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EFFECT OF CHROMIUM METHIONINE SUPPLEMENTATION ON MILK PRODUCTION, COMPOSITION AND SOME BLOOD METABOLITES OF LACTATING BUFFALOES

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ABSTRACT

This experiment was conducted to study the effect of chromium supplementation on performance and blood serum biochemistry of lactating buffaloes. Therefore, thirty lactating buffaloes (aged 3-6 years, average body weight 567± 22.78 kg) were equally divided into two groups. Group one (G1), control, which received no chromium supplementation and group two, treated group (G2), received 5mg/day chromium methionine from 6 wk to 18 wk postpartum. Milk production and milk composition were evaluated by weekly. Serum biochemistry concentrations (serum glucose, cholesterol, triglyceride, total protein, cortisol and insulin concentration) were estimated on the 42th, 72th, 102th and 132thday. The obtained results indicated that milk production was significantly affected by chromium methionine supplementation during the entire period (P<0.05) but no significant effect on milk composition. Supplemental chromium had no significant effect on serum glucose, cholesterol, triglycerides and insulin concentration. However, chromium supplementation tended to increase significantly serum total protein level and decrease cortisol level(P<0.05). The results of this study showed that dietary chromium methionine supplementation increased milk yield and total protein concentration in the blood.

Keywords: Buffalo, Chromium methionine, Milk yield, Serum biochemistry.

INTRODUCTION

Chromium was first shown to be essential in swine by Schwarz and Mertz (1957) when isolate "glucose tolerance factor" (GTF) from swine kidney. Furtheremore, this element has been reported to play essential roles in activity of certain enzymes, metabolism of protein and nucleic acids, as well as impact on immune functions Bonomi *et al*. (1997). However, only its function as related to glucose metabolism is sufficiently understood. Chromium also aids in the conversion of thyroxin to triodothyronine, increasing the metabolic rate Burton (1995). Potential benefits of supplementing Chromium to livestock have been shown to improve performance in growing and finishing swine and ruminants (Chang and Mowat,1992; Moonsie-Shageer and Mowat,1993; Kegley *et al*.,1997). In studies, chromium supplementation has been shown to increase dry matter intake and milk yields (Besong *et al.* 1996; Hayirli *et al*. 2001; Smith *et al*. 2002), reduce blood nonesterified fatty acid (NEFA) concentration (Yang *et al.* 1996; Depew *et al*. 1998; Hayirli *et al*. 2001; Bryan *et al.* 2004), improve fertility (Yang *et al.* 1996; Pechova *et al.* 2003; Bryan *et al.* 2004). Since there is no adequate measure of chromium status, establishing dietary requirement for livestock and human is difficult. While the recommended intake for chromium is 50-200 µg per day (National Research Council,1989) in human; currently there is no established chromium requirement for ruminant.

Improvement in impaired glucose tolerance after chromium supplementation is the most sufficient means to determine deficiency. The aim of the currents study was to assess the effect of supplemental chromium for lactating buffaloes, from 6 wk to18 wk postpartum on performance and blood serum biochemistry during the milking period .

MATERIALS AND METHODS

This study was conducted at the Animal Production Department Experimental Farm, Faculty of Agriculture, South Valley University from October 2011 to February 2012. Thirty lactating buffaloes weighing 567 ± 22.78 kg in the 3rd and 4th lactations season. The peak of their lactation curve (from 6 wk to18 wk postpartum during their lactation period) were used in this study.

Experimental animals and rations:

The thirty lactating buffaloes at peak of lactation (42day) were divided into two groups (15 animals/each):

G1 (Control group) : The control ration consisted of concentrate feed mixture (CFM) and rice straw, without chromium methionine (Cr-Met) from 6 wk to 18 wk after parturition

G2: control ration with added chromium methionine (Cr-Met 5 mg / head / day, via ball dough corn after the a.m. milking) from 6 wk to 18 wk after parturition**.** The CFM contained 33 % yellow corn, 33% wheat bran, 20 % rice bran,11% decorticated cottonseed meal, 2% calcium carbonate and 1% sodium chloride. Rice straw was offered ad lib as a roughage source and the amount consumed was calculated for each animals. Mineralized salts licking blocks were available throughout the experiment. Nutrient requirements were individually calculated according to body weight, daily milk yield and milk fat test according to Ghoneim (1966). Buffaloes had ad libitum access to clean water 24 h a day. Animals were adapted to the double daily mechanical milking at 5.0 a.m. and 4.00 p.m. Animals were fed the CFM at 8 am and 5 pm. Lactating buffalo cows were adapted gradually to the diet during the first 10 days. The animals were kept outdoors under shade day and night. The chemical composition of concentrate feed mixture (CFM) and rice straw (RS) are presented in Table (1). Body weight of animals were recorded at the beginning and at the end of the experiments. Also, the animals were monitored for the occurrence of mastitis .

Table (1).The proximate analysis of concentrate feed mixture (CFM) and rice straw (RS) consumed by lactating buffaloes.

Nutrients (%)	Feeds	
	CFM[1]	RS
DM	90.40	93.40
Chemical composition (% as DM):		
OM	88.39	85.33
CP	15.60	4.40
EE	2.20	1.80
CF	11.35	41.24
NFE	59.24	37.89
Ash	11.61	14.67

[1]CFM = Concentrate feed mixture contains: 33% yellow corn, 33 % wheat bran, 20 % rice bran, 11% decorticated cottonseed meal, 2 % calcium carbonate and 1 % sodium chloride.

Sample collection and measurement:

Feed samples:

A fixed portion of diets were collected daily in the last week of each month and composite samples were formed, dried at 70 ºC for 48 h, grind and kept in closely tight jars for laboratory analysis. Feeds were analyzed for dry matter (DM), organic matter (OM), crude protein (CP), crude fiber (CF), ether extract (EE) and ash according to A.O.A.C. (2006). Table (1) shows the chemical composition of the ingredients fed during the experimental periods.

Milk samples:

Animals were mechanically milked. Milk yield was recorded individually twice for each buffaloes, during the experimental periods. Individual milk samples, consisted of proportional volumes of morning and evening milk, were collected in order to evaluate milk composition (5 ml/kg of produced milk). Milk samples were taken for analysis fat, protein and total solid concentrations (AOAC, 2006). Solid not fat (SNF) was calculated by the difference (T.S% - Fat %). Milk yield was corrected to 7% fat for buffaloes (Raafat and Saleh 1962).

FCM=0.265×milk yield (kg) +10.5 × fat yield (kg).

Blood samples:

Blood samples were collected on the 42^{th} , 72^{th} , 102^{th} and 132^{th} day of lactation by puncture of the jugular vein. Blood was allowed to coagulate at room temperature. The blood serum was separated by centrifugation and stored at -20ºC for a maximum of 60 days until assayed. Serum were analyzed for estimation of glucose, total cholesterol, triglyceride, total protein, insulin and cortisol concentrations. Glucose, total cholesterol, triglyceride, and total protein, of serum were measured by RA1000 unit. Insulin and cortisole of serum were measured by hormonal insulin and cortisol kits using gamacounter (Kon Pron) system

Statistical analysis :

Data were statistically analyzed according to the General Linear Model (G.L.M). and the differences between means were detected by Duncan`s(1955). Multiple Range Test, SAS (2004). The model included one fixed factor, treatment, as follows:

$$Y_{ij} = \mu + Si + eij$$

Where Y = the least square average of the studied traits

μ = overall mean
Si= treatment
Eij = experimental error

RESULTS AND DISCUSSION

Milk yield and composition

As show in Table (2) results, Cr supplementation had increased milk yield which agreed to Besong *et al*. (1996); Hayirli *et al*. (2001) ; Smith *et al.* (2005) and Yang *et al*. (1996). As it is shown in Table 2, milk composition had not affected by Cr supplementation. The composition of milk with regard to Cr supplementation was studied by relatively few authors Pechova *et al.*(2003). In most cases they found no difference between the treated and control group (Besong *et al.* 1996 & Yang *et al.* 1996 & Simek *et al*. 1999). Hayirli *et al.* (2001) reported increased fat production and lactose levels in milk after Cr supplementation.

Tables (2): Effect of feeding buffaloes on experimental rations on milk yield of some chemical composition of milk .

Item	G1 Control	G2 Chromium
No	15	15
Milk yield (kg/d)	8.05±0.11^{b}	8.75±0.17^{a}
7% FCM (kg/d)	10.19±0.23^{b}	10.65±0.21^{a}
Fat (%)	7.68±0.43	7.94±0.44
Protein (%)	4.22±0.03	4.23±0.03
Solid Non Fat (%)	9.71±0.07	9.73±0.10
Total solid (%)	17.39±0.56	17.67±0.45
Ash (%)	0.78±0.04	0.77±0.03

$^{a-b}$ **Means in the same row followed by different letters are significantly different (p<0.05).**

Serum biochemical parameters

The effects of Cr methionine supplementation on serum biochemical parameters during experimental periods are shown in Table 3. Glucose and insulin concentration had not been affected by Cr supplementation. Previous studies by Besong *et al*. (1996) : Bryan *et al.* (2004) & Burton et al. (1993) on cow and Kitchalong *et al.* (1999) on sheep have shown that Cr supplementation has no effect on serum glucose and insulin concentration. However, Chang and Mowat (1992) and Kegley *et al*. (1997& 2000) on calves and Bunting *et al*.(1994) on cows studies had reported that Cr supplementation causes decrease in glucose concentration and increase of serum insulin concentration. In our study Cr supplementation decreased significantly ($p < 0.05$) serum cortisol. How chromium affects cortisol production is unknown, but it is clear that glucocorticoids inhibit excretion of insulin (Munk et al 1984). Because GTF, Cr potentates the action of insulin it may inversely inhibit cortisol excretion (Chang and Mowat. 1992). Moonsie-Shageer and Mowat (1993) had reported that Cr supplementation causes decrease in serum cortisol concentration.. As it is shown in Table (3), serum total cholesterol and triglyceride concentration were not affected by Cr supplementation. This can be because of disability of chromium on insulin concentration in our experiment.

The role of insulin is proved of lipogenesis stimulus and lipolysis inhibition (Kegley *et al.* 2000). Previous studies by Besong *et al*. (1996): Depew *et al*. (1998); Kegley *et al*. (1997) and Moonsie-shageer and Mowat (1993) had shown Cr supplementation has no effect on concentration of serum total cholesterol and triglyceride. The using chromium supplementation resulted in some increase in total protein of serum Table(3). This could be due to the decrease of serum cortisol concentration or an increase of sensitivity tissue to insulin. The role of insulin is proved at increase of synthesis of proteins (Roginski and Mertz, 1969). These results are in accordance with studies reported by Bunting *et al*. (1994), Roginskey and Mertz (1969) and Chang and Mowat (1992).

Table (3). Effect of feeding experimental rations on some boold parameters .

Item	G1 Control	G2 Chromium
No	15	15
Glucose (mg/dl)	52.58±.17	51.17±4.11
Total cholesterol (mg/dl)	146.5±14.21	143.2 ±14.23
Triglyceride (mg/dl)	48.91±44.44	52.83±4.37
Total protein (mg/dl)	7.02±0.179[b]	7.39±0.18[a]
Insulin (µIU/ml)	16.03±3.22	16.5±3.17
Cortisol (µIU/ml)	38.4±5.95[a]	26.2±5.56[b]

[a-b] **Means in the same row followed by different letters are significantly different ($p<0.05$).**

Conclusions

It could be concluded that Cr supplementation significantly increased milk production during the entire period. On other hand, It had no significant effect on milk composition. Biochemical findings revealed non significant changes in serum glucose , cholesterol, triglycerides and insulin concentrations in Cr treated animals , meanwhile there was an increase in serum total protein and decrease in serum cortisol levels .

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تأثير إضافة كروميوم ميثايونين على إنتاج وتركيب اللبن وبعض مكونات الدم في الجاموس الحلاب

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أجريت هذه الدراسة بمزرعة الإنتاج الحيواني- كلية الزراعة- جامعة جنوب الوادي بقنا من أكتوبر 2011 إلى فبراير2012. لتقييم تأثير استخدام عنصر الكروميوم على الصفات الإنتاجية في الجاموس (إنتاج وتركيب اللبن ومكونات الدم البيوكميائية) واستخدم في هذه الدراسة عدد (30 جاموسة حلابة) بعد وصولها لقمة الإنتاج من موسم حليبها عند اليوم 42 . وقسم الجاموس إلى مجموعتان متساوية- الأولى كنترول (مقارنة) حيث غذيت فيها الحيوانات على العلقية الأساسية والثانية: غذيت الحيوانات على العليقة الأساسية +5 مليجرام من عنصر الكروميوم/جاموسة /اليوم. وكانت المدة الكلية للتجربة 150 يوما وقد تم وزن الحيوانات عند بداية ونهاية التجربة.وتم تحليل اللبن وقدرت نسب الدهن والبروتين والجوامد اللادهنية والجوامد الكلية ونسبة الرماد وكذلك قدرت بعض قياسات الدم ،ويمكن تلخيص النتائج المتحصل عليها فيما يلي: أدى استخدام مستحضر عنصر الكروميوم (Cr-Met) إلى زيادة إنتاج اللبن وإنتاج اللبن المعدل(7%دهن) ولا توجد فروق معنوية في نسبة الدهن والبروتين والجوامد اللادهنية والجوامد الكلية. كما أظهرت نتائج قياسات الدم زيادة معنوية في مستوى الكروتيزول وانخفاض في مستوى البروتينات الكلية في دم الجاموس الحلاب التي غذيت على العليقة المركزة المضاف إليها 5 ملى جرام كروميوم بالمقارنة مع مجموعة الكنترول ولا توجد فروق معنوية في تركيز الكولسترول والدهون الثلاثية في الدم وعلى ذلك فانه يمكن إضافة 5 مليجرام/رأس /يوم من مستحضر الكروميوم للجاموس الحلاب أثناء موسم الحلب .

قام بتحكيم البحث

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