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INFLUENCE OF MONENSIN ON BLOOD METABOLITE AND REPRODUCTIVE PERFORMANCE OF SUCKLED BUFFALO-COWS

(With 7 Tables)

By

M.A.HEGAZY

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تأثيرمونننزين على معلميات التمثيل الغذائى بالدم والكفاءة التناسلية فى الجاموس المرضع

محمد حجازى

أجريت هذه الدراسه لمعرفة تأثير أضافة المونننزين الى الغذاء على بعض معلميّات التمثيل الغذائى فى الدم والكفاءة التناسلية فى الجاموس المرضع وكذلك على معدل الزيادة فى وزن الجسم فى العجول الرضيعه لذلك تم تقسيم عدد ١٤من الجاموس العشار الى مجموعتين متساويتين ، المجموعه الأولى (الضابطه) غذيت على علف مصنع لا يحتوى على المونننزين بينما غذيت المجموعه الثانيه (المونننزين) على نفس العلف المصنع مضافا اليه نسبة ١٥٠ ، ٢٠٠ مجم/ رأس / يوميا من المونننزين صوديوم وذلك فى فترة ٧٠ يوم الأخيرة قبل الولادة و١٢٠ يوما الأولى بعد الولادة على الترتيب وترك البرسيم الأخضر مفتوحا . وقد انخفض استهلاك المادة الجافة المأكولة من البرسيم فى مجموعة المونننزين عن المجموعة الضابطة بنسبة ٤,٨٢ ٪ و ٦,٩٨٪ فى فترتى ماقبل الولادة وما بعدها على التوالى ٠ وبينما لم تكن لاضافة المونننزين اى تأثير فى اوزان العجول عند الولادة ظهر هذا الاثر جليا عند عمر ١٢٠ يوما حيث كان هناك تحسن معنوى فى وزن العجول ٠وقد وجد ايضا أن الجاموس المغذى على المونننزين قد سجل زيادة فى نسب البربيونات والأنسولين فى الدم وأنخفاض فى نسبة الأسيتات و النسبه بين الأسيتات و البروبيونات بالأضافه الى أنخفاض اليوريا النيتروجينيه فى الدم ٠ لم يؤثر المونننزين على الفترة اللازمه لرجوع الرحم لطبيعته بينما أدى الى أنخفاض الفترة من الولادة حتى الشياع الأول ٦٠ر٣٠ يوما بدلا من ٤٠ر٥٦ فى المجموعة الضابطة وكان معدل الحمل (نسبة حدوث الحمل) حتى ١٢٠ يوما بعد الولادة أعلى من مثيلاتها فى المجموعه الضابطه٠ وكانت الفترة المفتوحه من الولادة حتى الأخصاب أطول فى مجموعة المونننزين (٩٠ يوما) عنها فى المجموعه الضابطه (١١٥ يوما)٠ومن هذا يتضح أنه يمكن أضافة المونننزين الى علائق الجاموس بجرعه ١٥٠مجم و٢٠٠ مجم / رأس / يوما فى فترة ما قبل وما بعد الولادة على الترتيب لتقصير فترة ما بعد الولادة وتحسين نسب الأخصاب وكذلك تحسن معدل الزيادة فى الوزن للعجول الرضيعه٠

SUMMARY

To study the effect of dietary monensin supplementation on the blood metabolite and reproductive performance of suckled buffalo-cows as well as the weight gain of their calves, a total of 14 multiparous pregnant buffalo-cows were divided into two groups 7 per each. One group (control) fed on pelleted concentrate containing no monensin sodium, the other group (monensin) fed a similar concentrate supplemented with 150 and 200 ppm\head\day during prepartum (70 days) and postpartum (120 days) period, respectively. Buffalo-cows in the monensin group consumed less forages (dry matter) during late pregnancy and early lactation by 4.82 and 6.98 % respectively than did the control group. Monensin feeding didn't affect calf birth weight, but significantly ($p<0.05$) improved their weight at 120 days of age. Meanwhile, body condition score of buffalo-cows at calving and at conception was significantly ($p<0.05$) increased in the monensin group compared with the control one. Buffalo-cows fed on monensin have a significantly higher plasma propionate($P<0.05$) and insulin($P<0.05$) concentrations and a significantly lower acetate ($P<0.05$) , acetate : propionate ratio ($P<0.05$) and blood urea nitrogen ($P<0.05$) concentrations than that fed on control diet. Glucose levels were not affected by treatment. There was no significant difference between control and monensin group in respect to uterine involution. However, the postpartum interval was significantly ($P<0.01$) decreased in buffalo cows supplemented with monensin compared to that recorded with control group (30.60 Vs 56.40 days). Pregnancy rate (up to 120 d postpartum) was higher in monensin-fed buffalo-cows(86% (6\7)) than control (52%(4\7)). Meanwhile, days open were significantly ($P<0.01$) decreased in monensin group compared with control one (90.00 Vs 115.00 days). It can be concluded that monensin can be safely used as feed supplement at a level of 150 and 200 mg/head/day during pre-and postpartum period, respectively for buffalo-cows to shorten the postpartum period, to improve their fertility rate and to enhance the weight gain of their suckling calves.

Key words: *Buffalo-Cows-Suckling-Reproductive performance-Monensin*

INTRODUCTION

The long interval from calving to first postpartum estrous is an important determinant of reproductive efficiency in buffaloes. Feeding

(especially low available dietary energy and protein during postpartum), body condition score (BCS), suckling or lactation are the most important factors in determining the length of postpartum anestrum period in both cattle and buffaloes (Short et al., 1990; Hegazy, 1993 and Hegazy et al., 1995 & 1996).

Feeding can be improved by increasing the efficiency of ruminal fermentation. Rumen fermentation patterns can be manipulated by means of increase ruminal propionic acid yield, depress methanogenesis and depress rapid ruminal proteolysis and deamination of dietary protein(Chalupa,1977). Such shifts in rumen fermentation should enhance the overall productive and reproductive efficiency of ruminants. Initial attempts to achieve this goal were by dietary manipulation, but during the last decade, a number of active compounds have been discovered that when fed, can achieve some or all of the above objectives and hence improve efficiency of production with ruminants. Such class of compounds are Carboxylic polyether ionophore antibiotics that were originally used as anticoccidial feed additives for poultry. These ionophores are produced by various strains of *Streptomyces* fungi and include monensin, lasalocid, salinomycin and narasin. The effect of ionophore feeding (monensin or lasalocid) on reproduction in cattle recorded as decreased age of puberty (Moseley et al.,1982), enhanced the LH response to both E2 and GnRh (Randel et al.1982),increased the ovarian response to a superovulation treatment (Ortuno & Carson.,1985) and shortening the postpartum period (Mason & Randel.,1983 and Beltran et al.,1992).

Very little research on the use of ionophore as an additive to buffalo diet has been reported. Badawy (1992) found that buffalo heifers fed monensin (100 mg\head\day) reach puberty earlier than control and have increased ruminal proportion of propionate as a percent of total volatile fatty acids. The aim of this work was to evaluate the effect of dietary monensin supplementation on some metabolite concentrations and reproductive performance of the suckled buffalo cows as well as the body weight gain of their suckling calves.

MATERIALS and METHODS

Fourteen pregnant multiparous buffalo-cows aged 5-10 years were used in this study starting from 72 days prepartum until 120 days postpartum. The experimental animals were divided according to age and body condition to two groups 7 per each. Animals in both groups were fed on pelleted concentrate mixture (4.5-6 Kg) and berseem (ad lib) according to

NRC 1971 adapted for buffaloes by Ranjhan and Pathak, 1979). Monensin sodium (Monensin premix by Eli Lilly Co.) was added at a level of 33 ppm to the concentrate mix. for one group and the other kept free and considered as control. Both groups were fed approximately equal amounts of the concentrate diet and the unconsummated amounts of berseem were recorded daily. Trace mineralized salt blocks were provided free choice for all animals. Samples from both concentrate mixture and berseem were taken for proximate analysis (table 1) according to A.O.C.A.(1980).

Animals fed on monensin were given approximately 99 mg/head^{-1}/day^{-1} during the first 28 days of the experiment (for rumen adaptation) and thereafter the level increased to 150 and 200 mg/head^{-1}/day^{-1} during pre-and post-partum periods, respectively. At calving and within 12 hr., calves were weighed and kept permanently with their dams. The calves were reweighed again at 120 days. All cows were conditionally scoring at the beginning of the experiment ,at calving and at conception according to Surinder et al (1987).

Table 1: Proximate analysis of the diet (on DM basis).

Item	Conc. mix.	Berseem
Dry matter %	91.70	17.20
Crude protein %	16.12	15.70
Ether extract %	3.70	2.90
Crude fiber %	12.50	24.60
Total digestable nutrient % (estimated)	77.00	60.00

Buffalo cows were examined rectally twice a week to detect both ovarian and uterine changes during postpartum. Interval from calving to 1st postpartum estrus was detected twice daily by a vasectomized bull. Blood samples were collected twice weekly by jugular vein puncture to evaluate serum progesterone starting from 2 weeks postpartum until 15 days after the 1st estrus or 120 days postpartum whatever occur ealier. The 1st postpartum estrus was verified by increasing serum progesterone (>1 ng/ml) or the occurrence of a repeat estrus 17 or 24 days later. Serum progesterone was qualified by radioimmunoassay (RIA) according to Dobson (1983). Assay sensitivity was 0.03 ng/ml. Intra and inter assay coefficient of variation were 0.99% and 0.46% respectively. An estrus followed by a short cycle was not considered to be the first postpartum estrus. Animals came in heat 40 days and up to 120 days postpartum were naturally served with a fertile bull and

were examined rectally for pregnancy 45 days later. Pregnancy rate as well as days open were recorded. Two blood samples were collected at 32 and 70 days postpartum for the determination of plasma glucose, insulin, volatile fatty acids (VFA) and blood urea nitrogen (BUN). Glucose and BUN were determined by enzymatic methods using reagents purchased from Sclavo diagnostici, Italy. Insulin estimation was carried out by RIA according the procedures of Starr (1979), The inter-and intraassay coefficient were 0.49 and 0.65%, respectively. Plasma samples were prepared for VFA analysis after that cited by Thonney et al (1981) then injected into a gas chromatography (model 5890, Hewlett Packard, USA). All data were statistically analyzed according to Snedecor & Cochran (1982).

RESULTS

As shown in table (2), the two groups of buffalo-cows consumed similar amounts of conc.mix. Control buffalo-cows consumed more forages (DM)during late pregnancy and early lactation by means of 4.82 and 6.98 % respectively than did monensin buffalo cows.

The present results revealed that feeding monensin during the prepartum period have no effect on calf birth weight (table, 3). However, supplementation of monensin to cow's diet significantly ($P<0.05$) improve the weight gain of the calves at 120 days compared with the control group. Meanwhile, Body condition score (BCS) in both groups (table 3) are similar at the start of the experiment, thereafter feeding of monensin did significantly increase the BCS to reach 3.80 and 3.50 at parturition ($P<0.01$) and at conception ($P<0.05$), respectively compared with 3.54 and 3.21 for control group.

Table 2: Mean daily dry matter intake during the experimental period.

DM intake/Kg feed	Control	Monensin
1- During 70 days prepartum		
Concentrate mix.	4.54	4.55
Egyptian clover	6.88	6.32
Total	11.42(100%)	10.87(95.18%)
2- During 120 days postpartum		
Concentrate mix.	6.01	6.02
Egyptian clover	8.60	7.57
Total	14.61(100%)	13.59(93.01%)

Values in parenthesis are % from control.

Table 3: Effects of monensin on BCS of the experimental buffaloes and the weight gain of their calves.

Tested parameters	Control	Monensin	P
1- BCS			
Initial	3.10±0.05	3.20±0.07	Ns
At calving	3.54±0.05	3.80±0.04	P<0.01*
At conception	3.21±0.08	3.50±0.09	P<0.05*
2- Calf weight/kg			
At birth	41.00±1.11	41.20±1.96	Ns
At 120 days	106.60±5.05	114.64±3.38	P<0.05*

P = Probability NS=nonsignificant *significant

The effect of monensin supplementation on plasma acetic and propionic acid, glucose, insulin and blood urea nitrogen are presented in tables (4,5&6). Analysis of variance of the tested parameters (table 4) revealed that, there were no time x monensin interactions for any of the measured traits, thus the discussion of the results is confined to treatment main effects only. Plasma concentrations of acetate and propionate were not significantly affected by time of sampling (32 Vs 72 days postpartum, table 5). Buffalo-cows fed on monensin (table 6) have a significantly higher ($P<0.05$) plasma propionate concentration and a significantly lower acetate ($P<0.05$) and acetate : propionate ratio ($P<0.05$) than that fed on control diet. Statistical analysis of the glucose data indicated a highly significant ($P<0.05$) level at 72 days postpartum compared with that at 30 days postpartum (table 5). Plasma glucose concentrations were not affected ($p<0.05$) by monensin feeding. The statistical analysis of insulin data showed that, the effect of sample day and monensin treatment were significant ($P<0.05$). Insulin concentrations were significantly higher for monensin-fed compared with control-fed animals and at 72 days compared with 30 days postpartum. Buffalo-cows fed on monensin (table 6) had significantly ($P<0.05$) lower BUN concentrations that control. Day of sampling didn't affect BUN levels.

Table 4: Analysis of variance for plasma acetic(c_2) and propionic(c_3) acids, plasma glucose, insulin and blood urea nitrogen(BUN)[@].

Source	df	C2	C3	C2:C3	Glucose	Insulin	BUN
Main Effect							
time	1	0.080	0.002	0.854	308.89*	2.24**	1.088
monensin	1	3.789**	0.039**	264.81**	0.04	0.49*	13.880*
Interaction							
time x monensin	1	0.003	0.001	6.044	26.03	0.04	0.34
Error	24	0.168	0.001	5.567	51.48	0.09	2.37

[@] mean squares *p<0.05 **p<0.01

Table 5: Effects of day of sampling on metabolic measurements.

Item	Day of sampling 30	72	P
No. samples	14	14	
Acetic acid (C_2)mg%	14.10±0.14	14.00 ±0.15	NS
Propionic acid (C_3)mg %	0.484±0.16	0.489±0.01	NS
C_2:C_3	29.43±1.18	29.08±0.91	NS
Glucose mg%	52.79±2.16	59.45±1.49	P<0.05*
Insulin ng/ml	2.79±0.07	3.36±0.10	P<0.05*
BUNmg%	15.76±0.56	16.15±0.30	NS

P = Probability NS=nonsignificant *significant

Table 6: Effect of monensin supplementation on metabolic measurements.

Item	Control	Monensin	P
No. samples	14	14	
Acetic acid (C_2)mg%	14.42±0.09	13.69±0.11	P<0.05*
Propionic acid (C_3)mg%	0.449±0.10	0.523±0.01	P<0.05*
C_2:C_3	32.34±0.77	26.18±0.38	P< 0.05*
Glucose mg%	56.07±1.59	56.14±2.46	NS
Insulin ng/ml	2.94±0.12	3.21±0.09	P<0.05*
BUN mg%	16.66±0.43	15.25±0.37	P< 0.05*

P = Probability NS=nonsignificant *significant

The effect of monensin supplementation on the reproductive performance are presented in table (7). There was no significant difference between control and monensin groups in respect to uterine involution. However, the postpartum interval was significantly (P<0.01) decreased by 26 days in buffalo cows supplemented with monensin compared with control group. Pregnancy rate was higher in monensin-fed buffalo-cows(86% (6\7)) than control (52%(4\7)). Meanwhile, days open were significantly (P<0.01) decreased in monensin group (90 days) compared with control one (115 day). In the present study there were no calving losses in either groups and no records for retained placenta or dystocia.

7: Effect of monensin on the reproductive performance of buffalo cows.

Reproductive traits	Control	Monensin	P
Uterine involution (day)	30.80±1.45	31.00±1.90	Ns
Postpartum interval (day)	56.40±7.32	30.60±2.23	P<0.01*
Pregnancy rate(%)	54.14 (4/7)	85.70(6/7)	
Days open (day)	*115.00±2.2*	*90.00±10.33*	*P< 0.01**

P = Probability NS=nonsignificant *significant

DISCUSSION

The recorded reduction in forage DM intake on monensin treatment is consistent with many studies in cattle (Goodrich et al., 1984 and Turner et al.,1977). The reported increases in feed efficiency associated with monensin (Warner and Douglas 1984) are capable of compensating for this reduction in feed intake and reflected in this experiment as a significant increase in body condition score (body gain). Turner et al.(1977) reported greater weight gain by cows fed 200 mg monensin with less hay than by cows not fed monensin. This decrease in forage intake was more during postpartum than prepartum period. The difference may be dose dependent (200 Vs 150 mg, respectively). Similar results were found by Turner et al.(1980). Moreover, the trend towards higher weight gains in calves from monensin-fed buffalo-cows suggested that, those cows had higher body reserves and feed efficiency to support lactation. Kiser et al.(1985)found that supplementation of monensin to cow's diet did not affect calf birth weight but significantly improve their growth rate up to weaning.

The effects of monensin on plasma VFA ratio (higher propionate and lower acetate with low C_2:C_3 ratio) are previously reported by Thonney et al. (1981) who also found a comparable ratios in ruminal fluid. The later was also reported in buffaloes by Badawy (1992). Warner and Douglas (1984) concluded that increased ruminal propionate lower the heat increments, spare amino acids normally used for gluconeogensis and stimulate protein synthesis which increased the efficiency of feed utilization. Also, they found that the propionic acid fermentation is more energetically efficient (20% more ME was available) and reduces great loss of methane associated with the production of acetic and butyric acids. The non-significant increase in glucose level in monensin-fed buffalo-cows in spite of high plasma propionate and insulin concentrations were previously reported by Thonney et al (1981) in cows. Probably, as Raun et al (1976) indicated, liver conversion of propionate to glucose and subsequent transport of glucose from plasma to cells mediated by high insulin level are so rapidly that only measurements of metabolite production or measurement of uptake by various tissues could elucidate the mechanisms of drug actions. The significant increases in insulin concentrations in monensin-fed buffaloes was in line with Istasse et al (1987) who found that, infusion of propionate into the rumen, increase concentration of insulin. The lower BUN with monensin feeding may be explained as the decreased amount of ammonia absorption from rumen and circulating in the blood with lesser deamination in the rumen and

more amino acids escaping in the lower intestine. It also reflect protein sparing effect of monensin, which might occur through increased supplies of propionate (Che-Ming and James; 1993).

In the present study, a significant reduction of more than 26 days in postpartum interval to first estrus was exhibited by the buffaloes receiving 200 mg monensin/head/day. This result is in line with Turner et al. (1980), Hixon et al. (1982), Mason and Randel (1983) in cattle. The recorded improvement in body condition and feed efficiency by monensin-fed buffaloes, in essence, elevated them to a higher energy diet than the group without monensin. In this respect, the present data agree with the research of Hegazy (1993) with buffaloes, who showed that, prepartum energy level had an effect on body score and consequently on the length of postpartum period. Moreover, this improvement may also be attributed to the shift in VFA towards increased propionate and decreased acetate, a matter which result in a favorable effect in hormonal production and/or enhance response of some target tissues as ovaries to these hormones. Such effects were previously reported by Rutter et al (1983). On the other hand, the increase in insulin level associated with monensin intake may mediate some of the positive effects of monensin feeding on postpartum period. Hegazy et al (1996) found a significant negative correlation between insulin concentrations and interval (day) to first postpartum estrus. In this trial, pregnancy rate and days open showed that monensin-fed buffaloes bred back at a high rate (85.7%) in a shorter duration (90.0 days) than control (54.14% and 115 days, respectively). This may be attributed to the recorded low in BUN in monensin group. It was found that the excess in rumen ammonia production, is associated with a reduction in the pH of the uterine environment (Elrod and Butler, 1993). Also Elrod (1992) reported that ammonia and urea differentially affected endometrial ion transport and have an adverse effect on the uterine environment and embryo survival.

From this study, it can be concluded that monensin can be safely used as a feed supplement at a level of 150 and 200 mg/head/day during pre-and postpartum periods, respectively for suckling buffalo-cows to shorten the postpartum period, improving their fertility rate and enhancing the weight gain of their suckling calves. From the economic point of view, the use of monensin save about 6% of forage intake through enhancing the feed efficiency rate.

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