	Chemical composition %						
	DM	OM	CP	CF	EE	NFE	Ash
Ingredients							
CFM*	92.85	91.65	16.40	11.99	2.75	60.51	8.35
CS	27.05	90.28	7.20	29.30	3.40	50.38	9.72
RS	88.02	82.62	4.26	36.64	1.82	39.90	17.38
Experimental rations:							
T1(control)	79.27	89.52	12.13	20.41	2.68	54.30	10.48
T2	78.34	89.55	12.05	20.55	2.70	54.25	10.46
T3	78.20	89.54	12.03	20.58	2.70	54.23	10.46
T4	78.35	89.50	11.95	20.74	2.70	54.11	10.50

*CFM; contained 40% yellow corn, 30% wheat bran, 8% soyabean meal, 19% sunflower meal, 1.8% limestone 1% common salt and 0.2% mineral and vitamins. CS : Corn silage, RS : Rice straw.

Table 2. Nutrient digestibilities and feeding values of experimental rations using lactating buffaloes.

Item	Dietary treatments				P. value
	T1	T2	T3	T4	
Digestibility %					
DM	61.63 ^b ±0.54	63.19 ^a ±0.06	63.53 ^a ±0.39	63.23 ^a ±0.12	0.02
OM	65.96 ^b ±0.35	67.18 ^b ±0.15	67.84 ^a ±0.24	67.90 ^a ±0.08	0.001
CP	60.10 ^b ±0.57	62.11 ^a ±0.19	62.05 ^a ±0.12	62.22 ^a ±0.40	0.01
CF	43.74 ^b ±0.69	46.46 ^a ±0.50	45.12 ^{ab} ±0.08	45.94 ^a ±0.20	0.01
EE	69.22 ^b ±0.91	72.32 ^a ±0.45	70.65 ^{ab} ±0.67	72.05 ^a ±0.44	0.03
NFE	75.46 ^b ±0.38	75.90 ^b ±0.13	77.61 ^a ±0.28	77.37 ^a ±0.19	0.0008
Feeding values (on DM basis) :					
TDN%	61.37 ^b ±0.38	62.59 ^a ±0.16	63.13 ^a ±0.27	63.21 ^a ±0.07	0.003
DCP%	7.29±0.12	7.48±0.04	7.47±0.03	7.44±0.05	0.21
DE (Mcal/Kg DMI) ^A	2.71 ^b ±0.18	2.76 ^b ±0.007	2.78 ^{ab} ±0.01	2.79 ^a ±0.003	0.005

^ADE (Mcal / Kg DMI) = 0.04409 x TDN%. (NRC, 1989).

a, b and c: Means in the same row with different superscripts are significantly different ($P<0.05$).

T1: control, T2:5g Cr-Met +10g yeast, T3 : 5g niacin + 10g yeast and T4 : 5g Cr-Met + 5g niacin + 10g yeast.

Earlier the same effect of organic chromium supplement was found by El- Tahan *et al.* (2005) when fed lactating cows on concentrate feed mixture plus berseem hay. In contrary, Behnam *et al.* (2008) reported that no effect of niacin supplementation into the diets of dairy cows in early lactations on OM digestibility. Also, Kumar *et al.* (2013) proved that no influence of organic Cr addition in the diets of buffaloes calves on nutrient digestibilities under the condition of heat stress.

The feeding values of the experimental rations respecting TDN seemed to be significantly ($P<0.05$) higher with all tested rations than that of control one. While, the differences among all experimental treatments in respect of DCP values appeared to be statistically insignificant. Otherwise, the value of DE Mcal/kg DM of T4 (Cr-Met + niacin + yeast) was significantly ($P<0.05$) higher than those of control (T1) and tested ration (T2), but the other tested ones (T2 and T3) were similar to that of control in this item. The results indicated that the positive response of the different feed additives on nutrient digestibilities was reflected on the feeding values of the tested rations and control one. These results are in close agreement with those results of Mostafa *et al.* (2015) and Abou Elenin *et al.* (2016) who reported that a markedly improvement in TDN

and DCP values when supplemented calve diets with niacin and thiamin especially with the high – concentrate diet.

Productive performance:

Feed intake and Feed conversion:

The results of daily feed intake that expressed as DM, TDN and DCP for lactating buffaloes are presented in Table 3. The DM intake was significantly ($P<0.05$) higher with supplemented tested rations compared with the unsupplemented ration (control). Similar trend among the experimented dietary treatments was observed with both TDN and DCP intakes. In fact, feed intake by ruminant animals potentially affecting by the digestion coefficients of rations consumed. For instance, in the present study feed intake (DM, TDN and DCP) significantly ($P<0.05$) increased as increasing the digestibility values of the tested ration in comparison with that of control one (Table 2). The results indicated that yeast with either Cr-Met or niacin and in combination together increased DM intake by 2.90, 5.19 and 6.11%, respectively than that of unsupplementation group (T1). Similarly, many studies with dairy cows (Bruno *et al.* 2009 and Shwartz *et al.* 2009) revealed that yeast culture addition increased feed intake during heat stress and lactation. Moreover, niacin supplemented under heat stress conditions by 12g in the diet for cows increased DMI by 3.6% relative to that of

control ration (Costanzo *et al.*, 1997). On the contrast to the present findings, addition rumen-protected niacin under the mild and heat stress conditions (Rungruang *et al.* 2014) for Holstein cows diets had no effect on DM intake. Similar trend were observed by Horner *et al.* (1988b) and Erickson *et al.* (1992) with cows in early and mid – lactation. Regarding the Cr-Met response in the present study, similar results are obtained by (Hayirli *et al.* 2001, Soltan, 2010 and Khili *et al.* 2011) who reported that DMI increase with cows received Cr-Met supplemented diets during prepartum and postpartum. These data are in harmony with those of (Moonsie-Shageer and Mowat 1993, Barajas *et al.*, 2005, McNamara and Valdez 2005, Kraidees *et al.* 2009 and Soltan *et al.*, 2012). This animals response might be due to the positive metabolic action of chromium that alleviate the negative effect of heat stress (Almeida and Barajas 2002), and thereby improving productive performance of farm animals (Amata, 2013). Yet vice versa, results were obtained by (Kegley *et al.* 1997) who indicated that Cr-Met supplementation did not affect DMI in steers. Also, lack of affect DMI was observed by Moawd *et al.* (2008) when supplemented different level of organic Cr to the diets of fattening lambs.

Table 3. Average feed intake and feed conversion of lactating buffaloes fed the experimental rations.

Items	Experimental rations				P value
	T1	T2	T3	T4	
Initial weight, kg	550	550	550	550	
Daily feed intake, (kg/h/d) as DM:					
CFM	7.88	7.97	8.12	8.08	
CS	2.50	2.77	2.86	2.95	
RS	2.71	2.73	2.79	2.86	
Yeast	00	10	10	10	
Cr-Met	00	5	00	5	
Niacin	00	00	5	5	
Total daily intake (kg/h/d) as					
DM	13.09 ^a ±	13.47 ^b ±	13.77 ^{ab} ±	13.89 ^a ±	0.003
	0.04	0.19	0.06	0.02	
TDN	8.04 ^c ±	8.43 ^b ±	8.69 ^a ±	8.78 ^a ±	0.0007
	0.06	0.14	0.04	0.009	
DCP	0.95 ^b ±	1.01 ^a ±	1.03 ^a ±	1.03 ^a ±	0.003
	0.01	0.02	0.004	0.007	
Feed conversion (kg feed/kg 7% - FCM ¹):					
DM	2.06 ^a ±	1.91 ^b ±	1.87 ^{bc} ±	1.85 ^c ±	0.0001
	0.007	0.03	0.009	0.004	
TDN	1.27 ^a ±	1.19 ^b ±	1.18 ^c ±	1.17 ^b ±	0.001
	0.009	0.02	0.007	0.00	

¹Fat corrected milk

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

T₁: control , T₂: 5g Cr-Met +10g yeast, T₃ : 5g niacin +10g yeast and T₄ : 5g Cr-Met + 5g niacin +10g yeast

Also, data in Table 3 indicated that significant (P<0.05) improvement in feed conversion respecting kg DM or TDN per kg 7% - FCM with all tested rations in comparison with control one, being the best one was associated with T4 treatment that supplemented with those of combined additives of (yeast, chromium and niacin). These findings are in agreement with those obtained by Moawd *et al.* (2008) who found that marked improvement in feed conversion when lambs fed diets containing different levels of organic chromium. Also, similar results are recorded by Meherz *et al.* (2004) who concluded that yeast supplementation to the diets of lambs had favorable

effect on feed conversion as DM or TDN per kg weight gain. On the other hand, Mostafa *et al.* (2015) indicated that insignificant improvement in feed conversion (DM: gain) when fed growing – fattening calves diets supplemented with 500 or 1000 mg niacin per head daily.

Milk yield and composition :

Milk yield and composition are presented in Table 4. The average milk yield were (6.11, 6.55, 7.11 and 6.99 Kg/h/d) for rations T1, T2, T3 and T4, respectively. Feed additives led to an increase in milk yield by 7.20, 16.37, and 14.40%, for tested rations T2, T3 and T4, respectively in comparison to control one T1. Also, results showed that milk yield was significantly (P<0.05) higher with rations T3 and T4 than that in tested ration T2 and the control one T1, being milk yield also was significantly (P<0.05) higher with ration T2 than that with control group. Similar trend among treatments regarding 7% - FCM yield was observed, where the daily 7% - FCM yield was increased by (11.18 %) for T2, (15.91%) for T3 and (18.43%) for T4 supplemented rations compared with unsupplemented ration (T1). These results might be due to the increases in nutrient digestibilities and feeding values for T2, T3 and T4 than that of control group (T1). Moreover, the beneficial response of lactating buffaloes to niacin addition may be due to that niacin is play a vital role in carbohydrates and lipids metabolism and consequently improves energy utilization via increasing blood glucose percentage as well as increasing microbial protein synthesis and ruminal fluid protozoa number which contributed in increasing the availability of amino acids for casein and lipoprotein synthesis, increased of VFAs and hence all these metabolic processes were responsible for enhanced milk production (Horner *et al.*, 1988b and Zimbelman *et al.*, 2010). Furthermore, niacin supplementation improves dry matter intake and feed efficiency as results of increasing the rate of digesta passage and escape of ruminal undegraded protein and consequently being available in small intestine for enzymatic digestion and absorption and subsequent use by the mammary gland (Riddell *et al.*, 1981 and Muller *et al.*, 1986). These findings are in agreement with those obtained by Muller *et al.* (1986) and Al-Abbasy, (2013) who reported that milk production increased with increasing the level of niacin in the diet of cows in early lactation in summer months. Similar trend was obtained during hot-dry and hot-humid seasons by Das *et al.* (2014) who found that milk yield of lactating buffaloes fed a basal diet plus supplementation of 6g niacin + 10g yeast + 150g mustard oil was higher than those fed the unsupplemented one. However, these findings are in disagreement with those obtained by some workers under summer season in which Small, (2010) and Rungruang *et al.* (2014) indicated that niacin supplementation did not affect actual milk production and 4% FCM of Holstein cows. On the other hand, results in Table (4) that related Cr-Met supplementation are in good agreement with those obtained by Hayirli *et al.*, (2001), Khalili *et al.*, (2011) and Targhibi *et al.* (2012) during early lactation. Moreover, under heat stress conditions in Egypt, Soltan (2010) reported that Cr supplementation into the diets of dairy cows increased milk production up to 12.1% based on untreated one during early lactation. In perspective, supplemental Cr and its positive effect on milk production may be explained by Ohh and Lee (2005) who reported altered insulin sensitivity and increased

glucose/insulin ratio in cows after parturition and in addition, Cr supplementation had increased dry matter intake. Earlier, Evans and Bowman (1992) observed comparable conclusion in which chromium functions primarily to potentiate insulin, by facilitating interaction between insulin and insulin receptors. Potentially, Chang *et al.* (1995) decided that supplemental inorganic Cr and niacin together tended to have beneficial effects on performance of stressed calves. They added that niacin may be additionally working as limiting factor at involving inorganic Cr in the diet of calves and its effect on metabolic processes.

Concerning milk composition, results indicated that fat, protein, SNF, TS and ash percents did not significantly affect by rations supplementation with feed additives, while inclusion of combination Cr-Met with yeast in diet T2 led to lower lactose percentage significantly ($P<0.05$) than that of other rations. Pointedly, milk fat was insignificantly increased by 5 and 4.7% with Cr-Met supplementation in T2 and T4, respectively than that in control one. These results may be due to the higher CF digestibility of both T2 and T4 (5 & 4.7) than that of the other experimental rations that leading to arise the acetate concentration in the rumen which excessively in turn affected positively on fat content. These results are supported by the findings of Hayirli *et al.* (2001) who observed an improvement in milk yield, fat and lactose contents when cows fed Cr-Met-diet during pre/post parturition in first of lactation. On the other hand, results in Table (4) that related to niacin supplementation were similar with those found by Muller *et al.* (1986) who reported that

milk composition did not affect by supplemental niacin into the ration of dairy cows during summer period. However, the current results are in contrast with those recorded by Das *et al.* (2014) who confirmed that supplemental niacin cause an increment of fat percent significantly ($P<0.01$) compared with control group. Regarding milk protein, similar finding were reported with dairy cows in early lactation by Targhibi *et al.* (2012) who found that supplemental Cr-Met did not affect milk fat and protein percents. Also, McNamara and Valdez (2005) and Soltan (2010) stated that no influence of supplementing Cr on milk composition. The results of this study (Table 4) are consistent with the findings of El- Tahan *et al.* (2005) who found insignificant effects of addition different levels of organic chromium to the diets of lactating cows, respecting milk composition (fat, SNF and protein). On the other hand, Masek *et al.* (2008) observed that dietary supplementation with live yeast cells significantly ($P<0.05$) increased total milk yield but chemical composition of milk was not influenced by treatments with the exception of milk fat that was significant higher in yeast culture group. On the other hand, there are also many reports that showed supplemental niacin had no effect on milk protein percent (Morey *et al.*, 2011 and Yuan *et al.*, 2012). However, the present data contrast with those of Karkoodi and Tamizrad (2009) who reported that milk protein percentages increased with increasing the level of niacin in the diet of cows. Recently, these discrepancies could be also associated with differences in breeds, stage of lactation, type of forage given, and feeding strategy over different studies.

Table 4. Effect of experimental rations on milk yield, and milk composition.

Item	Experimental groups				P. value
	T1	T2	T3	T4	
Milk yield (Kg/h/d)	6.11 ^c ±0.07	6.55 ^b ±0.06	7.11 ^a ±0.16	6.99 ^a ±0.08	0.0001
7% - FCM (Kg/h/d)	6.35 ^c ±0.07	7.06 ^b ±0.06	7.36 ^a ±0.16	7.52 ^a ±0.08	0.0001
Milk composition %					
Fat	7.37±0.26	7.74±0.28	7.35±0.49	7.72±0.38	0.79
Protein	4.30±0.05	4.39±0.05	4.31±0.05	4.32±0.06	0.37
Lactose	5.47 ^a ±0.04	5.34 ^b ±0.06	5.53 ^a ±0.04	5.58 ^a ±0.02	0.004
Solids not fat	10.39±0.26	10.33±0.29	10.41±0.51	10.40±0.38	0.81
Total solids	17.76±0.08	18.07±0.05	17.72±0.02	18.14±0.07	0.69
Ash	0.62±0.02	0.60±0.003	0.57±0.02	0.56±0.04	0.42

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

T₁: control, T₂: 5g Cr-Met +10g yeast, T₃: 5g niacin +10g yeast and T₄: 5g Cr-Met+5g niacin +10g yeast.

Blood parameters:

Data of some blood serum parameters are presented in Table 5. Concentrations of total protein and albumin as well as activity AST and ALT were not significant different among all the experimental rations, while, globulin concentration was significantly ($P<0.05$) lower with all tested rations than that of control one. While, serum A/G ratio was significantly ($P<0.05$) higher with all tested rations than that of control group. These results are similar with those found with dairy cows during transition period were recorded by Khalili *et al.* (2011) and Targhibi *et al.* (2012) who used Cr supplementation in cows' diet. Earlier comparable results were proven by Al - Saiady *et al.* (2004) who stated that chelated Cr supplementation in Holstein cow diets had no effect on AL concentration but decreased the TP and GL concentration and increased significantly A/G ratio compared with unsupplemented ration. Specifically, Moonsie-Shageer and Mowat (1993) explained that the increase in serum Al of Cr supplementation diet may be due to the increased amino acid synthesis in the liver, in which

Cr-Met may enhance amino acid synthesis possibly via insulin and incorporation of several amino acids into protein. Recently, Nejad *et al.* (2016) concluded that feeding diet supplemented with 400 ppb / d of Cr to Holstein steers for 4 months during the late fattening period can improve some blood metabolites and beef quality by increasing PUFA in beef. In general, Cr is one of the essential micronutrients for ruminants and is greatly considered to be a metabolic modifier and eventually the organic source of Cr is a promising form due to its higher bioavailability than inorganic ones (NRC, 1997).

Concerning niacin supplementation, Abou Elenin *et al.* (2016) indicated that concentration of total protein did not affect supplemented diets with either niacin or thiamin and its mixture supplementing for fattening buffaloes calves diets. In contrary, Mostafa *et al.* (2015) reported that total protein and albumin contents in blood serum were significantly ($P<0.05$) increased with supplementation of niacin and thiamin to the diets of fattening Friesian calves. In recent years, niacin has been widely used as a supplement

for diets of high-performing ruminants, particularly dairy cattle (Chang *et al.*, 1995). They added supplemental inorganic Cr and niacin together for its beneficial effects on performance of stressed calves, suggesting that niacin may be a limiting factor for absorption and/or use of inorganic Cr. Furthermore, Mehrez *et al.* (2004) reported that total protein was significantly ($P<0.05$) higher with yeast culture supplementation in the diet of lambs than that of unsupplemented one, while albumin, globulin and liver enzymes (AST & ALT) did not affected by this supplement. They concluded that yeast culture (as a good source of vit.

B) supplementation for growing lamb diets had positive response on their growth performance with high concentrate diet than the roughage one. On the other hand, liver functions as AST and ALT activities (Table 5) did not significantly affect by rations supplementation with feed additives in comparison with control one. All blood parameters were found to be within the normal range as reported by El -Kaneko *et al.*, (1997). The results of the serum parameters are considering as an indicators for normal protein metabolism and normal activity for kidney and liver cells of buffaloes.

Table 5. Some serum blood constituents of lactating buffaloes fed on the experimental rations.

Item	Experimental groups				P value
	T1	T2	T3	T4	
Total protein (g/dl)	8.00±0.12	7.37±0.31	7.48±0.29	7.57±0.32	0.43
Albumin (g/dl)	4.36±0.09	4.55±0.36	4.99±0.26	4.86±0.26	0.36
Globulin (g/dl)	3.63 ^a ±0.29	2.82 ^b ±0.06	2.50 ^b ±0.12	2.72 ^b ±0.27	0.003
Albumin / Globulin ratio	1.20 ^b ±0.02	1.62 ^{ab} ±0.65	2.00 ^a ±0.15	1.83 ^a ±0.24	0.04
AST (Iu/L)	8.67±2.31	8.34±0.33	9.67±2.6	8.00±0.34	0.75
ALT (Iu/L)	36.67±2.01	34.67±1.85	35.00±1	38.00±2.45	0.16

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

Economical efficiency:

Table (6) represents the effect of supplementing lactating buffaloes diets with different feed additives on the economical efficiency. Data showed that diets of lactating buffaloes which including feed additives greatly means an increases their productive performance and in consequent increasing the economical efficiency than the diet free from feed additives (control). The improvement of economical efficiency values being 105.30, 106.50 and 107.80 for T2, T3 and T4, respectively based on control (T1). Results here

are matching with those obtained by Mostafa *et al.* (2015) and Abou Elenin *et al.* (2016) when supplemented diets of growing – fattening calves with niacin and thiamin especially with the high – concentrate diet. Also, the results of this study were consistent with the findings of El- Tahan *et al.* (2005) who found favorable effects of addition different levels of organic chromium to the diets of lactating cows, respecting economical efficiency under normal conditions.

Table 6. Effect of feed additives supplementation in diets of lactating buffaloes on their economical efficiency.

Item	Experimental groups			
	T1	T2	T3	T4
Feed intake (kg/head/day) as fed:				
Concentrate feed mixture (CFM)	8.48	8.58	8.75	8.70
Corn silage	9.25	10.25	10.58	10.90
Rice straw	3.08	3.10	3.17	3.25
Feed additive				
Yeast	0	10	10	10
Cr-Met	0	5	0	5
Niacin	0	0	5	5
Economic evaluation:				
7% - FCM yield (kg/h/d)	6.35	7.06	7.36	7.52
Feed cost (LE/h/d):				
Concentrate Intake	35.62	36.04	36.75	36.54
Corn silage intake	5.09	5.64	5.82	6.00
Rice Straw intake	0.92	0.93	0.95	0.98
Price of additive (LE)	0.00	1.35	1.75	2.10
Total feed cost (LE/h/d) ¹	41.64	43.96	45.27	45.62
Price of 7% FCM yield (L.E./d)	63.50	70.60	73.60	75.20
Feed cost /kg 7% FCM (L.E./d) ²	6.56	6.33	6.15	6.07
Economic efficiency ³	1.53	1.61	1.63	1.65
Improvement of economic efficiency (%)	100	105.3	106.5	107.8

¹Total feed cost (L.E/h/d)= Price of each ration ingredient x its amount consumed. ²Feed cost of Kg 7% FCM (L.E/d) = Total feed cost /average daily 7% FCM yield. ³Economic efficiency = price of daily 7%- FCM produced / the cost of daily feed consumed. Price of feedstuffs and supplements: 4200 LE/Ton of CFM and 550 LE/Ton of corn silage, 300 LE/ton Rice straw, 100 LE/kg of yeast, 70 LE/kg of Cr-Met, 150 LE/kg of Niacin, and price of milk: 10 LE/kg.

CONCLUSION

Under hot-humidity conditions in Egypt, it could be concluded that supplementation of yeast combined with chromium methionine, or niacin or their mixture into rations of lactating buffaloes in mid-lactation had positive effects on digestibility, feeding values and milk production, beside better economic efficiency.

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الأداء الإنتاجي للجاموس الحلاب المغذاة على علائق تحتوي على بعض الإضافات الغذائية خلال الصيف في مصر

على أحمد عبده على

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أجريت هذه الدراسة لمقارنة أثر إضافة الخميرة مختلطة مع الكروميوم-مثنونين والنياسين ومخلوطهما على الأداء الإنتاجي للجاموس الحلاب في الصيف. حيث تم تقسيم الحيوانات (اثنى عشر من الجاموس حلاب) بمتوسط وزن 550 كجم، في الموسم الرابع أو الخامس في منتصف موسم الحليب، بشكل عشوائي إلى أربع مجموعات متماثلة (ثلاثة لكل مجموعة) وفقاً لوزن الجسم الحي وإنتاج اللبن. كانت المعاملات الغذائية (على أساس DM) على النحو التالي: غنية المجموعة الأولى (الكنترول): 60% علف مركز + 30% سيلاج الذرة + 10% قش أرز بدون إضافات بينما المعاملة الثانية: علفية الكنترول + 10 جرام خميرة + 5 جرام كروميوم-مثنونين، المعاملة الثالثة: علفية الكنترول + 10 جرام خميرة + 5 جرام نياسين، المعاملة الرابعة: علفية الكنترول + 10 جرام خميرة + 5 جرام كروميوم-مثنونين + 5 جرام نياسين. وتم تغذية الحيوانات بشكل فردي وفقاً لمقررات كيرل (1982) للماشية الحلابية. وأجريت 4 تجارب هضم على نفس الحيوانات التجريبية وذلك لتقدير القيم الهضمية والغذائية لعلائق التجربة. أوضحت النتائج أن الجاموس الحلاب المغذاة على الإضافات الغذائية المختلفة (T2 و T3 و T4) كانت الأعلى في معاملات هضم لمعظم العناصر الغذائية بالمقارنة بالكنترول. وإيضاً كانت القيم الغذائية (TDN و DCP) تقريبا أخذت نفس الاتجاه لمعاملات هضم المواد الغذائية. كما لا توجد فروق ذات دلالة إحصائية في تركيز الدم لكل من البروتين الكلى الألبومين ونشاط AST و ALT بين المعاملات. زاد إنتاج اللبن أو اللبن المعدل 7% دهن معنوباً لجميع العلائق التجريبية على النحو التالي T4 يليه T3 و T2 مقارنة بالكنترول. كما لم تظهر فروق ذات دلالة إحصائية فيما يتعلق بمكونات اللبن ولكن هناك انخفاض معنوي ($P < 0.05$) في نسبة اللاكتوز مع T2 بالمقارنة مع المعاملات الأخرى. وبالمثل، تحسنت الكفاءة التحويلية بشكل معنوي ($P < 0.05$) مع كل الحيوانات التي غذيت على العلائق المختبرة (المحتوية على إضافات غذائية) وكانت أفضلها T4. وفي الوقت نفسه كانت الكفاءة الاقتصادية 5.3 و 6.5 و 7.8%، بالنسبة للمعاملات T2 و T3 و T4 على التوالي بشكل أفضل مقارنة مع مجموعة الكنترول (T1). وبشكل عام، تشير النتائج التي تم الحصول عليها إن الإضافات الغذائية المختلفة المضافة إلى علائق الجاموس الحلاب كان لها تأثير إيجابي على معاملات الهضم، القيم الغذائية، إنتاج اللبن والكفاءة الاقتصادية دون أى تأثير عكسى على صحة الحيوانات.