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EFFECT OF ZINC SULFATE AND / OR MANGANESE SULFATE SUPPLEMENTATION ON FRIESIAN CALVES PERFORMANCE .

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ABSTRACT

This study was conducted to investigate the effect of supplementation of zinc sulfate and / or manganese sulfate on the digestibility and ruminal activity, some blood parameters and productive performance of Friesian calves . Twenty calves with initial body weight of 262±.7kg in a 180 days experiment were chosen and divided into four similar groups (5 calves each). The control group was fed on concentrate feed mixture (CFM) + berseem hay (BH) + rice straw (RS), while 1st tested group was fed on the control ration + 40 mg zinc sulfate($ZnSO_4$) / kg DMI, the 2nd tested group was fed on the control ration + 40 mg manganese sulfate ($MnSO_4$) / kg DMI of and the 3rd tested group was fed on the control ration + (40 mg $ZnSO_4$+40 mg $MnSO_4$)/kg DMI . Adding either zinc sulfate or manganese sulfate or mixture of both elements increased ($P<0.05$) the nutrients digestibility and in turn the nutritive values (TDN and DCP). Adding zinc sulfate or manganese sulfate reduced ammonia-N and increased TVFA's . With respect to blood parameter, rations supplemented with Zinc or Mn sulfate appeared to higher total protein, albumine and lower globuline and urea concentration. Daily gain of the animals fed supplemented rations (tested groups) were higher than that of the control group being 0.969, 0.883 and 1.037 kg for animals fed rations supplemented with Zn , Mn and both of Zn plus Mn sulfate, respectively. Consequently, feed efficiency was better for tested groups which was give more gain with less feed intake and lower feed cost.

It could be concluded that addition of 40 mg zinc sulfate and / or manganese sulfate/kg DMI improved nutrients digestibility, economic efficiency and daily gain of Friesian calves.

Keywords: Friesian calves – zinc sulfate - manganese sulfate – feed intake – digestibility –ruminal and blood parameters.– productive performance – daily gain

INTRODUCTION

Minerals make up a small portion of an animals diet; however, they play important rolls in health, growth and reproduction (Ward and Lardy 2005). The importance of trace mineral nutrition relative to the maintenance of productivity and prevention of deficiency symptoms has been recognized for quite some time (Miller, 1981 and NRC, 2001). However, scientists in industry and academia have shown a more recent interest in understanding factors influencing trace mineral requirements and digestibility. Specifically, goals of more recent work include measuring potential benefits of trace mineral supplementation above predicted requirements upon dairy cattle health and productivity (Nocek *et al.*, 2006; Siciliano-Jones *et al.*, 2008 and Spears and Weiss, 2008).

Trace mineral deficiencies can occur as a primary deficiency when mineral intake is inadequate or as a secondary deficiency when other factors in the diet interfere with the absorption and metabolism of the concerned trace elements (Olson *et al*.,1999).

Chemical analysis of the diet or an individual feed ingredient does not indicate the biological effectiveness of a nutrient in terms of trace minerals. Bioavailability may be defined as the proportion of an ingested mineral that is absorbed, transported to its site of action and converted to the physiologically active species (O'Dell 1983). Bioavailability of minerals particularly trace elements can be affected by a number of factors including animal species, physiological state, previous nutrition, interaction with other minerals and dietary nutrients, choice of standard source, chemical form and solubility of mineral element (Ammerman *et al*., 1995).

Manganese is linked to growth through its involvement in specific enzyme functions related to skeletal cartilage. Other results include poor growth rates (Ward and Lardy 2005).

Zinc plays a role in immune response, enzyme systems and hoof health. Zinc also plays an important role in DNA, RNA and protein production. Signs of deficiency include reduced feed intake and weight gain, excessive salivation, rough hair coat and eventually swelling of the feet and legs. Critical Zn deficiencies result in hair loss, thickening of skin, and lesions around the nose and mouth (Ward and Lardy 2005).

Zinc has a catalytic, coactive, or structural role in a wide variety of enzymes that regulate many physiological processes including metabolism, growth, and immune function (Vallee and Falchuk, 1993).

Feeding high levels of Zn from Zn sulfate altered ruminal fermentation and protozoa numbers in steers (Froetschel *et al*., 1990).

The objective of this study was to determine the effect of zinc sulfate ($ZnSO_4$) and manganese sulfate ($MnSO_4$) supplementation during the fattening period and also, investigate the digestion coefficients, nutritive values, ruminal and blood parameters and productive performance of Friesian beef calves.

MATERIALS AND METHODS

The present study was carried out during (2007) at EL-Karada Animal Production Research Station, Animal Production Research Institute, Agricultural Research Center, Ministry of Agriculture, Giza, Egypt.

Experimental animals and rations

Twenty Friesian calves, average body weight of 262±0.7 kg were randomly chosen and divided into four similar groups (5 calves each) according to body weight. The four groups were assigned at random to receive one of the four experimental rations. During the experimental trial, animals were fed the following experimental rations: 1- The control group was fed concentrate feed mixture (CFM) + berseem hay (BH) + rice straw (RS) without supplementation. The 1st tested group was fed control ration + 40mg $ZnSO_4$/kg DMI. The 2nd tested group was fed control ration +

40mg $MnSO_4$/kg DMI. The 3rd tested group was fed the control ration + (40mg $ZnSO_4$ and 40mg $MnSO_4$)/kg DMI. Calves were individually fed their experimental rations in quantities according to their body weight in order to cover their requirements according to NRC (2001) allowances for beef calves. Rations were offered twice daily at 8 a.m. and 4 p.m. and water was offered freely.

Digestibility and feeding trials

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 randomly to determine the digestion coefficients and nutritive values of the four experimental rations using acid insoluble ash techniques (A.I.A.) as a natural marker according to the method of Van Keullen and Young (1977). Representative samples of feedstuffs and feces were chemically analyzed according to A.O.A.C. (2000). Samples of CFM, BH, and RS were taken at the beginning, middle and the end of digestibility trials for chemical analyses. Daily fecal grab samples of nearly 200g were taken from the rectum of each animal at 12 hours apart during the collection period. The samples were composited, dried in a forced air oven at 65ºC for 48 hours and ground. Nutrients digestion coefficients were calculated from the equations stated by Schneider and Flatt (1975).

DM digestibility (%) = 100 – [(100 × (AIA% in feed/ AIA% in faces)]

Nutrient digestibility (%) =100–[(100× (AIA% in feed / AIA% in faces)(nutrient % in faces/nutrient % in feed)

Rumen liquor and blood samples

At the end of the digestion trials, rumen liquor samples were taken from the same three calves from each group which chosen randomly to determine the digestion coefficients and nutritive values of the four experimental rations at 0 time (before morning feeding) and at 3 and 6 hours after morning feeding using stomach tube. Samples were strained through four folds of cheese cloth. Ruminal pH value was determined immediately using Orian 680 digital pH meter. Samples were stored in dry clean glass bottles with added 2 drops of mercuric chloride and kept in deep freezer for chemical analysis. Concentrations of ammonia-N was determined according to the modified Semi-micro Kijeldehl digestion method A.O.A.C. (2000). The TVFA's were determined according to Eadie *et al.* (1967).

Blood samples were taken from the same three calves from each group which chosen randomly to determine the digestion coefficients and nutritive values of the four experimental rations from the jugular vein of each calve at 0 time (before morning feeding) at the same time of collection rumen liquor sampling by clean sterile needle into clean dry heparinized glass tubes, thereafter they were centrifuged for 15 minutes at 4000 r.p.m. to obtain blood plasma and stored at -20 ^{o}C until analysis. Plasma samples were analyzed for total protein according to Weichselbaum (1946) and albumin colorimetrically according to Drupt (1974).The globulin was calculated by difference. The GOT, GPT and blood urea were measured using commercial diagnostic kits (Test combination, Pasteur lab.). Urea concentration was

determined according to Fawcett and Scott (1960). Zinc and Manganese were determined according to Makino *et al.,* (1982).

Record keeping

The initial body weight of individual male calves was recorded with platform balance, and thereafter at 15 days interval before morning feeding and watering in order to asses the changes in body weight and average daily gain. Body weight gain (BWG) and average daily gain (ADG) were obtained by calculation.

Feed- and economic efficiencies

Feed efficiency was calculated as the amounts of DM, TDN, and DCP per kg gain. Economic efficiency of gain was calculated as the ratio between the income of gain production and the cost of daily feed consumed as follows: Economic efficiency = Income of daily gain / cost of daily feed intake, where the price of 1kg live body weight was 20 LE and 1 Ton of CFM, RS, BH was 1600, 140 and 700 LE, respectivly according to year 2007 market price

Statistical analyses

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

RESULTS AND DISCUSSION

Chemical composition of feedstuffs

Data of Table (1) show the chemical composition of the ingredients used to formulate the rations and the calculated composition of the experimental rations. It could be shown that the chemical composition of the ingredients such as CFM, BH and RS was within the normal values which published by APRI (1997). Moreover, chemical composition of different experimental rations were nearly equal as shown in Table (1) .

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

Item	DM	OM	CP	EE	CF	Ash	NFE
*CFM	90.07	93.37	16.84	2.76	12.59	6.63	61.18
Berseem hay (3^{ed} cut)	89.22	87.86	14.74	3.71	29.33	12.14	40.08
Rice straw	89.41	82.98	3.23	1.44	36.71	17.02	41.60
Calculated experimental ration:							
Control	89.67	88.75	12.40	2.65	23.23	11.25	50.47
Control+ 40 mg Zn sulfate	89.66	88.60	12.23	2.64	23.72	11.40	50.01
Control+ 40 mg Mn sulfate	89.66	88.59	12.24	2.64	23.71	11.41	50.00
Control +40 mg Zn +40 mg Mn sulfate	89.65	88.56	12.21	2.64	23.78	11.44	49.93

Concentrate feed mixture (CFM) contained: 42% undecorticated cotton seed meal , 10% wheat bran, 30% yellow corn, 10% rice bran, 5% molasses , 2% limestone and 1% common salt.

Digestibility and Nutritive values

Data presented in table (2) indicated that adding mixture of both of zinc sulfate and manganese sulfate to the tested rations significantly ($P<0.05$)

increased all nutrients digestibility and hence nutritive values (TDN and DCP) compared to control ration. The highest digestibility coefficient of DM, OM and NFE were recorded with zinc sulfate ration followed by manganese sulfate ration. This might be attributed to the increase of protein and energy utilization in the rumen (Valdes *et al*., 2000 and Salem,2003). Feeding high levels of Zn from Zn sulfate altered ruminal fermentation and protozoa numbers in steers (Froetschel *et al*., 1990). Generally, supplemented ration with zinc and manganese sulfate tended to higher digestibility.

These results are in harmony with those obtained by, Shakweer *et al*., (2010). They found that the addition of zinc sulfate or zinc methionine to the ration of Friesian suckling calves and growing Friesian calves increased the digestibility of DM, OM, CP and CF also nutritive values (TDN and DCP) compared with those of the control group. Mousa and El-Sheikh, (2004) found that both apparent digestibility coefficients of all nutrients and feeding values as TDN and DCP were significantly (P<0.05) increased by different levels of zinc sulfate supplementation to the ration of buffalo-calves. Durand and Kawashima, (1980) concluded that addition of 50mg Zinc / kg DMI of rations showed optimize microbial metabolism and consequently led to improvement of the digestibility of DM, OM, CP, CF, EE and NFE.
Mondal *et al*. (2008), reported that supplementation of Cu, Fe, Zn and Mn improved (P<0.05)digestibility of DM,CP,CF, ash, EE and NFE compared to the unsupplemented control ration.

Table (2) : Digestion coefficients and nutritive values of experimental rations fed to Friesian calves supplemented with $ZnSO_4$ and / or $MnSO_4$.

Item	Experimental rations				SE ±
	control	Control + 40mg Zn sulfate/ kg DMI	Control + 40mg Mn sulfate/ kg DMI	Control +40 mg (each) Zn &Mn sulfate/ Kg DMI	
Digestion coefficients,(%)					
DM	62.25^{c}	70.71^{a}	66.36^{b}	69.67^{a}	.658
OM	64.41^{c}	71.72^{a}	67.40^{b}	70.45^{a}	.744
CP	61.14^{d}	71.50^{b}	66.87^{c}	74.58^{a}	.647
CF	57.26^{c}	67.77^{a}	64.38^{b}	69.79^{a}	.798
EE	67.15^{b}	74.79^{a}	66.65^{b}	77.65^{a}	1.726
NFE	64.69^{b}	70.84^{a}	66.67^{b}	67.76^{a}	1.093
Nutritive values, %					
TDN	57.53^{c}	64.68^{a}	60.13^{b}	65.14^{a}	.640
DCP	7.58^{d}	8.75^{ab}	8.18^{c}	9.11^{a}	.085

a , b, c, and d: Means in the same row followed by different superscripts are significantly different (P<0.05).

Rumen liquor parameters

Ruminal pH values (Table 3) were almost similar among all the experimental rations at 0, 3 and 6 hours post feeding even the control ration showing no significant differences . These results are in line with those

obtained by Robinson *et al.* (2002) and Shakweer *et al.* (2010). However, Arelovich et al., (2000) reported that pH at 2hrs. after feeding was linearly decreased , but at 6.00 hrs. was linearly (P<0.05) increased by adding zinc sulfate .

Over the three sampling times, the concentrations of NH_3.N in Table (3) reduced with zinc sulfate addition compared to that of the control ration during the different period, while it was the highest concentrations by manganese sulfate addition group followed by the mixture of the Zn and Mn sulfate addition group. These results are in accordance with those obtained by Skakweer *et al*. (2010). Also, ruminal ammonia- N was linearly decreased (P<0.05) by adding zinc sulfate as presented by Arelovich *et al.,* (2000). This might be due to that adding zinc sulfate to the ration depressed urease activity directly or it might inhibit growth and reduce the population of ureolytic bacteria as stated by Arelovich *et al.* (2000) .

Table (3): The Effect of $ZnSO_4$ and/ or $MnSO_4$ supplementation on ruminal pH, NH_3, TVFA's values.

Item	Time	Experimental rations: Control	Control+40 mg Zn sulfate/ kg DMI	Control + 40mg Mn sulfate/ kg DMI	Control +40 mg (each) Zn &Mn sulfate/ kg DMI	SE ±
pH	0	6.58[a]	6.48[a]	6.50[a]	6.57[a]	.092
	3	6.28[a]	6.18[a]	6.07[a]	6.17[a]	.085
	6	6.48[a]	6.38[a]	6.48[a]	6.38[a]	.076
NH_3.N (mg/100ml RL)	0	20.80[ab]	19.80[ab]	21.14[a]	18.77[b]	.622
	3	28.60[a]	25.60[bc]	26.63[b]	24.63[c]	.361
	6	23.04[c]	20.04[d]	28.63[a]	25.63[b]	.455
TVFA's(meq/100ml RL)	0	6.88[a]	7.28[a]	7.08[a]	7.38[a]	.194
	3	8.98[c]	9.98[ab]	9.78[b]	10.23[a]	.108
	6	6.42[c]	7.12[b]	6.52[c]	7.32[a]	.061

a , b, c and d: Means in the same row followed by different superscripts are significantly different (P<0.05)

On the other hand, the TVFA's was similar for all the experimental rations even control ration at Zero time. Samples taken at 3 and 6 hrs were significantly (P<0.05) higher for the ration supplemented by the mixture of the Zn and Mn sulfate followed by ration supplemented with zinc sulfate followed by ration supplemented with Mn sulfate. Recorded higher TVFA's might be due to the increase of apparent digestibility of organic matter. These results are in accorde with Arelovich *et al.,* (2000) and Shakweer *et al.,* (2010) who reported that the increased proportion of propionate in ruminal VFA's leads to an increased energetic efficiency of ruminal fermentation which might explain the consistent benefits obtained from addition of chelated zinc supplement.

Blood plasma parameters

The data in Table (4) showed that addition mixture of zinc sulfate and manganese sulfate resulted in significantly (P<0.05) higher each of total protein, albumin, globulin, Zn and Mn that those recorded with control ration. However, urea concentration in blood plasma was significantly the lowest by adding mixture of $ZnSO_4$and $MnSO_4$ followed by ration supplemented with

$MnSO_4$ then ration supplemented with $ZnSO_4$ compared to the control ration which had the highest urea concentration. Also, it could be noticed that adding either Zinc or Mn sulfate to rations tended to higher the previous parameter, except urea concentration. These results are in line with those obtained by Shakweer *et al.* (2010) who found that plasma total protein, plasma albumin, plasma globulin and Zn concentrations of Friesian suckling calves and growing Friesian calves which were supplemented zinc sulfate or zinc methionine were higher than the control ration. Mousa and EL-Sheikh (2004) indicated that zinc sulfate addition increased total protein and globulin concentration, while it decreased albumin and urea concentration in blood serum of buffalo-calves.

Table (4): Effect of $ZnSO_4$ and/ or $MnSO_4$ supplementation on some blood parameters.

Item	Experimental rations				SE ±
	control	Control+40 mg Zn sulfate/ kg DMI	Control + 40mg Mn sulfate/ kg DMI	Control +40 mg (each) Zn &Mn sulfate/ kg DMI	
Total protein g/dl	7.96^{d}	8.66^{b}	8.23^{c}	8.93^{a}	.017
Albumin g/dl	4.72^{c}	5.22^{ab}	4.95^{bc}	5.35^{a}	.089
Globulin g/dl	3.25^{b}	3.45^{ab}	3.28^{ab}	3.58^{a}	.093
urea mg/dl	36.75^{a}	32.75^{ab}	31.75^{b}	24.75^{c}	1.40
Zinc mg/dl	0.69^{d}	0.89^{b}	0.79^{c}	0.98^{a}	.005
Manganese mg/dl	0.25^{b}	0.21^{c}	0.27^{b}	0.31^{a}	.007

a, b, c and d: Means in the same row followed by different superscripts are significantly different(P<0.05) .

Increasing in plasma globulin by zinc supplementation might be due to refelect the rise in total protein as reported by El-Masry and Habeeb (1989) and El-Masry and Yousef (1998). Also, Malcolm-callis *et al.,* (2000) found that zinc addition (30mg /kg DMI) for beef steers significantly increased serum globulin concentration. Similar observation was recorded by Olson *et al* (1999), who reported that supplementation of trace minerals containing Mn and Zn in organic and inorganic forms raised the serum level of respective minerals compared to the control but within sources only plasma Zn level was higher from organic than inorganic.

Growth performance

Data in Table (5) revealed that addition of a mixture of zinc sulfate and manganese sulfate with rate of 40 mg /kg DMI significantly (P<0.05) increased the average daily gain and the total gain followed by ration containing Zn sulfate ($ZnSO_4$) then that supplemented with Mn sulfate ($MnSO_4$) compared to the control ration.

The improvment in growth performance with zinc supplementation ration 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 its role in improving acid – base balance as stated by Halhn and Baker (1988) and digestive enzymes activities by Izhboldina

(1994). 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 zinc/d/animal) than that without zinc supplementation by beef steers. Shakweer *et al.* (2010) found that the daily gain of Friesian suckling and growing Friesian calves was higher (P<0.05) with supplement of 40mg zinc sulfate or zinc methionine than control group. Moreover, Zeedan *et a*l. (2008) stated that daily gain and body weight gain were significantly higher with buffalo-calves fed 40mg and 80mg zinc methionine compared to the control ration. Mousa and EL-Sheikh (2004) found that the addition of zinc at different concentrations increased daily gain of buffalo-calves when compared to the unsupplemented control group.

On the other hand, Greene et al. (1988) reported that there was no significant difference in growth rate and feed conversion of steers fed zinc oxide or zinc methionine in excess of requirement. Moreover, Kessler *et al*. (2003) found that zinc supplementation to fattening bulls in the form Zinc oxide, Znic proteinate and Zinc polysaccharide did not have significant impact on growth performance and feed conversion.

Bioavailability may be defined as the proportion of an ingested mineral that is absorbed, transported to its site of action and converted to the physiologically active species (O'Dell 1983). Bioavailability of minerals particularly trace elements can be affected by a number of factors including animal species, physiological state, previous nutrition, interaction with other minerals and dietary nutrients, choice of standard source, chemical form and solubility of mineral element (Ammerman *et al*., 1995). Feeding high levels of Zn from Zn sulfate altered ruminal fermentation and protozoa numbers in steers (Froetschel *et al*., 1990).

Manganese is linked to growth through its involvement in specific enzyme functions and also Zinc plays an important role in immune response, enzyme systems, an important role in DNA, RNA and protein production. Signs of deficiency include reduced feed intake and weight gain (Ward and Lardy 2005). Zinc has a catalytic, coactive, or structural role in a wide variety of enzymes that regulate many physiological processes including metabolism, growth, and immune function (Vallee and Falchuk, 1993).

Mondal *et al*. (2008), found could be established between that no significant (P>0.05) difference among the various treatment groups in respect to body weight gain (BWG) and average daily gain (ADG) during the first 30 days of the trial, but after 30days throughout the experimental period (BWG) and (ADG) were significantly improved in all mineral supplemented groups compared to the control group.

This is also consistent with the findings of Olson *et al* (1999) and Muchlenbain *et al* (2001) who revealed that different trace minerals, particularly Cu, Mn, Zn, function biochemically as a component of several metalloenzymes and as a cofactor for numerous other enzymes. Zapsalis and Beck 1985, Sorensen 1987 and Boland 2003 revealed that it is possible that different trace minerals enhance growth of calves by stimulating activities of enzymes involved in nutrient utilization.

Table(5): Feed intake, feed efficiency, body weight gain (BWG) and average daily gain (ADG) of Friesian calves given $ZnSO_4$ and/or $MnSO_4$ supplementation .

Item	Experimental rations				SE ±
	Control	Control+40 mg Zn sulfate/kg DMI	Control+40mg Mn sulfat/kg DMI	Control+40mg (each) Zn&Mn sulfate/kg DMI	
No. of animal	5	5	5	5	
Duration /days	180	180	180	180	
Initial body weight, kg	261.6[a]	262.3[b]	262.7[a]	261.3[a]	6.17
Final body weight, kg	395.3[d]	436.7[b]	421.7[c]	448.0[a]	3.28
Total gain, kg	133.7[c]	174.4[ab]	159.0[b]	186.7[a]	7.58
Average daily gain, (g/h/day)	0.743[c]	0.969[ab]	0.883[b]	1.037[a]	.042
(on DM basis) Average daily feed intake					
CFM, (kg/h/day)	3.08	3.21	3.15	3.28	
Berseem hay, (kg/h/day)	1.62	1.87	1.83	1.93	
Rice straw , (kg/h/day)	1.81	2.08	2.03	2.14	
Total intake, (kg/h/day)	6.51	7.16	7.01	7.35	
Total TDN, (kg/h/day)	3.745	4.631	4.215	4.787	
Total DCP, (kg/h/day)	0.493	0.627	0.573	0.669	
Feed efficiency					
Kg DM/ kg, gain	8.8	7.4	7.9	7.1	
Kg TDN/ kg, gain	5.0	4.8	4.8	4.6	
Kg DCP/kg,gain	0.66	0.65	0.65	0.65	

A , b, c and d: Means in the same row followed by different superscripts are significantly different (P<0.05) .

Feed intake and feed efficiency

Daily feed intake as kg DM, TDN and DCP/ head are shown in table (5) .The highest intake and the efficiency were recorded with addition of mixture of 40 mg $ZnSO_4$ +40 mg $MnSO_4$ /kg DMI followed by ration supplemented with 40 mg $ZnSO_4$ then ration supplemented with $MnSO_4$ compared to the control ration. Regarding feed efficiency expressed as a mounts of DM, TDN and DCP per 1 kg gain, it could be noticed that the ration containing mixture of 40 mg $ZnSO_4$ +40 mg $MnSO_4$ had the best values (7.1, 4.6, 0.65) followed by ration supplemented with 40 mg $ZnSO_4$ (7.4, 4.8, 0.65) then ration supplemented with 40 mg $MnSO_4$ (7.9, 4.8, 0.65) compared to the control ration (8.8, 5.0, 0.66), respectively.

Results here are in agreement with those of Shakweer and *et al*. (2010) who found that feed efficiency was improved with adding zinc sulfae or zinc methionine supplementation for growing Friesian calves . Mousa and El-Sheikh (2004) reported that feed intake and feed efficiency were improved with adding 40mg zinc sulfate /kg DMI for buffalo-calves compared to the control group.

Economic efficiency

The economical study in Table (6) showed that the feed cost/kg weight gain (L.E.) of control group was (9.68 L.E/kg gain) while, the supplemented groups were 7.12 , 8.39 and 10.86 LE/ kg gain for ration supplemented with $ZnSO_4$+ $MnSO_4$ followed by that supplemented with $MnSO_4$ then that supplemented with $ZnSO_4$, respectively. The best economic efficiency was detected with ration supplemented with ($ZnSO_4$+ $MnSO_4$)

with rate of 40 mg (each) /kg DMI (2.8%) followed by ration supplemented with $ZnSO_4$ (2.6%) then ration supplemented with $MnSO_4$ (2.4%) compared to the control ration (2.1%).

$$\text{Economic efficiency (\%)} = \frac{\text{Price of daily gain (L.E)}}{\text{Average daily feed cost (L.E.)}}$$

Table (6): Economic efficiency of Friesian calves fed on ration supplemented with $ZnSO_4$ and/or $MnSO_4$ supplementation .

Item	control	Control+ 40mg Zinc sulfate/kgDMI	Control + 40mg Mn sulfat/kgDMI	Control + 40mg (each) Zn&Mn sulfate/kgDMI
Daily feed intake (as fed),kg				
CFM	3.48	3.57	3.50	3.65
Berseem hay (3rd cut)	1.88	2.13	2.07	2.18
Rice straw	2.12	2.33	2.27	2.40
Total feed intake, kg/h/d	7.48	8.03	7.84	8.23
Zinc supplement , g/h/d	--	.11	--	.11
Mn supplement, g/h/d	--	--	.13	.13
Total daily feed cost (L.E.)/h/d	7.19	7.56	7.41	7.81
Average daily gain, kg/h/d	0.743	0.969	0.883	1.097
Feed cost/kg gain (L.E.)	9.68	10.86	8.39	7.12
Price of daily gain (L.E.)	14.86	19.38	17.66	21.94
Economical return (L.E/h/d)	5.18	8.52	9.27	14.82
Economic efficiency(%)	2.1	2.6	2.4	2.8

Calculation based on the following price in Egyptian pound (L.E.) per ton according to year 2007 market price. The price of 1kg live body weight = 20 LE , Concentrate feed mixture (CFM) = 1600 L.E./ton, Berseem hay=700 L.E./ton, Rice straw=140 L.E./ton, zinc sulfate=30 L.E./kg, manganese sulfate =30 L.E./kg,

Conclusion

From these results, it could be concluded that ration containing 40 mg $ZnSO_4$ plus 40 mg $MnSO_4$ tended to higher digestibility coefficient, increase daily gain, improved feed efficiency and decrease feed cost to give 1 kg gain of Friesian calves. Moreover, using Zinc sulfate appeared higher performance that using Mn sulfate with the previous parameter.

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تـأثير إضـافة كبريتـات الزنـك و/أو كبريتـات المنجنيزعلـى الاداء الانتـاجى للعجـول الفريزيان

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أجريت هذه الدراسة بهدف دراسة تأثير إضافة كبريتات الزنك و/أو كبريتات المنجنيز على معاملات الهضم والقيمة الغذائية وبعض مقاييس الكرش والدم ومعدل النمو.حيث استخدم في هذه الدراسة عشرون عجل فريزيان بمتوسط وزن 262 كجم غذيت على علائق مضاف إليها 40 ملجم زنك مصدرة كبريتات الزنك أو 40 ملجم منجنيز مصدرة كبريتات المنجنيز وقسمت العجول إلى أربعة مجاميع (5 عجول في كل مجموعة) و غذيت العجول خلال فترة النمو التى استمرت 180 يوما على النحو التالي :-

1. مجموعة المقارنة غذيت على علف مركز + دريس برسيم + قش الأرز بدون إضافات طبقا لمقررات NRC(2001) .
2. المجموعة المختبرة الأولى غذيت على عليقة المقارنة +40 ملجم كبريتات الزنك /كجم مادة جافة ماكولة .
3. المجموعة المختبرة الثانية غذيت على عليقة المقارنة +40 ملجم كبريتات المنجنيز /كجم مادة جافة مأكولة.
4. المجموعة المختبرة الثالثة غذيت على عليقة المقارنة +40 ملجم كبريتات الزنك +40 ملجم كبريتات المنجنيز /كجم مادة جافة مأكولة.

- اظهرت النتائج أن إضافة كبريتات الزنك و كبريتات المنجنيز أدى إلى تحسن في معاملات الهضم والقيمة الغذائية للعليقة المأكولة مقارنة بمجموعة المقارنة . أما بالنسبة لمقاييس الكرش فقد أدت إضافة الزنك و المنجنيز على صورة كبريتات إلى انخفاض تركيز أمونيا الكرش وزيادة تركيز الأحماض الدهنية أما بالنسبة لمقاييس الدم أدت إلى ارتفاع ضئيل في تركيز بروتين الدم والجلوبيولين بينما انخفض تركيز الالبيومين ويوريا الدم مقارنة بمجموعة المقارنة بينما أدى إلى إضافة الزنك و المنجنيز على صورة كبريتات معا إلى أفضل معدلات النمو والكفاءة التحويلية للغذاء وكذلك العائد الاقتصادي حيث سجل متوسط النمو اليومى مقدار 1.037 كجم ، 7.1 كجم مادة جافة/كجم نمو مع 2.8% كفاءة اقتصادية.

وتوصى الدراسة :

بإضافة الزنك و المنجنيز على صورة كبريتات معا بمعدل 40 ملجم/كجم مادة جافة مأكولة مما يؤدي إلى زيادة معدلات النمو والكفاءة التحويلية للعجول خلال فترة التسمين مقارنة بمجموعة المقارنة كما أعطت أفضل عائد اقتصادي لعلائق عجول التسمين الفريزيان.

قام بتحكيم البحث

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