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Productive Performance of Dairy Buffalo Cows Supplemented with *Aspergillus oryzae* Extract or Malate Salt during the Transition Period

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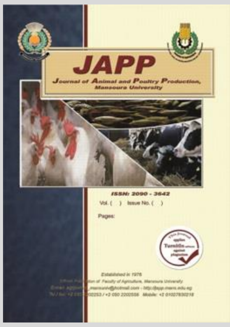

ABSTRACT

This study aimed to evaluate 2-months pre- and 3- months' post-partum dietary supplementation of *Aspergillus oryzae* (AO) extract (Amaferm®) or malate salt (MS) on productive performance of buffalo cows. Multiparous buffalo cows (n=15, 446.92±26.54 kg LBW, and 2-5 parities) at late pregnancy period were divided into three groups., The control group was fed a basal ration, while the 2nd and 3rd groups received the basal diet with 15 g/h/d of AO and 10 g/h/d MS, respectively. Results indicated that AO supplementation improved ($P<0.05$) DM and OM digestibility during post-partum, while CF digestion, feeding values, and ruminal TVFA's concentration were increased ($P<0.05$) by MS and AO. Treated groups increased ($P<0.05$) milk yield and composition, MS group recorded the highest benefits. AO addition improved ($P<0.05$) milk production persistency during lactation period. Economic efficiency had increased ($P<0.05$) for AO and MS groups by 4.6 and 13.3% compared with the control, respectively. Dietary AO supplementation (15 g/h/d) 2 months pre- and 3-months post-partum improve nutrient utilization and productive performance of multiparous buffalo cows.

Keywords: Buffaloes, *Aspergillus oryzae*, malate, nutritive values, milk production

INTRODUCTION

Nutrition management, during pre-calving are equal important in the post-calving for successful dairy farming. During the transitional phase, dairy farm animals are exposed to many critical physiological and reproductive changes that affect the animal's offspring, the animal's productive cycle, reproductive capacity and efficiency and the farm's economies consequently. Udder in dry period has no milk production, the cattle reduce feed intake capacity despite of fetal and placental development as well as postpartum milk synthesis so that, the energy and protein requirements deficit during the pregnancy and reaches the lowest levels before calving (Ingvartsen and Andersen, 2000). Cattle can ability to compensate the food energy deficits by adipose reserves mobilization with body fat β-oxidation reserves, and liver increased the formation of hepatic gluconeogenesis so that, fat depots declining in dry cow. (Sharad *et al*., 2016). In the last stage of pregnancy and before delivery, it is important to increase energy and protein metabolism levels to prevent risks metabolic diseases after birth to lactating animals as a result of a negative energy imbalance. (Duffield, 2000). Dietary fat is common essential practice to support milk production (Hayirli and Grummer, 2004). This can be associated with ruminal acidosis risk increases, (Drakely, 1999). Thus, alternative feed technologies one of the nutritional strategies that minimizing metabolic disorders on animal health and support maximal production efficiency of milk production, body weight, feed conversion, and carcass traits. In early lactation fed fungal products can improve rumen fermentation processes, feed digestive, energy status and animal health (AlZahal *et al*., 2014). *Aspergillus oryzae* (AO) has a positive effect on DMI, digestibility of DM and milk yield production Wallace and Newbold (1995) also, enhance rumen amino acid deamination, microbial N flow, microbial yield, ruminal pH, and increases lactate utilization also, reduce methane production and risk of acidosis, bloat, laminitis etc Chiquette (2009). Organic acids such as malate salt beneficial production performance for dairy cows fed under stressful conditions (Hutjens, 2008). Improve milk fat synthesis and milk yield production in dairy cow by improving rumen conditions ecosystem that enhancing microbial protein quantity and fiber digestion stimulating synthesized activity, (Sniffen *et al*., 2006), and associated with total volatile fatty acids produced by amilolytic and cellulolytic flora Lui *et al*. (2009). Therefore, our study aims to compare the effect of feeding Egyptian buffalo cows on *Aspergillus oryzae* (AO) fermentation extract (Amaferm®) and malate slate (MS) as a natural feed additives on feed efficiency, digestibility of nutrients, nutritive value, milk production (yield and composition) and economic evaluation during the last two months of pre-partum and suckling period.

MATERIALS AND METHODS

This study was conducted at Mahallet Mousa Animal Research Station, Kafr El-Sheikh Governorate, belonging to Animal Production Research Institute (APRI), Agricultural Research Centre. Fifteen multiparous buffaloes (446.92±26.54 kg as average live body weight, LBW) at the last two months of gestation, and from the 2nd to 5th parity, were used in this study. The experimental animals were divided randomly into three groups according to parity, LBW, expected calving date, and previous milk yield (5 animals in each). During the experimental period, all animals were fed a basal ration consisted of concentrate feed mixture (CFM), berseem hay (BH) and rice straw. Animals in the

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first group fed the basal ration without additive (control), while the second group (AO) received the basal ration with 15 g/h/d of Amaferm® (*Aspergillus oryzae* fermentation extract, Biozyme Enterprises Inc., St. Joseph, MO65404, USA), while the third group (MS) received the basal ration with 10 g/h/d of malate salt. (Laboratorios Ovejero S.A., Leo ´n, Spain). Rumalate® (Norel and Nature, S.A., Barcelona, Spain) commercial product as supplemented concentrate was composed of (0·16 disodium malate: 0·84 calcium malate, w/w). Concentrate feed mixture consisted of cake undecorticated cotton seed 32%, wheat bran 24%, yellow corn 22%, rice bran12%, linseed cake 5%, molasses 3%, limestone 1% and common salt 1%. Chemical analysis of ration is presented in Table 1. Animals were housed until time of delivery under semi-open shed and transferred after that to the maternity unit and each group was placed on pen equipped shaded with free stalls with available free choice of fresh water and mineral blocks. All buffalo cows were allowed to nurse their calves for only one week one-week post calving period of for colostrum's intake, and then dams were transferred to milking unit twice daily at 7 a.m. and 3 p.m. At the time of feeding, daily amounts of feed additives were directly hand mixed well with the concentrate and animals were individually fed in two daily equal meals according to Kearl, (1982). The amounts of feeds were recalculated biweekly, based on reproductive status and milk yield also; dams were weighed before and after calving

Table 1. Chemical composition and fiber fraction of dietary feed stuffs.

Item	Chemical composition as DM basis (%)			
	Calculated chemical composition (%):			
	CFM	Berseem Hay	Rice straw	Basal ration
DM	90.87	87.85	88.86	90.54
OM	92.96	88.06	85.67	89.53
CP	16.06	11.70	2.83	13.57
CF	12.61	29.45	39.61	19.25
EE	3.68	2.61	1.67	3.41
NFE	60.61	44.30	41.56	53.3
Ash	7.14	11.94	14.30	10.29
	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.**

Experimental procedures:

Feed intake and feed efficiency

During pre- and post-partum periods, average daily feed intake was recorded individually by weighing the offered feeds and refusals. Feed efficiency was calculated as required to produce 1 kg of the amounts of 7% FCM per intake as DM, TDN (kg), CP, and DCP (g).

Digestibility trials

Three animals from each group were randomly taken at the end of experimental period and using acid insoluble ash as a natural marker (AIA) to conducting nutrients digestibility coefficients and feeding values according to Van Keulen and Young, (1977). During 7 days as a collection period, 100 g/kg of the complete output feces samples was buckets collected and then composted for each animal and stored under -20˚C. Samples were dried in a forced air oven for 72 h at 60˚C, then grinding and descended through a 1-mm screen and stored until analysis at room temperature.

Rumen liquor samples

Rumen liquor samples were collected at 3 hours after feeding morning via stomach tube on the last day of digestibility trail, and separated through four gauze layers and frozen for subsequent analysis to estimate, pH value directly using digital pH meter (Microcomputer pH-vision Model 6007 (JENCO), ammonia nitrogen concentration (mg/100 ml NH_3-N) and total volatile fatty acids concentration (meq/100 ml VFA) in rumen liquor by water distillation using Markham apparatus method, according to Warner,(1964) and Preston, (1995).

Milk yield and milk Sampling:

Buffalo cows were milked twice daily (7 a.m. and 3 p.m.) after 7 days of calving. Average daily milk yield per head and corrected actual milk yield for 7% fat (7% FCM) was calculated using the formula as follow:- 7% FCM = 0.265 x milk yield (kg) + 10.5 x fat yield (kg) as given by Raafat and Saleh, 1962). Milk samples (ratio of 1% of milk yield) were taken during mid-lactation period until 60 days' post-partum and mixed for chemical analysis using infrared milk analyzer (Milko-Scan apparatus (Model 133 B), to estimate percentages of protein, lactose, urea, fat and total solid (TS) while, milk of energy (Kcal) was calculated using the formula: Milk energy (Kcal / Kg milk) = 115.3 (2.51 + fat %), according to Overman and Sanmann, (1926),

Chemical analyses

Over the entire feeding period weekly feed samples were composited and analysis by chemical official methods used AOAC, (1990) to determined feedstuffs contents as described by procedures (method number 930.15 for DM,), (976.05 for crude protein CP) and (number 927.02 for ash). While, organic matter (OM) content and nitrogen-free extract (NFE) was calculated by using the differences methods. Acid detergent fiber (ADF) and neutral detergent fiber (NDF) fractions were determined according to procedures of Van Soest *et al*. (1967) while, cellulose and hemicellulose percentages were calculated according to Calsamiglia *et al*., (1995).

Economic efficiency

Economic efficiency expressed as daily feed cost, 7% FCM price, and daily feed cost/price of 7% FCM was calculated. The feedstuff and supplementation costs according to Egyptian prices of year 2020 was concentrate feed mixture (CFM) (6000LE/ton) and berseem hay (3000 LE/ton), rice straw (700LE/ton), malate salt (72LE/kg), Amaferm® (63.82LE/kg) and price of raw milk (7% FCM) was 10LE/kg, also net revenue (LE/h/d) was determined.

Statistical analysis:

Analysis of variance for the obtained data was performed by using procedures of General Linear Model (GLM) (SAS, 2002) and one-way design was used to test the significant group's differences according to model:

Observed values (Yij) = overall mean (µ) + treatments group (Ti) + random error (eij); based on ($P<0.05$) for all statements significance using Duncan multiple range test within the computer program.

RESULTS AND DISCUSSION

Dry matter intake

Data in table (2) showed that feed intake as DM, TDN and DCP (kg/h/d) of control and treated groups had no significant differences among groups during pre and post-partum period (lactation period). However supplemented rations increases (P<0.05) in rice straw intake during post-partum period when compared with the control group diet, being higher (P<005) for AO than MS group as related to similar fed CFM and berssem hay. Despite of, no milk production at the last trimester of pregnancy (late- pregnancy LP), there are reduction of dry matter intake (DMI) which reaches the lowest level of food intake at calving as a result to the grows enormously fetus and exerting pressure on the rumen that sending a negative signals before calving to balance energy from hypothalamus or due to decreased plasma estradiol concentration with the parturition approaches that reduces of dry matter intake (Grummer, 1995). DM intake decreased by 30% during the transition period (Bertics *et al*., 1992). Moreover, Osorio *et al*., (2014) suggested that much effective when fed dairy animals on malate as feed additive during the transition stress. Caton *et al.* (1993) showed that steers grazing cool-season grasses via the rumen cannula on AO was increased intake responses by 26%. In contrast, some authors observed that fed malate supplementation had no effect of lactating cows DMI, (Wang *et al*., 2009), growing fattening lambs (Mungoi *et al*., 2012), or growing lambs fed high-concentrate with 4 g/day of malate (Malekkhahi *et al*., 2015). Also, AO supplementation had no effect on feed consumption of Holstein cows in either early or mid-lactation (Gomez-Alarcon *et al*., 1990; Sievert and Shaver, 1993).

Table 2. Average feed intake of buffalo dams fed supplemented rations during late- pregnancy and post-partum period.

Item	Experimental groups			SEM
	Control	AO	MS	
Average dry matter intake during late- pregnancy period (LP) (kg /h/d):				
CFM	4.90	4.90	4.90	-
RS	1.70	1.78	1.74	0.03
BH	2.30	2.30	2.30	-
Total DMI	8.90	8.98	8.94	0.08
Total DMI as (% of LBW)	1.914	1.916	1.947	0.11
Total TDNI	5.567	5.617	5.592	0.07
Total DCPI	0.728	0.734	0.731	0.05
Average dry matter intake during post-partum period (PP) (kg /h/d):				
CFM	5.35	5.35	5.35	-
RS	1.73^{c}	1.96^{a}	1.83^{b}	0.02
BH	2.83	2.83	2.83	-
Total DMI	9.91	10.14	10.01	0.06
Total DMI as (% of LBW)	2.254	2.286	2.273	0.13
Total TDNI	6.198	6.342	6.261	0.12
Total DCPI	0.811	0.830	0.819	0.04

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

Nutrient digestibility and feeding values

Data in Table 3 showed that treated animal groups enhance the most nutrient digestibility coefficients and nutritive values of buffalo cows, DM and OM digestibility coefficient increased (P<0.05) in AO ration group by 2.09% and 2.75% respectively, also, CF digestion coefficients enhanced (P<0.05) in AO and MS treated rations by 13.35% and 6.84% respectively, as compared to the control. MS supplemented group recorded the highest values in nutritive values as TDN, DCP% and DE followed by AO group while; the control ration recorded the lowest values. Numerous studies showed that addition of malate improved nutrient digestibility coefficients in ruminants fed low quality roughage (Carro *et al*., 2006; Sniffen *et al*., 2006; and Lui *et al*., 2009). In this context, Carrasco *et al*., (2012) reported that ruminants fed malate as add to concentrate with low quality roughage improved feed intake and efficiency of digestibility. The negative effect of pre-partum nutrient restriction is followed by partially increased effective in post-partum nutrient intake (Lalman *et al*., 1997). AO, as the fungal probiotics, enhanced DMI performance by increases diet palatability and intake-driven characteristics (Wallace and Newbold, 1995) or due to improve fiber degradation rate in the rumen by stimulation fermentation modifying and ruminal bacterial, protozoal, fungal growth, and lactic acid metabolism which stabilized ruminal pH and decreased gut fill (Chiou *et al*., 2000). Also, Hutjens, (2008) reported improving the digestibility and DMI as related to AO fibrolytic enzyme activities

Table 3. Nutrient digestibility coefficients and nutritive values of buffalo dams fed supplemented rations

Items	Experimental treatments			SEM
	control	AO	MS	
Digestibility coefficients, %				
DM	70.89^{b}	72.37^{a}	71.93^{b}	0.52
OM	69.52^{b}	71.43^{a}	70.02^{b}	0.50
CP	71.11^{b}	73.16^{a}	73.93^{a}	0.49
CF	59.40^{c}	67.33^{a}	63.46^{b}	0.54
EE	68.45	70.89	72.35	0.39
NFE	71.71^{b}	73.50^{a}	73.91^{a}	0.44
Feeding values %				
TDN%	66.37^{b}	67.44^{ab}	67.96^{a}	0.43
DCP%	10.89^{c}	11.13^{b}	11.25^{a}	0.06
*DE kcal/Kg DMI	2.926	2.973	2.984	0.03

a,b,c Means Value in the same row with different superscripts differ significantly (P<0.05), *DE (Mcal / Kg DMI) = 0.04409 x TDN% . NRC (1988). TDN: (total digestible nutrients); DCP: (digestible crude protein)

Khampa and Wanapat, (2006) reported that calves fed malate improved carbohydrates digestion and VFA production due to increased microbial population flora (amilolytic and cellulolytic). Also, AO treatment in non-lactating dairy cows increased DM digestibility and fiber digestion with improving cellulolytic ruminal bacteria and energy availability as subsequence of high density nutrient as well as extra cellular enzymes secretion stimulation of gut micro flora (Gomez-Alarcon *et al*., 1990; Wang *et al*., (2009). In contrast, malate salt additive had no effect on total digestibility tract (Khampa and Wanapat, (2006), in dairy steers (Malekkhahi *et al*., (2015) growing lambs. and fattening lambs (Mungoi *et al.* (2012). Similarly, addition of AO had no positive effects on digestibility of heifers was observed b (Sievert and Shaver, 1993) or dry Holstein cows fed on 2.63 g/d *Aspergillus oryza* (Wiedmeier *et al*., 1987). While, Martin and Nisbet, (1990) found that addition of 1.0g/L AO decreased the NDF and ADF digestibility by 6.1 and 5.4%, respectively.

Activities of rumen fermentation

Feeding ruminal fermentation activities at 3 hours post-morning feeding are presented in Table 4. Concentration of TVFA in rumen increased (P<0.05) in MS and AO supplemented groups compared with control. Moreover, supplemented rations insignificantly decreased ruminal pH values and insignificantly increased NH3-N concentration. Similar results were reported by several authors (Martin, 2004; Gomez *et al*., 2005; Carro *et al*., 2006; Lui *et al*., 2009). Khampa and Wanapat (2006) found increased volatile fatty acids production when malate was given as extra energy in dairy cows. Martin (2004) showed that addition of malate increased ruminal pH value *in vitro* due to increased *lactate* utilization by *S. ruminantium* bacterium and CO_2 production. Also, Carrasco *et al*. (2012) showed higher ruminal NH3-N concentrations in heifers fed malate salt.

Table 4. Activity of ruminal fermentation for experimental ration.

Item *	Experimental rations			SEM
	Control	AO	MS	
TVFA's (meq/100 ml)	17.36^c	18.12^b	21.52^a	0.04
pH value	6.80	6.76	6.65	0.15
NH3-N (mg/100 ml)	20.01	19.78	21.70	0.09

a,b,c Means Value in the same row with different superscripts differ significantly (P<0.05).

In the same way, Chiquette (2009) reported that AO prevents the decline in rumen pH in fed sub-acute ruminal. Martin and Nisbet, (1990) demonstrated that AO added to the diet increased ruminal TVFA and NH3 production, however, acetate: propionate ratio decreased with no change in final pH value or the other products of fermentation as related to increased lactate utilization by *S. ruminantium* bacterium. Latif *et al*., (2014) found that TVFA concentration and acetic acid increased with adding AO with improving stimulated fermentation products inhibitory effect on digestion and providing growth factors for cellulolytic ruminal bacteria. Frumholtz *et al*. (1989) observed that 30% over increased in NH3 concentrations due to increased proteolytic activity endogenous and butyrate production when AO was mixed to ruminal microbes in vitro. In contrast to our results, AO feed additives appeared a slight increase in rumen pH value (Fiems *et al*., 1993), Carrasco *et al*., (2012) reported that cattle and lambs fed on malate salts has no change in TVFA concentration. Also, Malekkhahi *et al*. (2015) found that pH value, NH3-N concentration, total VFA, acetate: propionate ratio and the molar proportions of acetate, butyrate, valerate in the rumen fluid was not affected by fed lamb with 4 g/day malate diet addition

Milk production (Milk yield)

Data in Table 5 and Fig 1 revealed that treated groups increased (P<0.05) milk production and fat corrected milk yield (7% FCM) compared with control. Malate group showed lower actual and fat corrected milk yields (4.00 and 14.91) than AO group (6.24 and 7.28 %), respectively compared with the control (0.00). Increasing milk yield in AO group might be due to increase DMI and rumen performance by improvement nutrients digestibility rate especial fiber digestion (Sniffen *et al*., 2006), or increasing microbial production efficiency, and decreasing methane production in the rumen (Khampa and Wanapat, 2006).

Figure 1 show that lactating buffalo cows fed malate had the highest peak of lactation curve (11.5 kg) during the 5th and 6th weeks of milking period followed by AO group (9.6 kg), however, the control fed ration observed the lowest one by (9.2 kg). The AO group had the greatest milk production persistency of lactation period so; the milk production beginning to increase in the 45th to 90th days of lactation and then kept increase until the 10th weeks while, the control group was sharply declined even production period ended. Gomez-Alarcon *et al*., (1990) found that fed cows on 3 g AO increased daily milk yield production. Wallace and Newbold, (1995) reported that cattle fed on AO increased in milk yield production by 4.3% compeer with control during early lactation. Hutjens, (2008) reported that improved in milk production, nutrients digestibility and DMI as related to improved ruminal fibrolytic enzyme activities when, fed dairy cattle on AO. Similarly, results were found when fed dairy cattle on malate (Kung, *et al*., 1982; Devant, and Bach, 2004; Sniffen *et al*., 2006; Wang *et al*., 2009). Hayat *et al*., (2009) found that milk yield and lactation persistence curve increased in dairy cows fed malate due to increase ruminal microbial production. On the other hand, Higginbotham *et al*. (1993) reported that add AO to Holstein cow's diet in mid-lactation was not affected in milk production, FCM yield, persistency of milk yield and milk fat. Also, Campanile *et al*. (2004) reported that fed high producing buffaloes on AO as supplementation was not affected milk quantity and quality.

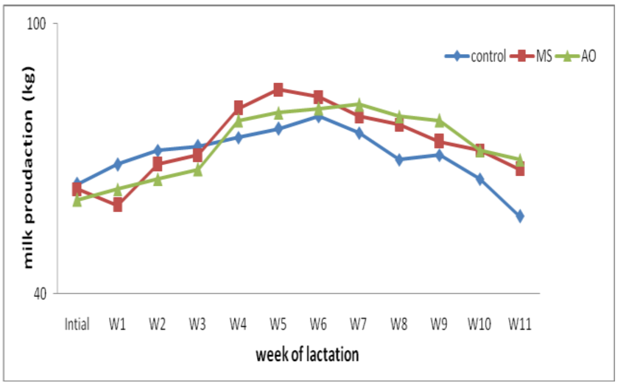

Figure 1. Weekly milk yield of buffalo cows in the experimental groups during lactation period of 11 weeks.

Table 5. Average milk yield and milk composition for experimental treatments of lactating buffalo cows.

Item	Control	AO	MS	SEM
milk yield, kg / day	8.50^c	9.03^a	8.84^b	0.16
milk improvement %:	100.00	106.24	104.00	1.00
7% FCM, kg / day	8.17^c	8.76^b	9.39^a	0.23
7% FCM improvement %:	100.00	107.28	114.91	8.54
Milk composition (%)				
Fat, %	6.63	6.72	7.59	0.21
Fat yield (kg)	0.56^c	0.61^b	0.67^a	0.12
Protein, %	4.18	4.14	4.34	0.25
Protein yield (kg)	0.36^c	0.37^b	0.38^b	0.09
Lactose, %	3.79	3.76	3.99	0.21
Lactose yield (kg)	0.32^c	0.34^b	0.35^a	0.05
Solid not Fat (SNF), %	8.69	8.57	9.04	0.31
SNF yield (kg)	0.74	0.77	0.80	0.12
Total solids (TS), %	15.32	15.29	16.63	0.54
T.S yield (kg)	1.30	1.38	1.47	0.23
Ash, %	0.72	0. 67	0.71	0.02
Urea (mg %)	17.02	16.76	16.94	0.48
Milk energy (kcal / kg milk)	1053.84	1064.22	1164.53	35.69

a,b,c Means Value in the same row with different superscripts differ significantly (P<0.05).

Milk composition

Table 5 showed that the daily milk yield (kg / day), yields of fat, protein, and lactose were higher (P<0.05) in treated groups than in the control one. Meanwhile, there were non-significant effects on milk composition percent, SNF yield, T.S yield, milk energy (kcal / kg milk), and milk urea content (mg %). The results agreed with, (Manston and Allen, 1981; Waterman *et al*., 2006; Wang *et al*., 2009). Similarly, Chiou *et al*. (2000) found that increased significantly in milk protein yield and milk fat while, total milk solids percent decreased with AO supplementation in lactation diet as related to hence cellulose digesting and bacteria growth. Similar, Rogers and Withman, (1991) suggested that malate salt increased rumen energy extraction efficiency due to increase microorganisms growth and enhancing organic acids convert into propionate. Wang *et al.* (2009) found non-significantly increases milk-fat percent in malate treated group dairy cows due to high close relation between ruminal VFA's proportion (acetate: propionate ratio) and milk fat percent. On the other hand, Croom *et al*., (1981) reported that the high proportions of propionic acid in the rumen VFA's with high concentrate diet associates with the depression of milk fat percent.

Also, fed dairy cows on high concentrate diet with malate case a slight increase in milk fat percent as related to increases ruminal propionic and acetic acid reported by (Kung *et al*., 1982; Sievert and Shaver, (1993); Martin *et al*., 2000). In present study, milk protein yield was significantly increased in malate treated group this may be related to higher propionic acid production, as glucose precursor and amino acids spare for milk protein synthesis (Devant, and Bach, 2004). El-Malky (2007) reported that reduction in plasma glucose level during late pregnancy in Egyptian buffaloes then increased gradually in 3 months after parturition as indicated to heavy energy demand in late gestation and early lactation especially glucose as a main energy source. On contracts, Kung *et al*. (1982) and Hayat *et al*. (2009) found that add malate in early lactating Egyptian buffaloes increased significantly milk protein, lactose and solid not fat percent without affect on milk fat percentage and total solid percentage. Also, cows fed AO in early and mid-lactation had no improvement in milk fat and milk protein contents was observed by Gomez-Alarcon *et al*. (1990) and Denigan *et al*. (1992)

Feed efficiency

Results in Table 6: showed feed efficiency was slightly higher in supplemented groups than control as produced (7% FCM) per kg DM or kg TDNI and kg DCP). This may be attributed to enhancement of animal performances (nutrients digestibility, DM intake, activity of rumen fermentation and higher milk yield. Carrasco *et al*., (2012) observed that there was improvement in feed intake and feed efficiency ruminants by add malate to concentrate.

Economic evaluation:

Data of economic efficiency are presented in Table (6). The cost of feed to produced one kg milk as (7% FCM) decreased with supplementation of MS and AO by 11.5 and 4.29%, respectively. As well as net revenue of malate salt and AO groups increased by 28.85 and 11.98% respectively, in comparison with the control ration. Also, 1 LE cost of AO and MS supplementation improved in milk yield income by 4.62 and 13.33 LE respectively. These results agreed with Hutjens, (2008) who reported that adding AO to dairy cows benefit to cost ratio as well as reduced acidosis risk, laminitis, bloat, etc. so that the most beneficial were under stressful conditions On the other hand, Martin, 2004 showed that ruminants fed malate as a feed additive diets not economically feasible.

Table 6. Feed efficiency and economic efficiency for lactating buffalo's dams fed different experimental treatments

Item	Experimental treatments			SEM
	Control	AO	MS	
7% FCM Yield (kg /day)	8.17^{c}	8.76^{b}	9.39^{a}	0.23
Feed conversion (ratio):				
DM kg/ (kg FCM)	1.213	1.158	1.066	0.02
TDN kg/ (kg FCM)	0.681	0.641	0.596	0.03
DCP g/ (kg FCM)	89.11	83.79	77.85	1.56
Feed efficiency:				
7% FCM / kg DMI	0.824	1.031	0.938	0.07
7% FCM / kg TDNI	1.468	1.560	1.679	0.06
7% FCM / kg DCPI	11.223	11.935	12.845	0.10
Economic efficiency:				
Milk price LE/day (total revenue	81.7	87.6	93.9	2.50
Feed cost LE/day	41.80	42.92	42.49	0.38
Feed cost LE/kg 7%FCM	5.12^{c}	4.90^{b}	4.53^{b}	0.04
Net revenue LE/day	39.90^{c}	44.68^{b}	51.41^{a}	1.22
Net revenue improvement %	100	111.98	128.85	8.98
Economic efficiency **	1.95^{c}	2.04^{b}	2.21^{a}	0.02
Improvement%	00	4.62	13.33	6.43

a, b, c: Values in the same row with different superscripts differ significantly (P<0.05).

CONCLUSION

It can be concluded that, feeding multiparous Egyptian buffaloes during transition period with 10 g/ head /day malate an extra energy or 15 g/ head /day AO in the diet improved feed consumption, nutrients digestibility and rumen metabolism by beneficial ruminal fermentation activities of the host animal and increases microbial protein production and TVFA's. Then the energy balance has a beneficial stimulation effect that increases milk yield production and persistence of the lactation curve, also, milk composition enhancement, feed conversion ratio and economic efficiency. Also, AO apparently had the greatest effect during the early stages of lactation cycle and subsequent milk production increasing due to higher initial production, which was reflected to increased persistency and economic efficiency evaluation.

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الاداء الانتاجى لاناث الجاموس الحلاب عند اضافة مستخلص فطر الأسبراجلس وملح المالات خلال المرحلة الانتقالية

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الملخص

استخدمت الدراسة لتقيم اضافة مستخلص الاسبرجلس وملح المالات على الكفاءة الانتاجية للجاموس المصري الحلاب خلال المرحلة الانتقالية. استخدام 15 جاموسة عشر بمتوسط وزن 446,92 + 26,54 وقبل الولادة بشهرين واستمرت بعد الولادة بثلاثة أشهر، قسمت الحيوانات عشوائيا لثلاثة مجاميع تجريبية تبعا لوزن الجسم والموسم وتغذت على (العليقة اساسية) مركزات ودريس البرسيم وقش الارز وغذى الكونترول بدون اضافات وغذيت مجموعة الاسبرجلس بإضافة 15جم/راس/يوم من مستخلص الاسبرجلس (التجاري) وغذيت مجموعة المالات بإضافة 10جم/راس/يوم ملح المالات. وجد ان إضافة الاسبرجلس للجاموس خلال المرحلة الانتقالية قد زاد من كفاءة هضم المادة الجافة والعضوية وهضم الالياف وهضم المادة الكلية وتحسين البروتين الخام المهضوم والطاقة المهضومة الكلية ومجموع تركيز الاحماض الدهنية الطيارة بالكرش (بعد الاكل) للإضافات بالمقارنة بالكونترول الا ان تركيز الاحماض والنتروجين بالكرش لم يظهرا أي اختلافات بين المجاميع كذلك لم يظهر الغذاء المأكول اختلافات معنوية بين المعاملات والمقارنة قبل الولادة وبعدها اما قش الارز المأكول فقد تحسن بالإضافات بالمقارنة بالكونترول. كما حسنت الاضافات من الانتاجية الكلية والمعدلة ل7% دهن و مكونات اللبن وكانت المالات اكثرهم انتاجا للبن ثم الاسبرجلس واقلهم الكونترول اما اضافة الاسبرجلس فزادت المثابرة لإنتاجية اللبن يليها الاسبرجلس ومع ذلك فالإضافات لم تظهرا اختلافات لنسب المكونات او الطاقة او اليوريا باللبن او الكفاءة التحويلية للغذاء. وكانت الاضافات اعلى قيمة للعائد الاقتصادي واقل التكاليف واعلى صافي للعائد لتكلفة الغذاء وانتاج اللبن. مما سبق يتضح ان استخدام مستخلص الاسبرجلس وملح المالات كإضافات خلال مرحلة الحمل الاخيرة وبعد الولادة قد حسن من بيئة الكرش وزيادة قدرة الميكروفلورا على تكسير جدر الخلايا بالغذاء وتحسين القيم الهضمية والغذائية للعلف وبالتالي تحسين الكفاءة الانتاجية والاقتصادية للجاموس.