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EFFECT OF SUPPLEMENTAL ZINC METHIONINE CONCENTRATIONS ON DIGESTIBILITY, FEED EFFICIENCY AND SOME RUMINAL AND BLOOD PARAMETERS AND PERFORMANCE OF FRIESIAN CALVES.

Shakweer, I.M.E.; H.M. El-Nahas and A.A.M. El-Mekass
Animal Production Research Institute, Agricultural Research Center, Ministry of Agric., Giza. Egypt.

ABSTRACT

This study was conducted to investigate the effect of different levels (40mg, 80mg and 120mg /kg DMI) of zinc methionine supplementation on the digestion coefficients, nutritive value, ruminal and some blood parameters and productive performance of Friesian calves . Animals were fed according to requirements of the NRC (1984). Twenty growing Friesian calves of average initial live body weight (154.5 kg), aged 5 months were divided into four similar groups (5 calves each) and fed on the following rations: 1- The control group (G1) was fed concentrate feed mixture (CFM) + berseem hay + rice straw) without zinc methionine supplementation . 2- The 1st tested group(G2) was fed the control ration + 40mg zinc methionine /kg dry matter intake (DMI) . 3- The 2nd tested group (G3) was fed the control ration + 80mg zinc methionine /kg DMI 4- The 3rd tested group (G4) was fed the control rations + 120mg zinc methionine /kg DMI. . Results indicated that addition of zinc methionine increased ($P<0.05$) the digestibility of all nutrients which was reflected on the nutritive values (as TDN and DCP) .However, the daily gain of growing Friesian calves given 80mg zinc methionine supplementation was higher than that of the other tested groups fed the zinc levels and the control group. Total protein and volatile fatty acids (TVFA's) were increased by increasing the level of znic methionine supplementation in the ration, However, ammonia and albumin were decreased.

Generally , it could be concluded that addition of 80 mg zinc methionine /kg DMI improved nutrient digestibility , feed efficiency and daily gain for growing Friesian calves.

Keywords : Friesian calves –zinc methionine –feed intake and efficiency- digestibility – productive performance - ruminal and blood parameters.

INTRODUCTION

Anumber of different classes of organic trace minerals are commercially available for use in ruminant diets (Spears, 1996). Metal proteinates are produced by chelation of a soluble metal salt with amino acids and or partially hydrolyzed protein (AAFCO,2000). Zinc is known to be essential for the function and /or structure of several enzymes such as dehydrogenases peptidases and it was found to be an essential component of both DNA and RNA polymerases Miles and Henry (1999). Zinc organic source have greater availability than sulfate forms (Wedekind *et al*., 1992). Zinc is generally added to diets to ensure that nutritional requirements for Zn are sufficient . However ,Zn sometimes is to affect the nutritional properties of feed . For example , Zn has been shown to reduce ruminal degradability of feed protein, and diets that contain Soya protein treated with Zn have been shown to promote greater quantities of ruminal escape protein (Kincaid *et al* .,1997) .The depression in urea degradation is greater with supplemental Zn than that with supplemental Mn (Arelovich, 1998). Previously, Zn proteinate improved performance and certain carcass characteristic in finishing steers (Spears and Kegley , 2002). Improved bioavailability of Zn methionine may stimulate weight gain and feed conversion ratio in cattle (Kessler *et al.*, 2003).

Therefore, the objective of this study was to investigate the effect of adding different levels of zinc methionine to the ration of growing Friesian calves on digestion coefficients, nutritive values, ruminal and blood parameters and productive performance .

MATERIALS AND METHODS

This study was conducted in karada Animal Production Research Station belonging to the Animal Production Research Institute. Agricultural Research Centre Giza, Egypt during 2004-2005. Tewenty growing Freisian calves of an average Initial live body weight (154.5 kg) , aged 5 months were used in this experiment. Calves were blocked by weight in four similar groups (5 in each). Each group of calves was assigned at random to receive one of the four experimental rations. Calves in all four groups were fed on the following tested rations : 1- The control group(G1) was fed on concentrate feed mixture (CFM) + berseem hay + rice straw) without zinc methionine supplementation . 2- The 1st tested group (G2) was fed the control ration + 40mg zinc methionine /kg dry matter intake (DMI) . 3- The 2nd tested group (G3) was fed the control ration + 80mg zinc methionine /kg DMI 4- The 3rd tested group (G4) was fed the control rations + 120mg zinc methionine /kg DMI according to the feed allowances of NRC (1984). Feed additives (zinc methionine which contains 80% methionine hydroxy analogue and 15.10% zinc sulfate) The assigned amounts according to treatment were mixed manually with some grinded amounts of CFM . Rations were offered twice daily at 8 a.m. and 4 p.m. and water was offered freely. The feeding trial lasted for 180 days. Live body weight changes and feed intake were recorded at two weeks interval . At the end of the feeding experiment , three calves from each group were chosen at random to determine the nutrients digestibility of the experimental four rations using acid insoluble ash technique (A.I.A.) according to Van Keulen and Young (1977). Proximate analysis of feedstuffs and faeces samples were carried out according to the methods of A.O.A.C (2000). At the end of the digestion trials , rumen liquor samples were collected by stomach tube three times at (just before morning feeding , 3.00 and 6.00 hrs after feeding). Samples were strained in four folds of cheese cloth and pH value was determined immediately using a digital pH meter . Ammonia_N was determined according to the modified Semi-micro Kijeldehl digestion method A.O.A.C. (2000).TVFA's was determined according to Eadie *et al.*, (1967). Blood samples were taken from each animal at the end of the collection period in each digestion trial . Blood samples were taken from jugular vein and allowed to flow into acid washed heparinzied tubes. Blood samples were centrifuged at 3000 r.p.m. fot 15 min to separate plasma and stored at -20 °C until analysis .Total protein and albumin were determined according to Weichselbaum (1946) and Drupt

(1974) respectively. Urea concentration was determined according to Fawcett and Scott (1960). Zinc was determined according to Makino *et al.*, (1982).

The obtained data were statistically analyzed by general linear , model using ANOVA procedures of SAS (1985).The significant differences among treatments were tested using Duncans multiple range test, (Duncan) (1955).

RESULTS AND DISSCUTION

Chemical composition of feedstuffs.

Data of table (1) .Showed that the chemical composition of the ingredients in the experimental rations was within the normal values published by **A.P.R.I. (1997).**

Table (1): Chemical analysis of the ingredients and the experimental rations(DM basis %)

Item	DM	OM	CP	EE	CF	Ash	NFE
*CFM	90.4	90.22	16.2	2.99	13.1	9.78	57.93
Berseem hay (3[ed] cut)	90.9	86.4	15	2.4	26.4	13.6	42.61
Rice straw	92.18	85	3.1	1.76	36.12	15	44.02
Calculated experimental ration:							
Ration1 (control)	90.95	88.03	12.7	2.55	21.91	11.97	50.85
Ration2	90.92	88.15	12.8	2.57	21.45	11.85	51.3
Ration3	91.24	88.44	12.9	2.58	21.56	11.9	51.38
Ration4	90.93	88.05	13	2.56	21.73	11.95	50.81

*** Concentrate feed contaiend : 42% undecorticated cotton seed meal ,10% wheat bran, 30% yellow corn, 10% rice bran,5% molasses ,2% limestone and 1% common salt.**

Digestibility coefficients and feeding values :

Data presented in table (2) indicated that the addition of different levels of zinc methionine to the fed rations increased ($P<0.05$) the digestibilities of DM, OM, EE, and NFE compared with those of the control group ration .

However, there were no significant differences in case of CP and CF digestibilities either in case of rations supplemented with 40mg and 120mg of zinc methionine and the control group, the highest digestibility values as TDN and DCP were obtained with ration supplemented with 80mg and 120 mg zinc methionine / kgDMI, followed by the ration which contained 40mg zinc methionine. However, there were no significant differences ($P<0.05$) between either 80 and 120mg and 120 and 40 levels of zinc methionine , concerning the digestibility coefficients of all nutrients.The improvement in apparent digestibility coefficients with zinc methionine supplementation may be due to either improved of their digestibility and or their absorption in the abomasums. These results are in line with those obtained by Shakweer et al., (2005) and Shakweer and El-Nahas, (2005) They found that the addition of different levels of zinc methionine to the ration of Friesian dairy cows and suckling calves increased the digestibilities of DM, OM,CP and CF compared with those of the control group . Mousa and El-Sheikh, (2004) found that the apparent digestibility of DM, OM,CP,CF,EE and NFE were slightly increased by different levels of zinc sulfate supplementation to the ration of lactating buffaloes. Nutritive values as TDN andDCP were significantly ($P<0.05$) increased by different levels of zinc methionine supplementation compared to that of the control group (Table 2). Nutritive value(as TDN and DCP) was significantly ($P<0.05$) increased by ration supplementation level of 80mg /kg DMI of zinc methionine than to that of the other levels (40mg and 120mg of zinc methionine and control ration). However, there were no significant differences between levels of 40mg and 120mg /kg DMI of zinc methionine . Improved of TDN and DCP might be due to the higher digestibility values of all nutrients by addition of different levels of zinc methionine supplementation. These results are in accordance with Shakweer *et al.*, (2005) and Sakweer and EL-Nahas, (2005) working with suckling calves they found that TDN and DCP were significantly ($P<0.05$) increased by different levels of zinc methionine addition compared to that of the control group. Mousa and EL-Sheikh, (2004) found that TDN and DCP were significantly ($P<0.05$) increased by the addition of the highest level of zinc sulfate.

Table (2) : Digestion coefficients and nutritive values of rations fed to growing Friesian calves and supplemented with different levels of zinc methionine .

Item	control	Experimental ration		
	Ration(1)	Ration (1) + 40mg / kg DMI	Ration (1) + 80mg / kg DMI	Ration (1) + 120mg / kg DMI
digestibility (%)				
DM	64.24^{c}	67.13^{b}	69.72^{a}	68.15^{ab}
OM	66.73^{c}	69.99^{b}	71.82^{a}	71.34^{ab}
CP	67.19^{b}	69.69^{b}	73.46^{a}	70.67^{ab}
CF	60.98^{b}	63.15^{ab}	64.82^{a}	64.15^{ab}
EE	65.17^{c}	67.71^{bc}	71.51^{a}	68.75^{ab}
NFE	71.91^{c}	74.61^{b}	77.40^{a}	75.36^{ab}
Nutritive values %				
TDN	62.21^{c}	64.50^{b}	67.14^{a}	65.29^{b}
DCP	8.49^{b}	8.73^{ab}	9.82^{a}	8.85^{ab}

a,b.c: means in the same raw followed by different superscripts are singinificantly different ($P<0.05$).

Rumen parameters :

The sampling time (0.00,3.00 ,6.00 hrs) showed that the pH value was decreased after the 0.00 time feeding meanwhile , ammonia_N and TVFA's were increased at 3hrs post feeding and then began to decreased again at 6hrs post feeding table (3) . It was found that the average pH values were not affected by the different levels of zinc methionine supplementation. However, rumen pH was decreased only when 80mg zinc methionine level was added at 6.00 hr (time of sampling) compared with other zinc levels and the control group.

Table (3): The Effect of different levels of zinc methionine supplementation on ruminal pH, NH_3, TVFA's values.

Item	Time	Control	Experimental rations		
		Ration(1)	Ration (1) + 40 mg / kg DMI	Ration (1) + 80 mg / kg DMI	Ration (1) + 120 mg / kg DMI
pH	0	7.13ᵃ	7.32ᵃ	7.17ᵃ	7.08ᵃ
	3	6.26ᵃ	6.24ᵃ	6.28ᵃ	6.10ᵃ
	6	5.98ᵃ	6.02ᵃ	5.85ᵃ	6.13ᵃ
Ammonia-N mg/100ml(RL)	0	22.53ᵃ	19.33ᵇ	19.06ᵇ	17.10ᵇ
	3	34.01ᵃ	30 19ᵇ	27.96ᵇ	25.35ᶜ
	6	29.74ᵃ	23.47ᵇᶜ	19.51ᵇᶜ	17.69ᶜ
TVFA's (meq/100ml RL)	0	7.14ᵇ	7.98ᵇ	8.65ᵃᵇ	9.34ᵃ
	3	9.13ᵇ	10.42ᵃᵇ	11.11ᵃ	11.39ᵃ
	6	7.33ᵇ	7.37ᵇ	8.09ᵃᵇ	9.57ᵃ

a,b,c: means in the same raw followed by different superscripts are singinificantly different ($P<0.05$) .

These results are in accordance with those of Shakweer *et al.*, (2005), Shakweer and EL-Nahas, (2005) and Robinson *et al.*, (2002). However, Demeterova *et al.*, (2002) reported that there was slight decrease in rumen pH value when protected amino acid supplemented to the basal diet of lactating buffaloes. Overall mean of ammonia-N in ruminal fluid was decreased with different levels of zinc methionine compared with that of the control group at 3hr post feeding .These results are in line with those obtained by Skakweer *et al.*, (2005) , Shakweer and EL-Nahas , (2005) and Arelovich *et al.*, (2000) who found that added zinc or zinc plus Mn inhibited NH_3_N accumulation from urea , which may be due to decreased ureolysis or increased ammonia utilization by ruminal microbes. On the other hand, the TVFA's was increased with all different levels of zinc methionine supplementation compared with that of the control group at 3hr post feeding. This increase in TVFA's may be due to the increase of apparent digestibility of organic matter. These results are in accordance with Shakweer *et al.*, (2005), Shakweer and EL-Nahas, (2005) and Arelovich *et al.*, (2000) who reported that the increased proportion of propionate in ruminal VFAs leadfs to an increased energetic efficiency of ruminal fermentation which might explain the consistent benefits obtained from addition of chelated zinc supplement. Aly *et al.*, (2005) found an also an increased of TVFA's with addition of protected amino acids to goats ration.

Blood parameters

The data in table (4) Show normal concentrations of total protein, globulin and zinc with different levels of zinc methionine supplementation. However, albumin and urea concentrations in blood serum were decreased.

These results are in line with those obtained by Shakweer *et al.*, (2005) and Shakweer and EL-Nahas, (2005) since they found that normal concentration of total protein, globulin and zinc with different level of zinc methionine supplementation. Mousa and EL-Sheikh (2004) who indicated that addition of 80 and 120 mg zinc sulfate increased total protein and

Table (4): Effect of different levels of zinc methionine supplementation on some blood parameters.

Item	control	Experimental rations		
	Ration(1)	Ration (1) + 40 mg / kg DMI	Ration (1) + 80 mg / kg DMI	Ration (1) + 120 mg / kg DMI
Total protein g/dl	7.73^{b}	7.82^{ab}	7.99^{a}	8.01^{a}
Albumin g/dl	4.55^{a}	4.45^{a}	4.35^{a}	4.28^{a}
Globulin g/dl	3.18^{a}	3.37^{a}	3.65^{a}	3.73^{a}
urea mg/dl	38.08^{a}	35.98^{a}	30.26^{b}	29.30^{b}
Zinc mg/l	0.80^{b}	0.89^{ab}	0.91^{ab}	0.99^{a}

a,b.c: means in the same raw followed by different superscripts are singinificantly different($P<0.05$) .

Growth performance

Data in table (5) revealed that zinc methionine addition at 80 mg zinc methionine /kg DMI level significantly ($P<0.05$) increased final body weight compared to that of the other levels of zinc methionine and that of control group. The daily gain of Friesian calves given 80mg zinc methionine supplementation was higher than that of the other zinc levels and also the control group. On the other hand , this improved growth performance due to zinc supplementation was not only due to its importance through acting as a component and activator to more than 200 metalloenzymes and hormones Riordan and Vallee (1976) but also can improves acid – base balance as stated by Halhn and Baker (1988) and digestive enzymes activities Izhboldina (1994).

Table(5): Feed intake and feed efficiency of growing Friesian calves given different levels of zinc methionine

Item	Control	Experimental rations		
	Ration(1)	Ration (1) + 40 mg / kg DMI	Ration (1) + 80 mg / kg DMI	Ration (1) + 120 mg / kg DMI
No. of animal	5	5	5	5
Duration /days	180	180	180	180
Initial weight, kg	153.33^{a}	154.67^{a}	156.67^{a}	153.33^{a}
Final weight, kg	303.33^{c}	323.00^{b}	344.67^{a}	323^{b}
Total gain, kg	150^{b}	168.33^{ab}	188.00^{a}	169.67^{ab}
Averag daily gain, g/head/day	0.833^{b}	0.933^{ab}	1.044^{a}	0.943^{ab}
Average daily feed intake(as DM)				
CFM DM, g/head/day	4128	4318	4471.67	4306
Berseem hay DM, g/head/day	1818	1818	1818	1818
Rice straw DM,g/head/day	1997.7	2151.3	2305	2151
Total DM intake, g/head/day	7943.67	8287.3	8594.7	8275
Total TDN, g/head/day	4939.31	5349.71	5754.38	5402.85
Total DCP, g/head/day	672.94	722.58	784.53	732.61
Feed efficiency				
Kg DM/kg,gain	9.583	8.84	8.236	8.786
Kg TDN/kg,gain	5.96	5.71	5.513	5.736
Kg DCP/kg,gain	0.815	0.771	0.752	0.778

The present results are in agreement with those of Goetsch *et al.*, (1990) who found that the daily gain was higher (P<0.05) with supplemented ration (4g daily of zinc /animal) than that without zinc supplementation by beef steers . Shakweer and EL-Nahas , (2005) working on weaned Friesian calves found that the daily gain was higher (P<0.05) with supplemented 40mg zinc methionine than that of the control group . Mousa and EL-Sheikh (2004) found that the addition of zinc at different concentrations increased daily gain of buffalo-calves when compared with those of the control group. Feed intake as /kg DM, TDN and DCP/ head are shown in table (5) . The highest intake was recorded with 80mg zinc methionine supplementation /kg DMI compared to that of the other levels and the control group . On the other hand, there was an improvement in feed conversion as kgDM, kgTDN and kgDCP / kg gain by addition of different levels of zinc methionine to the ration of growing Friesian calves. The best feed efficiency as kg DM, kgTDN and kg DCP required for each kg gain was obtained with level of 80mg zinc methionine addition level followed by 40 and 120mg zinc methionine levels , respectively compared with that of the control group with no significant differences . The present results are in agreement with those of Malcolm-Callis *et al.*, (2000) who found that feed efficiency was increased with supplemental of zinc and Shakweer and EL-Nahas (2005) who found that feed efficiency was increased with 40mg zinc methionine working with weaning Friesian calves . Mousa and El-Sheikh , (2004) reported that feed intake and feed efficiency were increased with addition of 40mg zinc sulfate /kg DMI for buffalo-calves cpmpared to that of the control group .

Conclusion :

From all the above results , it could be concluded that addition of 80mg zinc methionine /kg DMI gave the best results concerning feed digestibility , nutritive value, feed efficiency and performance of growing Friesian calves.

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تأثير اضافة مستويات من الزنك العضوى على اداء عجول الفريزيان النامية

إبراهيم محمد السيد محمد شقوير، حسن محمود النحاس.أحمد عبد العزيز مرس المقص
معهد بحوث الانتاج الحيوانى- قسم بحوث تغذية الحيوان - مركز البحوث الزراعية - جمهورية مصر العربية.

أجرى هذا البحث بهدف دراسة تاثير اضافة مستويات مختلفة من زنك المثيونين على معاملات الهضم والقيمة الغذائية وبعض مقاييس الكرش والدم ومعدل النمو .حيث استخدم ٢٠ عجل فريزيان نامى بمتوسط وزن ١٥٤,٥ كيلو جرام وقسمت الى اربع مجاميع وتم تغذيتها على مستويات مختلفة من زنك المثيونين (صفر ،٤٠ملجم ، ٨٠ملجم ، ١٢٠ ملجم) حتى ١٨٠ يوم واستمرت فترة التجربة . وتم تغذية المجاميع على النحو التالى : ١- مجموعة الكنترول غذيت على علف مركز + دريس برسيم + قش الارز بدون اى اضافة زنك . ٢- مجموعة مختيرة غذيت على عليقة الكنترول +٤٠ ملجم زنك ميثيونين /كجم مادة جافة ماكولة .٣- مجموعة مختيرة غذيت على عليقة الكنترول +٨٠ ملجم زنك ميثيونين /كجم مادة جافة ماكولة. ٤- مجموعة مختيرة غذيت على عليقة الكنترول +١٢٠ ملجم زنك ميثيونين /كجم مادة جافة ماكولة.وكانت النتائج كالاتى :-

اضافة زنك المتثيونين بمستوياتة المختلفة ادى الى تحسن فى معاملات الهضم والقيمة الغذائية للعليقة الماكولة وسعدلات النمو والكفاءة التحويلية للغذاء مقارنة بمجموعة الكنترول . اما بالنسبة لمقاييس الكرش فقد ادت اضافة زنك الميثيونين الى انخفاض تركيز امونيا الكرش مع كل مستويات الزنك المضافة ولكنها ادت الى ارتفاع تركيز بروتين الدم والجلوبيولين بينما انخفض تركيز الالبيومين ويوريا الدم مقارنة بمجموعة الكنترول.

وتوصى الدراسة : بان اضافة ٤٠ ، ٨٠ ، ١٢٠ ملجم زنك ميثيونين الى علائق العجول النامية لابقار الفريزيان ادت الى تحسن فى المركبات الكلية المهضومة للعلائق ومعدلات النمو والكفاءة التحويلية وكذلك قياسات سائل الكرش وبعض قياسات الدم للعجول الفريزيان النامية بينما كان اضافة المستوى ٨٠ ملجم زنك ميثيونين هو افضل مستوى مقارنة بالمستويات الاخرى وعليقة الكنترول.