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EFFECT OF SUPPLEMENTING RATIONS WITH BUFFERS ON THE YIELD, COMPOSITION AND PHYSICAL PROPERTIES OF BUFFALOES MILK DURING LACTATION PERIOD

M.A. El-Ashry[1], S.M. Hamdy[1], H.A. El-Alamy[2] and A.M. Kholif[2]

1- Department of Animal Production, Faculty of Agriculture, University of Ain Shams, Cairo, Egypt, 2- Food Technology and Dairy Scince Department, National Research Centre, Giza, Egypt

SUMMARY

Twenty nine lactating buffaloes were used to assess the effect of supplementing diets with buffers on milk yield, milk composition and physical properties of milk. Animals were fed diets of 15% berseem hay, 15% rice straw and 70% concentrate feed mixture according to their nutritional requirements for energy and protein. The animals were grouped in four feeding treatments namely (I) control, (II) control + 1.5% $NaHCO_3$, (III) control + 2% dolomite and (IV) control + 3% calcium bentonite. The study was started at the end of the first week of lactation and extended to the 39th week .

Sodium bicarbonate significantly ($P<0.05$) increased milk fat content , milk pH and animal body weight, and decreased solids-not-fat, total protein, acidity and specific gravity contents of milk than control treatment. Dolomite treatment compared with control, significantly increased milk yield , F.C.M. yield and animal body weight, and decreased specific gravity of milk ($P<0.05$). Bentonite treatment significantly decreased total protein, acidity and specific gravity contents of milk and animal body weight.

The buffer treatments significantly ($P<0.05$) decreased zinc content of milk than control treatment. Milk contents of total phosphorus, sodium, potassium, magnesium, copper, iron and manganese were similar among treatments. Sodium bicarbonate supplementation increased milk calcium content than bentonite treatment .

Lactation period had a significant effect on milk yield, milk composition and animal body weight ($P<0.0001$) except total phosphorus, calcium and iron contents. There was an interaction (treatment x weeks of lactation) with milk pH, acidity, calcium, sodium, potassium, magnesium and copper contents and animal body weight .

Keywords: Buffalo, ration, buffer supplimentation, milk

INTRODUCTION

The addition of buffers to dairy rations are being advocated to reduce the negative

effects of high concentrate diets, during the last three decades. Sodium bicarbonate increased milk yield and its fat content (Erdman *et al.*, 1980, Rogers *et al.*, 1985, Coppock *et al.*, 1986 and Woodford and Murphy, 1988 with dairy cows). However, Kertez *et al.* (1977), reported that milk yield declined by supplementing cows diets with 2% dolomite. Brings and Schultz (1969), Rindsig and Schultz (1970), Fisher and Mackay, (1983) and Zalewska *et al.* (1985) reported that milk yield and its fat content were increased when they supplemented dairy cows diets with bentonite. Fettman *et al.* (1984) revealed that $NaHCO_3$ addition decreased milk sodium and potassium contents from 16.0 and 39.4 mg/liter to 14.9 and 38.6 mg/liter, respectively .

This experiment was conducted to compare the effectiveness of supplementing lactating buffaloes diets with sodium bicarbonate, dolomite or bentonite on the yield, composition and properties of milk during the first 39 weeks of lactation period .

MATERIALS AND METHODS

Twenty nine lactating buffaloes in the first week of lactation were blocked in groups of four by their weight and milk yield in the preceding lactation and assigned randomly to four dietary treatments in a 39-weeks feeding trial. They were selected from the buffaloes herd of Milk Replacer Research Center, Fac. of Agric., Ain Shams Univ. Mean body weights of animals in groups I, II, III and IV were 570, 589, 577, and 566 kg. respectively. Treatments were: (I) No supplemental buffers (7 animals), (II) 1.5% sodium bicarbonate (8 animals), (III) 2% dolomite (7 animals) and (IV) 3% bentonite (7 animals). The intended ratio of roughage to concentrate was 30:70. Berseem hay and rice straw (1:1) were used as a source of roughage, while concentrate feed mixture (CFM) used as the concentrate source (Table1). The offered feeds (twice daily) were assesed to cover the maintenance as well as the production requirements for each animal from strach value and digestable protein (Abou-Raya, 1967). The animals were drinked water (ad libitum) twice daily ; which contains (in mg/liter) Mn, 0.05; Fe,0.12; Zn, 0.82; Cu,0.02; K,6.43; Mg,7.46; Na,25.18 & Ca, 40.0.

Sampling and analysis of milk :

The animals were machine milked twice daily and milk yield was recorded. The animals were weighted and milk samples were collected once every two weeks for 15 weeks, then every four weeks till the end of lactation period.

The pH and acidity of milk were determined immediately after milking (Ling, 1963). Comosite samples (morning and evening) were analysed for milk fat, total solids, solids-not-fat, total protein and ash contents (Ling, 1963) and lactose content (Barnett and Tawab, 1957). The sodium, potassium, magnesium, calcium, iron, manganese, zinc and copper in milk samples were determined in the ash according to Jackson (1958) by using Atomic. Absorption Spectrophotometer (IL-S-12), while total phosphorus content was determined according to Troug and Meyer (1939).

The statistical analysis system (SAS) of Damon and Harvey, 1987, was used for least square of variance for repeated measures of milk weight, animal weight, milk composition and physical properties of milk. The model was:

$Y_{ijk} = \mu + T_i + e_{ik} + A_j + (TA)_{ij} + E_{ijk}'$

where μ represented the mean, T treatment, A week of lactation , T x A treatment by week of lactation interaction , e_{iik} error T which is animal within treatment, E_{ijk} residual term. The Tukey procedure (HSD test) was used to test the significant between treatments means at 5% level.

Table 1. Average chemical composition of experimental rations(Fresh matter basis)

Items	CFM	BH	RS	$NaHCO_3$	Dolomite	Bentonite
Moisture%	9.48	11.13	8.68	-	-	-
Dry matter %	90.52	88.87	91.32	-	-	-
Ash %	9.07	11.82	17.83	-	-	-
Organic matter %	81.45	77.05	73.50	-	-	-
Crude protein %	16.92	13.72	2.94	-	-	-
Ether extract %	4.28	2.37	1.94	-	-	-
Crude fiber %	12.17	29.68	31.22	-	-	-
Nitrogen-free-extract%	48.08	31.28	37.40	-	-	-
Minerals :						
P %	0.59	0.16	0.07	0.02	0.02	0.09
Ca %	0.57	1.68	0.75	1.12	17.80	4.00
Na %	0.21	0.63	0.24	27.00	0.21	0.40
K %	1.33	1.78	0.29	0.52	0.67	0.82
Mg %	0.60	0.41	0.04	0.08	11.95	9.00
Zn (mg/kg)	19.00	21.00	11.00	52.00	23.00	20.00
Cu (mg/kg)	8.00	16.00	10.00	15.00	5.00	17.00
Fe %	0.012	0.022	0.006	0.023	0.042	14.00
Mn (mg/kg)	74.00	30.00	11.00	29.00	56.00	19.00
Starch Value**	54.10	28.50	23.00	-	-	-
Digestible protein**	10.20	8.60	0.00	-	-	-
Milk value**	58.90	32.40	23.00	-	-	-

* Average of 5 samples for each ingredient .
** These values are calculated using the nutrient digestibilities of Abou-Raya, (1967).

RESULTS AND DISCUSSION

Data on milk yield, animal body weight, milk composition and physical properties of buffaloes'milk are presented in Table (2). Milk yield and 4% F.C.M. yield were significantly ($P>0.05$) higher with dolomite supplementation than with other treatments. Sodium bicarbonte and bentonite supplementations, also, increased the yields of milk and F.C.M. than control treatments, but these increases were insignificant. Many published reportes indicated that milk yield increased with supplemmenting dairy cows' rations with 1.2 to 2.0% $NaHCO_3$ (Erdman *el al.*, 1980, Rogers *et al.*, 1985, Coppock *et al.*, 1986, and Woodford and Murphy, 1988) or with bentonite (Brins and Schultz, 1969, Rindsig and Schultz, 1970, Fisher and Mackay, 1983, Moate *et al.*, 1985 and Zalewska *et al.*, 1985) due to increasing feed intake. Contrary to these results, Rogers *et al.* (1982); DePeters *et al.* (1984) and Vicini *et al.* (1988) (with $NaHCO_3$); and Kertz *et al.* 1977 (with dolomite) reported that milk yield declined when cows fed on the diet with 1.0-2.0% $NaHCO_3$ or 2.0% dolomite. However, Wheeler and Noller (1976) noted that dolomitic limestone buffer increased diet effeciency by improving the utilization of starch in the small intestine with a

decline in the loss of energy as starch in faeces .

Table 2. Effect of supplementing rations with buffers on animal weight, milk yield, milk composition and some physical properties of buffaloes'milk, during 39 weeks of lactation period*

Component	Means of treatments			
	Control	$NaHCO_3$	Dolomite	Bentonite
No. of Samples	80	92	85	85
Animal weight (kg) (Ave.)	579.78^{b}	597.71^{a}	581.79^{a}	571.46^{c}
Milk yield (kg/day)	5.71^{b}	5.84^{b}	6.54^{a}	6.24^{b}
4% Fat-corrected milk (Kg/day)	8.30^{b}	8.68^{b}	9.60^{a}	8.84^{b}
Fat %	7.16^{b}	7.46^{a}	7.16^{b}	7.04^{b}
Total solids %	17.20^{ab}	17.30^{a}	17.20^{ab}	16.97^{b}
Solids - not - fat %	10.04^{a}	9.83^{b}	10.01^{ab}	9.95^{ab}
Total protein %	3.94^{a}	3.75^{b}	3.82^{ab}	3.68^{b}
Lactose %	4.99	4.97	5.07	5.11
Ash %	0.95	0.95	0.97	0.96
Acidity %	0.22^{a}	0.21^{b}	0.22^{a}	0.20^{b}
pH value	6.68^{b}	6.71^{a}	6.69^{ab}	6.71^{a}
Specific gravity (at 60°F)	1.03^{a}	1.03^{bc}	1.03^{b}	1.03^{a}
Macro elements (mg/100 ml) :				
P	94	97	95	100
Ca	187^{ab}	196^{a}	189^{ab}	186^{b}
Na	57	60	57	56
K	167	167	165	162
Mg	16	16	15	16
Micro elements (mg/liter) :				
Zn	6.00^{a}	5.29^{b}	5.39^{b}	5.16^{b}
Cu	0.37	0.42	0.36	0.36
Fe	1.29	1.43	1.21	1.21
Mn	0.29	0.26	0.29	0.27

Different superscripts; at the same raw, means significant differences ($P< 0.05$, a, b and c)

The live body weight was significantly higher ($P<0.05$) with $NaHCO_3$ or dolomite supplementation than for control, which revealed a higher weight than bentonite supplementation, while changes in live body weight , at the end of lactation for treatments I, II, III, and IV, were 17.4, 17.7, 19.5, and 25.2 g/100 kg live body weight, respectively. These results agreed with those reported for cows fed diet with $NaHCO_3$ (Donker and Marx, 1980, Erdman *et al.*, 1980 and Edward and Poole, 1983) or with bentonite (Rindsig and Schultz, 1970).

Milk fat content from the animals fed bicarbonate was higher than those for all treatments ($P<0.05$), however, dolomite or bentonite supplementations did not affect milk fat content . Some workers have reported increasing in milk fat content with $NaHCO_3$ addition to dairy cow diets (Erdmen *et al.*, 1982a; Rogers *et al.*, 1982 and Zhelev *et al.*, 1984) or with bentonite addition (Brings and Schultz, 1969, Rindsig *et*

al., 1969 and Rindsig and Schultz, 1970). However, Kertz *et al.* (1977), reported no changes in milk fat content with dolomite addition to cows' diets.

Sodium bicarbonate group showed the highest total solids content of milk, while control group showed the highest solids-not-fat and total protein contents of milk ($P<0.05$).

These results agreed with those of Coppock *et al.* (1982 a&b); DePeters *et al.* (1984), Vicini *et al.* (1988), however, Coppock *et al.* (1986) and West *et al.* (1986), showed an increase in milk total protein content when cows fed the diet with 1.5% $NaHCO_3$. Fisher and Mackay (1983) reported a decrease in milk total protein conten with bentonite addition to cow diets.

Milk lactose and ash contents did not affected with buffer supplementation to the diet, but slightly increased ($P<0.05$) with dolomite and bentonite supplementation . These results are in accordance with those reported by Okeke *et al.* (1983) and Boisclair *et al.* (1986) (with $NaHCO_3$) and Fisher and Kackay (1983) (with bentonite) for lactose and Hadjipanayiotou (1982), (with $NaHCO_3$) for ash content of milk .

The buffer supplementation, generally, increased milk pH and decreased the acidity and specific gravity of milk ($P<0.05$). Lachmann (1979) and Lachmann *et al.* (1982) concluded that the addition of $NaHCO_3$ to diet decreased significantly the titeratable acidity in milk .

Milk zinc content was significantly ($P<0.05$) higher with control treatment than with buffer treatments. Also, $NaHCO_3$ supplementation increased milk Ca content than bentonite supplementation ($P<0.05$). Milk P, Na, K, Mg, Cu, Fe and Mn contents were not affected significantly by treatment. Fettman *et al.* (1984), found that milk Na and K were not affected when they fed Holestein cows diet without or with 0.7% $NaHCO_3$. The reasons of decreasing Zn content of buffaloes milk with buffer supplementation diets than control diet and increasing milk Ca content with $NaHCO_3$ than bentonite supplementation diet are not clear .

Lactation period had a significant effect on milk yield, F.C.M., animal body weight, milk general composition and physical properties of milk ($P<0.0001$); Na ($P=0.0069$), K ($P=0.0881$), Mg ($P=0.0001$), Cu ($P=0.0734$), Zn ($P=0.0258$) and Mn ($P=0.0370$), while milk P, Ca and Fe did not differ significantly during lactation period. Abd El-Salam and El-Shibiny (1966), found that total P of buffaloes'milk fluctuated throughout lactation and appeared to exhibit no definite trend, while milk Ca, Mg, Na and K were generally affected by lactation period. Also, Dilanyan and Alsanyan (1967) showed that Fe, Mg, Cu, and Mn contents of buffaloes milk were generally high during the first month of lactation, followed by a tendency to decrease with advancing lactation and increased somewhat towards the end of lactation. There were interactions (treatment x weeks of lactation) with milk pH ($P=0.06$), acidity percent ($P=0.02$), animal body weight ($P=0.1$) Ca ($P=0.085$), Na) $P= 0.038$, K ($P=0.048$), Mg ($P=0.029$) and Cu ($P=0.085$), but not with P, Zn, Fe and Mn contents of buffaloes' milk.

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تأثير تدعيم العلائق بالمنظمات على إنتاج اللبن الجاموسى وتركيبة والخواص الطبيعية له خلال موسم الحليب

محمد عبد المنعم العشرى[1] - سلوى محمود حمدى[1] - حمزة على العلمى[2] - عبدالقادر محمود خليف[2]

١- قسم الإنتاج الحيوانى، كلية الزراعة، جامعة عين شمس، شبرا الخيمة، القاهرة. ٢- قسم الصناعات الغذائية والألبان، المركز القومى للبحوث، الدقى، القاهرة.

أستخدم فى هذه الدراسة ٢٩ جاموسة حلابة أنتخبت من قطيع الجاموس بمركز بديلات اللبن - كلية الزراعة - جامعة عين شمس، كانت تغذى على علائق تحتوى على ١٥٪ قش أرز و٧٠٪ علف مركز تبعا لإحتياجاتها من الطاقة والبروتين . وقد قسمت هذه الحيوانات الى أربعة مجموعات كما يلى :-

(١) الكونترول ، (٢) الكونترول + ١,٥٪ من العليقة بيكربونات صوديوم، (٣) الكونترول + ٢٪ دولوميت، (٤) الكونترول + ٣٪ كالسيوم بنتونيت . وقد بدأت الدراسة من نهاية الأسبوع الأول وحتى الأسبوع ٣٩ من موسم الحليب.

وكانت النتائج كما يلى :-

- أدت إضافة بيكربونات الصوديوم الى العليقة الى زيادة معنوية (على مستوى ٥٪) فى دهن البنودرجة الـ pH للبن ووزن الحيوان وفى نفس الوقت أنخفضت نسبة الجوامد اللادهنية والبروتين والحموضة والوزن النوعى للبن عنها فى مجموعة المقارنة (الكونترول) كما أدت إضافة الدولوميت الى حدوث زيادة معنوية (على مستوى ٥٪) فى كمية اللبن واللبن المعدل والدهن ووزن الحيوان مع إنخفاض فى الوزن النوعى بالمقارنة مع مجموعة الكونترول ، أما إضافة البنتونيت فقد خفضت نسبة البروتين والحموضة والوزن النوعى فى اللبن ووزن الحيوان بمعنوية عنها فى مجموعة الكونترول .

- أدت إضافة المواد المنظمة الى العليقة الى إنخفاض محتوى الزنك فى اللبن بمعنوية (على مستوى ٥٪) عنه فى مجموعة الكونترول ، أما محتوى اللبن من الفوسفور والصوديوم والبوتاسيوم والماغنسيوم والنحاس والحديد والمنجنيز فقد كان متشابها مع جميع

المعاملات ، وقد أدت إضافة بيكربونات الصوديوم الى العليقة الى زيادة محتوى اللبن من الكالسيوم عنها فى حالة إضافة البنتونيت الى العليقة .

- قد كان للوقت من موسم الحليب تأثير معنوى على إنتاج اللبن وتركيبه (على مستوى ٠,٠٠٠١) وكذلك على وزن الحيوان فيما عدا محتوى اللبن من الفوسفور والكالسيوم والحديد . وقد كان هناك تداخل بين المعاملة والأسبوع من موسم الحليب فى حالة درجة الـ (pH) والكالسيوم والصوديوم والبوتاسيوم والماغنسيوم والنحاس فى اللبن، وكذلك فى حالة وزن الحيوان الحى.

وفى النهاية ينصح بإضافة الدولوميت بنسبة ٢٪ الى عليقة الجاموس الحلاب لأنها تؤدى الى زيادة كبيرة فى إنتاج اللبن تصل الى ١٥٪ من الإنتاج اليومى.