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EFFECT OF DIFFERENT LEVELS OF ZINC SUPPLEMENTATION ON UTILLIZATION OF NON – PROTEINOUS NITROGEN AND PRODUCTIONERFORANCE OF BUFFALO –CALVES.

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ABSTRACT

Twenty male of buffalo-calves weighing 216 kg ± 1.5 kg on average and aged one year were used in 208 days (feeding trials).Animals were divided into four groups (5 calves each) G_1,G_2,G_3 and G_4 ,respectively to study the effect of different levels of Zinc supplementation on animal performance, nutrient digestibility, some blood parameters, carcass characteristic and feed efficiency. Calves were individually fed on rations consisted of concentrate feed mixture and rice straw, provided with 1% urea and zinc sulfate ($ZnSO_4$) at different levels being 0,40, 80 and 120 mg/kg DM intake, respectively.

Results showed that digestibility of DM, OM, CP, CF, EE and NFE, nutritive values (as TDN), daily gain, feed conversion (as kg DM, kg TDN, kg DCP/kg gain) and eye muscle area (cm^2) were significantly increased by increasing zinc supplementation levels. Supplementing 40 mg /Kg DM intake (DMI) of zinc to concentrate feed mixture (G_2) was significantly increased levels of total protein, albumin, globulin and Zn in plasma and decreased plasma urea concentration of buffalo-calves. It also significantly decreased weight of different organs and kidney fat . Moreover economic efficiency was higher and feed cost /kg gain was decreased by adding zinc in concentrate feed mixture compared with control.

Generally, addition of zinc improved nutrients digestibility, daily gain, feed conversion and economic efficiency and did not affect carcass characteristics.

Keywords: Buffalo-calves-Zinc-Digestibility-Nutritive value-Daily gain – Feed conversion – Blood parameters – Carcass – Economic efficiency.

INTRODUCTION

Zinc is a trace mineral that is required in the diet for proper metabolic function of ruminants as well as other animals. Considerable uncertainty exists concerning zinc (Zn) requirements of ruminant animals and possible effects of marginal concentrations of Zn in forages on animal health and performance. Requirements for beef cattle (NRC, 1984) are listed as 30 mg/kg DMI (range of 20 to 40).

Urea is widely used because it is an economical source of non protein nitrogen for ruminants. Inadequate ruminal ammonia can reduce microbial activity (Satter and Slyter, 1974). Spears and Hatfield (1978) reported that elevated concentrations of Cu, Zn, Cd, Sr, Ca, Co, Mn, Ba and Mg can inhibit ammonia accumulation from urea in vitro. Also, Arelovich *et al.* (2000) reported that supplementation of the diet with Zn at a dietary level of 250 ppm, to increase Zn concentration in ruminal liquid to approximately 7 ppm, may prove beneficial to decrease the potential for urea toxicity and to favorably alter the pattern of volatile fatty acids in the rumen. The purpose of this work was to study 'the effects of dietary supplementation of different concentrations of zinc on digestibility, some blood constituents, daily gain, and carcass quality of buffaloe-calves fed on 1% urea – contoining diets.

MATERIALS AND METHODS

This work was carried out at Sids, Animal Production Experimental Station in middle Egypt (150 k.m. south Cairo), Animal Production Research Institute, Ministry of Agriculture, to investigate the effect of different levels of zinc supplemention on utilization of non proteinous nitrogen for buffalo-calves.

Feeding trail:

Twenty male buffalo-calves of 216 kg average weight and about one year age were chosen randomly from Sids Station. The animals were kept under semi open sheds in summer. Animals were divided into four nearly similar groups (5 calves each) according to their average live body weight. Calves were individually fed for 208 days (experimental period). Animals were individually weighted biweekly just before eating and drinking. Daily feed intake and refusals were recorded .Also, daily weight gain and feed efficiency were calculated. The average annual atmospheric maximum temperature at Sids area during the period of this work was about 31.3°C and the annual mean relative humidity was 65.1%.

At the end of the experimental period, three calves from each feeding group were randomly chosen, fasted for 18 hours prior to slaughter and weighed immediately before and after slaughtering .Hot carcass ,body offals and internal organs were separately weighed. The content of the digestive tract were removed and their weights were subtracted from the slaughter live body weight to obtain the empty body weight .Samples were taken from 9^{th} -11^{th}. ribs cut for determined of lean ,fat and bone percentages and chemical analysis according to A.O.A.C (1980). Area of rib eye was measured by calk paper placed over the cut surface and measured by planometer.

Experimental rations:

Four experimental rations (control + 3 treatments) were used in this study.

Ration 1: Animals were fed on 2% of LBW concentrate feed mixture mixed with 1% urea of DM intake without zinc additive and 1% of LBW rice straw .

Ration 2: Animals were fed on control ration plus 40 mg zinc (as 0.11g $ZnSO_4$) per Kg DM intake.

Ration 3: Animals were fed on the control ration plus 80 mg zinc (as 0.22 g $ZnSO_4$) per kg DM intake.

Ration 4: Animals were fed on control ration plus 120 mg zinc (as 0.33 g as Zn SO_4) per kg DM intake.

Animals were individually fed on the experimental rations. Concentrate feed mixture and rice straw were offered twice daily at 9.0 a.m. and 3.0 p.m. All animals were watered twice daily.

Digestion trial:

Four digestion trails (3calves each) were carried out using buffalo-calves to determine the nutritive values of the experimental rations. The digestion trail was extended for 15 days as primary period and 4 days as collection period. Nutrient domesticities were determine by acid insoluble ash (A.I.A.) methods using 4NHcl procedure (Van Keulen and Young 1977). Proximate analysis of ration and faeces samples was carried out according to the methods of A.O.A.C. (1980).

Blood parameters:

Blood samples were taken at the beginning and at the end of feeding trail from three fasted animals from each group, three blood heparinized samples were collected from the jugular vein and plasma was separated by centrifugation of the uncoagulated blood samples for 15 minute at 3500 rounds per minute. Blood parameters were measured, included total protein (Gornal *et al.*, 1949), Albumin (Dumas and Biggs, 1972), urea (Coulomboe and Favreau, 1963) and zinc concentration (Homsher and Zak, 1985). Globulin was calculated by difference between total protein and albumin.

The data were statistically analyzed by using a general linear models procedure (GLM) according to SAS (1988) , Duncan multiple range test was carried out when the mean effect was significant (Duncan, 1955).

RESULTS AND DISCUSSION

Chemical composition of feedstuffs and experimental rations:

Data for chemical analysis of concentrate feed mixture (CFM) and rice straw are given in Table 1.Crude protein (CP) and crude fiber (CF) contents of the concentrate mixture were 14.24 and 12.01%, respectively, while CP and CF contents of the rice straw were 3.89 and 37.01%, respectively (Table 1). These results are in accordance with those of Hanafy *et al.* (1996) and Fouad *et al.* (2003). On the other hand, all the experimental rations had nearly the same content of OM, CP, CF, EE, NFE and ash percentages.

Table (1): Proximate analysis of the feed ingredients and experimental rations.

Item	DM%	Chemical composition on DM basis (%).					
		OM	CP	CF	EE	NFE	Ash
CFM*	88.15	93.91	14.24	12.01	3.11	64.55	6.09
Rice straw	90.08	84.79	3.89	37.01	1.28	42.61	15.21
Rations:							
R_1	88.79	90.95	10.85	20.21	2.51	57.38	9.05
R_2	88.78	90.96	10.86	20.18	2.51	57.41	9.04
R_3	88.79	90.91	10.80	20.31	2.50	57.30	9.09
R_4	88.78	90.94	10.84	20.22	2.51	57.37	9.06

*: concentrate feed mixture consisted of 30% decorticated cottonseed cake, 25% corn grain, 30% wheat bean, 6% rice bran, 5% molasses, 2% lime stone, 1% common salt and 1% minerals and vitamins.

Effect of Zn addition on digestibility coefficients and feeding values:

The addition of different concentrations of zinc to the rations significantly (P<0.0) increased digestibility of CP, CF, EE and NFE when compared to the control ration (Table 2). These results cleared that the digestibility of calves increased by elevating the level of Zn supplementation (Froetschel *et al*, 1990, Abdel-Rahim *et al*, 1995 and Daghash and Mousa, 1999). While ,DM digestibility significantly (P<0.0) increased with G_3 and G_4 and in significant increased with G_2 than that in control ration .This might be attributed to the increase of protein and energy utilization as indicated by the increase improvement of rumen traits (Valdes *et al.*, 2000 and Salem, 2003).Also, This might be attributed to increasing the activity of carbohydrates, fats and protein enzymes such as amylase, lipase, trypsinogen and some peptidase, since these enzymes are known to be Zn-dependent enzymes (Banerjee, 1988 and Lu and Combs, 1988). While, Durand and Kawashima (1980) concluded that addition of 50 mg Zn/kg DM to rations would optimize microbial metabolism and consequently led to improvement of the digestibilities of DM, OM, CP, CF, EE and NFE.

Table (2): Digestion coefficients and nutritive values of buffalo-calves fed on the experimental rations.

Item	Groups			
	G_1	G_2	G_3	G_4
Digestibility, %:				
DM	65.07^{c}	65.58^{bc}	66.60^{ab}	66.85^{a}
OM	67.48^{b}	68.79^{ab}	69.13^{ab}	69.33^{a}
CP	63.69^{b}	65.09^{a}	65.32^{a}	65.40^{a}
CF	54.93^{b}	55.85^{ab}	56.95^{a}	57.08^{a}
EE	66.07^{b}	67.58^{a}	67.08^{a}	68.39^{a}
NFE	72.68^{b}	74.09^{a}	74.25^{a}	74.51^{a}
Nutritive values , %:				
TDN	63.15^{b}	64.41^{ab}	64.60^{ab}	64.90^{a}
DCP	6.91	7.07	7.06	7.09

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

As shown in Table (2), the nutritive values as TDN % was significantly (P < 0.05) increased by increasing the levels of Zn addition. Improving of TDN may be due to increasing digestibilities of most nutrients when Zn was added to rations. Moreover, in the present study, DCP % increased when Zn was added to the concentrate ration with no significant differences among groups. This may be due to increased CP digestibility for these groups.

Effect of Zn addition on blood parameters:

Results in Table (3) show that Zn addition at level of 40 mg/kgDMI increased total protein, globulin and Zn in plasma, but it decreased plasma urea of buffalo-calves compared with other levels and control .The differences were not significant. These results indicate that addition of 40 mg zinc may be increases the available zinc for absorption (Kegley and Spear, 1994). On the other hand ,the increase in plasma protein may be due to increased protein synthesis as a result of the elevation of anabolic hormone secretion (Freeman, 1983 and El-Masry and Habeeb, 1989) and the decrease in the catabolic hormones such as glucocorticoid and catecholamine (Alvarez and Johnson, 1973 and Baillet *et al*, 1997). The increase in plasma globulin in zinc treated calves might be a reflection of the rise in total protein (El-Masry and Yousef, 1998). While, a lower plasma urea nitrogen concentration of zinc treated calves suggests a great utilization of amino acids for protein synthesis (Madson, 1983 and Duncan and Prassa, 1986) and increases the efficiency of nitrogen retention (Bires *et al*. 1993). On the other hand, the high levels of Zn concentrations (80, 120 mg Kg/DMI) did not affect total protein, albumin and globulin, but significantly increased both urea and Zn concentrations in plasma of buffalo-calves when compared to the control animals. These results are in accordance with those of Malcolm-Callis *et al*. (2000) who found that Zn fed at 30 mg/kg DM by beef steers significantly increased serum Zn. While, Grings *et al*. (1999) reported that the addition of zinc (30 mg/kg DM) did not affect plasma Zn concentration by beef heifers. Campbell *et al*. (1999) found that plasma urea nitrogen was not different between the control group and group of cows fed on Zn supplemented diet.Blood metabolic profiles of this study are within the normal ranges as reported by Kaneko (1989), Salama *et al*. (1989), Daghash and Mousa, (1999) and Borai, (2003) with buffalo-calves.

Effect of Zn addition on daily gain, feed intake and feed conversion:

Table (3): Blood parameters of buffalo-calves fed on the experimental rations.

Item	Groups			
	G_1	G_2	G_3	G_4
Total protein,g/dl:				
Initial trail	6.61^{ab}	7.23^{a}	6.02^{b}	6.63^{ab}
Final trail	7.71^{ab}	8.04^{a}	7.04^{b}	7.72^{ab}
Albumin, g/dl:				
Initial trail	2.51	2.54	2.53	2.58
Final trail.	2.86	2.91	2.76	2.97
Globulin, g/dl:				
Initial trail	4.10^{ab}	4.69^{a}	3.49^{b}	4.05^{ab}
Final trail	4.85^{ab}	5.13^{a}	4.28^{b}	4.75^{ab}
Albumin/Globulin ratio				
Initial trail	0.61^{b}	0.54^{c}	0.72^{a}	0.64^{b}
Final trail	0.59^{ab}	0.57^{b}	0.64^{a}	0.63^{a}
Urea, mg/100 ml:				
Initial trail	14.82^{b}	14.00^{b}	41.75^{a}	35.76^{a}
Final trail	53.14^{a}	29.04^{b}	52.75^{a}	53.06^{a}
Zinc, mg/100 ml:				
Initial trail	37.04^{b}	39.46^{b}	57.20^{a}	40.14^{b}
Final trail	66.26^{c}	125.93^{b}	159.47^{a}	167.32^{a}

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

Data in Table (4) revealed that the addition of Zn at different concentrations increased daily gain of buffalo-calves when compared with the control group.The differences were not significant . While, the level of 40 mg Zn/kg DMI was the most effective one on daily gain when compared with the other groups. The response of buffalo calves to zinc addition may be due to the lack of zinc content that usually occurs in Egyptian feedstuffs (Attia *et al*, 1987 and Abdel-Malik *et al*, 2001). On the other hand, this improved growth performance could be due to Zn supplementation which a very important element because it acts as a component and an activator for over than 200 metalloenzymes and hormones (Riodran and Vallee, 1976).Zinc led also to the improvement of acid-base balance (Hahn and Baker, 1988), the activities of digestive enzymes (Izhboldina, 1994), propionate concentration and ruminal protozoa numbers (Froetschel *et al*, 1990), efficiency of dietary protein utilization and nutrients metabolism (Banerjee, 1988), total protein and globulin in blood plasma (Bednarek *et al*, 19991) and immunity protection (Gross *et al*, 1979 and Bires *et al*, 1993). The present results are in agreement with those of Goetsch *et al.* (1990) who found that the daily gain was ($P < 0.05$) higher with supplemented ration (4g daily of Zn/animal) than that without zinc supplementation by beef steers. In addition, Grings *et al.* (1999) and Malcolm-Callis *et al.* (2000) found that ,there was no significant influence on weight gain in beef steers fed on 30 mg Zn supplemented diet. On the other hand, results in Table (4) indicated that the overall average daily gain was 874 g/h/d. These values were higher than those of reported by some investigators in Egypt when buffalo calves fed CFM and roughages. El-Bendary *et al.* (1994) reported 842 g/h/d, Abdel-Baki *et al* (2003) reported 835 g/h/d , Etman *et al.* (2001) reported 814 g/h/d, El-Shinnawy, (1989) reported 768 g/h/d, Boraei, (2003) reported 760 g/h/d, Etman and Ahmed (1996) reported 733 g/h/d, Ragheb *et al.* (1989) reported 725 g/h/d,El-Ashry *et al.* (1985) reported 711 g/h/d and Baraghit *et al.* (1999) reported 700 g/h/d.

Table (4): Performance of buffalo-calves fed on the experimental rations.

Item	Groups			
	G_1	G_2	G_3	G_4
No. of animals	5	5	5	5
Duration/day	208	208	208	208
Initial weight, Kg.	216.60	217.60	214.40	215.20
Final weight, Kg.	392.80	407.60	393.90	396.40
Total gain, Kg.	176.20	190.00	179.50	181.20
Daily gain, Kg.	0.847	0.913	0.863	0.871
Daily feed intake, (Kg/Head):				
Concentrate feed mixture	5.38	5.44	5.27	5.32
Rice straw	2.73	2.74	2.53	2.69
Total intake (Kg DM/Head)	8.11	8.18	7.80	8.01
Kg TDN/Head	5.126	5.270	5.172	5.204
Kg DCP/Head	0.561	0.579	0.551	0.568
Feed conversion:				
Kg DM/Kg gain	9.57	8.95	9.03	9.06
Kg TDN/Kg gain	6.05	5.78	5.99	5.98
Kg DCP/Kg gain	0.661	0.633	0.637	0.653

Feed intake as Kg DM, TDN, DCP/head are shown in Table 4.The lowest value of feed intake as DM and DCP/head was observed with G_3 (80 mg Zn/Kg DMI) and the highest was recorded with G_2 (40 mg Zn/Kg DMI) compared with that in control group without significant differences. On the other hand, there was an improvment in feed conversion as Kg DM, Kg TDN, Kg DCP/Kg gain by addition of Zn for buffalo-calves (Table 4). The best feed conversion as Kg DM, Kg TDN and Kg DCP required for each Kg gain was obtained with G_2 followed by G_3 and G_4 ,respectively , than that in control with no significant differences among them. Ward *et al.* (1992) found similar DMI for stressed cattle supplemented with $ZnSO_4$. While, Malcolm-Callis *et al.* (2000) reported that there was no differences ($P<0.1$) for the overall 126-d trial for DMI by beef steers fed 30 mg Zn in finishing diets. Nunnery *et al.* (1996) reported that feedlot steers fed one of five supplemental concentrations (5, 35, 95, 215, or 445 mg/kg) of zinc as $ZnSO_4$ had no effect ($P<0.1$) on feed efficiency . Yet, Malcolm-Callis *et al* (2000) found that feed efficiency of steers for day 56 to day 84 exhibited a linear ($P<0.1$) increase and a positive quadratic ($P<0.1$) response with supplemental zinc.

Effect of Zn addition on Carcass:

Data concerning mean of carcass characteristics for the experimental groups (Table 5) show that the average of fasting weight, empty weight, hot carcass weight, dressing per fasting body weight, bone weight and boneless weight of group (4) which fed 120 mg Zn were significantly lower than the other groups. On the other hand, the differences among groups for dressing per empty body weight, percentage of boneless meat and meat : bone ratio were found insignificant. These data are in accordance with those of Berrie *et al.* (1995) who reported no differences ($P < 0.10$) in carcass characteristics of lambs supplemented with zinc sulfate (70 mg/kg of DM). Likewise, Nunnery *et al.* (1996) reported that carcass characteristics were similar ($P< 0.10$) for steers regardless of dietary zinc concentration. In addition, Malcolm-Callis (2000) found that increasing added zinc concentration up to 200 mg/kg did not greatly influence carcass characteristics.

Table (5): Some carcass parameters of buffalo-calves fed on the experimental rations.

Item	Groups*			
	G_1	G_2	G_3	G_4
Fasting body weight, kg.	401.50^{ab}	415.00^{a}	421.00^{a}	387.50^{b}
Empty body weight, kg.	375.70^{ab}	376.50^{ab}	389.25^{a}	362.50^{b}
Hot carcass weight, kg.	214.75^{b}	218.50^{b}	224.00^{a}	201.65^{c}
Dressing, (%)**.	53.63^{a}	52.53^{b}	53.21^{ab}	52.11^{b}
Dressing, (%)***.	57.22	57.98	57.55	55.63
Bone wt. (Kg)	38.78^{a}	39.50^{a}	40.50^{a}	35.88^{b}
Boneless wt. (Kg)	175.97^{a}	179.00^{a}	183.50^{a}	165.77^{b}
Percentage of boneless meat	81.94	81.92	81.92	82.21
Meat: bone ratio	4.54	4.53	4.53	4.62
The hide weight, Kg.	40.50^{a}	40.00^{a}	38.00^{b}	40.00^{a}
The hide, (%)**.	10.11^{a}	9.64^{ab}	9.02^{b}	10.21^{a}

: Per fasting body weight, *: per empty body weight.

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

On the other hand, results in Table (5) indicated that the overall average percentage of boneless meat (82%) is higher than that reported by Ragheb *et al.* (1989), El-Bendary *et al.* (1994), El-Basiony *et al.* (1998 and 2003) and El-Kholy *et al.* (2003) for native buffalo calves being 81.1, 77.8, 77.5, 81.1 and 78.9%, respectively.

Data in Table (6) indicate that 40 mg Zn/KgDMI significantly (P< 0.05) decreased weight of different organs of the carcass and kidney fat but it did not affect heart and intestine fat. While, both 80 and 120 mg Zn/Kg DMI did not greatly influence carcass organs and organs fat. Similar findings were obtained by Malcolm-Callis *et al.* (2000) who reported that percentage of kidney weight, and heart fat thickness were less (P < 0.10) for steers supplemented with Zn SO_4 (30 mg/kg of DM). The authors also found that no differences (P<0.1) were noted in percentage of kidney weight and heart fat by using high concentrations of zinc (100 and 200 mg/kg of DM). Different responses to zinc supplementation by buffalo-calves may be due to the result of differences in initial zinc status, so zinc supplementation during back grounding may alleviate the effects of zinc supplementation at the feedlot.

Table (6):Organs and organs fat of buffalo-calves fed on the experimental rations.

Item	Groups			
	G_1	G_2	G_3	G_4
Organs:				
Heart weight, Kg.	1.50^{ab}	1.10^{b}	1.75^{a}	1.10^{b}
Heart (%).	0.37^{ab}	0.27^{b}	0.42^{a}	0.29^{b}
Liver weight, Kg.	6.13^{a}	5.38^{b}	6.00^{a}	5.25^{b}
Liver, (%).	1.53^{a}	1.30^{b}	1.43^{a}	1.36^{b}
Kidney weight, kg.	1.10^{bc}	1.00^{c}	1.45^{a}	1.20^{b}
Kidney, (%).	0.27^{b}	0.24^{c}	0.34^{a}	0.31^{ab}
Spean weight, Kg.	1.05^{a}	0.75^{b}	1.00^{a}	0.80^{b}
Spean, (%).	0.26^{a}	0.18^{b}	0.24^{a}	0.21^{b}
Lungs weight, Kg.	5.05^{b}	4.75^{c}	5.95^{a}	5.60^{ab}
Lungs, (%).	1.25^{b}	1.15^{c}	1.42^{a}	1.45^{ab}
Testes weight, Kg.	0.48^{a}	0.40^{b}	0.45^{ab}	0.40^{b}
Testes, (%).	0.12^{a}	0.10^{b}	0.11^{ab}	0.10^{b}
Organs fat, Kg:				
Heart	0.75^{ab}	0.85^{a}	0.90^{a}	0.68^{b}
Kidney	1.90^{a}	1.00^{b}	2.15^{a}	1.60^{ab}
Intestine	2.25	2.00	2.50	1.95
Total organs fat	4.90^{ab}	3.85^{b}	5.55^{a}	4.23^{b}

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

Effect of Zn addition on eye muscle:

Addition of zinc at different concentrations significantly (P<0.05) increased eye muscle (Longissimius dorsi) area (cm^2), while it had no effect on tenderness (cm^2), while it had no effect on tenderness (cm^2), water holding capacity (cm^2), pH value and chemical analysis of eye muscle as percentages of moisture, protein and ash.

On the contrary, Rust and Schlegel (1993) found that zinc supplementation provided as ZnO or zinc methionine decreased *Longissimius muscle area* compared to control steers. Moreover, Malcolm-Callis *et al.* (2000) noted no differences in Longissimius muscle area of finishing steers fed on concentrate diets with different zinc sources. Geay (1992) mentioned that the physical characteristics of eye muscle are vary according to different factors related to animal (breed, six, age and physicologcial state) and its environment (level and nature of the food intake).

Table (7): Physical characteristics and chemical analysis of eye muscle of buffalo-calves fed on the experimental rations.

Item	Groups			
	G_1	G_2	G_3	G_4
10,11 and 12 ribs weight, kg	3.58	3.75	3.50	3.75
Meat, (%)	69.77^a	65.50^{ab}	65.02^{ab}	60.87^b
Bone, (%)	12.98^b	16.54^a	15.13^a	12.83^b
Fat, (%)	17.25^b	17.96^b	19.85^{ab}	26.30^a
Physical eye muscle:				
Area, (Cm^2)	14.25^b	16.00^{ab}	18.00^a	16.75^{ab}
Tenderness, (cm^2)	11.00	10.50	10.25	11.00
Water holding capacity, (cm^2)	15.75	13.75	14.75	15.50
pH value	5.44	5.38	5.08	5.47
Chemical eye muscle				
(%) On fresh basis :				
Moisture	75.89	76.24	75.91	75.88
Protein	15.27^b	16.81^a	16.48^a	16.73^a
Ether extract	5.20^a	3.43^b	3.77^b	3.84^b
Ash	3.64	3.52	3.84	3.55
(%) on DM basis:				
Protein.	86.01^a	87.93^a	87.35^a	87.40^a
Ether extract.	5.45^a	3.60^b	3.95^b	4.04^b
Ash.	3.84	3.71	4.04	3.74

a,b: means in the same row followed by different superscripts are significantly ($P < 0.05$) different

Economic efficiency:

Data in Table (8) indicate that the addition of zinc at different concentrations decreased total costs/kg daily gain which was reflected on the economic efficiency (increase). While, addition of 40 and 80 mg Zn/Kg DMI decreased total costs/ dressing percentage/fasting or empty body weights which was reflected on the economic efficiency for dressing percentage/fasting or empty body weight.

Results of this study suggest that the performance and carcass characteristics are not improved as a results of increasing the level of zinc sulfate in a typical feedlot diet above NRC recommendations. Therefore, it could be concluded that the use of zinc sulfate in feeding buffalo-calves should be economic.

Table (8): Economic efficiency of buffalo-calves fed on the experimental rations.

Item	Groups			
	G_1	G_2	G_3	G_4
Daily consumption (Kg) :				
Concentrate feed mixture	5.38	5.44	5.27	5.32
Rice straw	2.73	2.74	2.53	2.69
Urea	0.0811	0.0818	0.0780	0.0801
Zinc sulfate	-	0.0009	0.0017	0.0026
Total costs*/Kg daily gain (L.E.)	7.14	6.75	6.94	7.00
Economic efficiency*	1.25	1.42	1.30	1.31
Total costs*/kg daily dressing** (L.E.)	13.31	12.85	13.04	13.43
Economic efficiency**	0.87	0.97	0.92	0.86
Total costs*/kg daily dressing*** (L.E.)	12.48	11.65	12.06	12.58
Economic efficiency***.	0.99	1.19	1.09	0.98

Price of feedstuffs(L.E./ton): concentrate feed mixture 750 , rice straw 50 ,urea 800 and zinc sulfate 30 (L.E. per Kilogram). While price of kg live body weight was 10.50 L.E. and price of meat 26 L.E. per kg.

*** 70% daily feed costs + 30% another costs.**

*** Per daily gain**

****: Per fasting body weight.**

*****: Per empty body weight.**

REFERENCES

A.O.A.C. (1980). Association of Official Analytical Chemists, official methods of analysis. 13th Ed., Washington, D.C.

Abdel-Baki, S.M., S.M. Bassuny, H.M. Ghanem; R.I. Moawd and A.H. Ghoneim (2003). Clays in animal nutrition. 2. Study on using tafla in buffalo bull calves feeding. Egypt. J. Nut. and Feeds., 6:703.

Abdel-Malik, W.H., M.F. El-Sayes, A.E.M. Khinizy and E. Soliman (2001). Yield and quality of berseem and alfalfa cultivated in newly reclaimed sandy soil in response to foliar trace mineral fertilization and its effect on lamb performance. Egypt. J. Nut. and Feeds., 4:167.

Abdel-Rahim, M.I., M.N. El-Gaffary; M.I. Tawfeek, H.M. Kelawy and R.S. Amin (1995). Effect of dietary supplementation with different level of zinc on growth performance, nutrients digestibility, minerals metabolism, blood constituents, organs histopathology and reproductive efficiency in NZW rabbits. Egypt. J. Rabbits Sci., 1:11.

Alvarez, M.B. and H.D. Johnson (1973). Environmental heat exposure on cattle plasma catecholamine and glucocorticoid. J. Dairy Sci., 56:189.

Arelovich, H.M., F.N. Owens, G.W. Horn and J.A. Vizcarra (2000). Effects of supplemental zinc and manganese on ruminal fermentation, forage intake and digestion by cattle fed prairie hay and urea. J. Anim. Sci., 78: 2972.

Attia, A.N., S.A. Awadalla, E.Y. Esmail and M.M. Hady (1987). Role of some microelements in nutrition of water buffaloes and its relation to production. 2. Effect of zinc supplementation. Assiut Vet. Med. J., 18 : 91.

Baillet, G., G. Cuzon, M. Cosin and C. Kerlequer (1997). Effect of dietary protein levels on growth of Penaeus Stylivostris Juveniles. Nut. Abst. Rev., 68: 145.

Banerjee, G.C. (1988). Feeds and Principles of Animal Nutrition. 2nd Ed. Oxford and IBH Publishing Co. PVT. LTD., 636 p.

Baraghit, G.A., M.M. Youssef, B.M. Ahmed, S.S. Omar and O.M. El-Malky (1999). Effect of lasalocid supplementation on nutrients digestibility, rumen fermentation and performance of buffalo calves. Egypt. J. Nut. and Feeds., 2:393.

Bednarek, D., M. Kondrachi and J. Krasucki (1991). Effect of zinc on mineral, hematological and immounological indices in calves. Polskie Archiwum Vet., 31:129.

Berrie, R.A., D.M. Hallford, and M.L. Galyean (1995). Effect of zinc source and level on performance, carcass characteristics and metabolic hormone concentrations of growing and finishing lambs. Prof. Anim. Sci., 11: 149.

Bires, J., P. Bartko, H. Seidel, M. Sedovic, Z. Juhasova and T. Weissova (1993). Zinc deficiency and possibilities of its supplementation by injection administration. Trace Element Nauki, 1:327.

Boraei, M.A. (2003). Utilization of different fiber sources in ruminants nutrition. Egypt. J. Nut and Feeds., 6:1267.

Campbell, M.H., J.K. Miller and F.N. Schrick (1999). Effect of additional cobalt, copper, manganese and zinc on reproduction and milk yield of lactating dairy cows receiving bovine somatotropin. J. Dairy Sci., 82: 1019.

Coulomboe, L.J. and C.D. Favreau (1963). Urea determine. Am. J. Clin. Path., 16:40.

Daghash, H.A. and S.M. Mousa (1999). Zinc sulfate supplementation to ruminant rations and its effects on digestibility in lambs; growth, rectal temperature and some blood constituents in buffalo calves under heat stress. Assiut Vet. Med. J., 40 (1): 128.

Dumas, B.T. and H.G. Biggs (1972).Standard Method of Clinical Chemistry. Vol. 7, Academic Press, New York. P. 175.

Duncan, D.B. (1955). Multiple range and multiple F. tests. Biomerics, 11:1.

Duncan, J.R. and K.W. Prassa (1986). Veterinary Laboratory Medicine (2nd Ed.). Iowa State Univ. Press, Ames.

Durand, M. and R. Kawashima (1980). Influence of minerals in rumen microbial digestion. In: Y. Ruckebusch and P. Thivend (Eds.). Digestive Physiology and Metabolism in Ruminants. pp. 375-408. AVI Publ. Co., Inc., Westport, CT.

El-Ashry, M.A., M.A. Abdel-Hamid, R. Graziani and E.S. Ragheib (1985). The efficiency of fattening buffalo calves on whole grain system. First World Buffalo Congress. Dec., Cairo, p. 380.

El-Basiony, A.Z., E.E. Ragheb and H.M. Metwally (1998). Effect of lasalocid and Yea-sacc supplementation on performance, digestibility and carcass characteristics of buffalo calves. Arab Univ. J. Agric. Sci, Ain Shams Univ., Cairo, 6(1): 99.

El-Basiony, A.Z., E.E. Ragheb, H.M. El-Nahas and G.A. Abdel-Rahman (2003). A comparison among some growth promoters for fattening Egyptian Buffalo calves. Egypt. J. Nut. and Feeds., 6: 685.

El-Bendary, M.M., I.A. Abou-Selim, M.R.M. Mostafa, A.M. Mahmoud and A.E.M. Khinizy (1994). Performance of fattening buffalo calves fed different levels of fat for two different periods. Egypt. J. Anim. Prod., 31:613.

El-Kholy, N.M., G.A. Baraghit, S.S. Omar, B.M. Ahmed and Kh. I. Zedan (2003). Effect of different sources of dietary fat on performance, ingestive behavior and carcass traits of fattening buffalo calves. Egypt. J. Nut. and Feeds, 6:709.

El-Masry, K.A. and A.A. Habeeb (1989). Thyroid function in lactating Friesian cows and water buffaloes under winter and summer Egyptian conditions. Proc. of 3rd Egypt-British Conf. on Anim. Fish and Poult. Prod., Vol. 20, Alex, Egypt ,P: 613.

El-Masry, K.A. and H.M. Yousef (1998). Effect of supplemental Zn and vitamin A on some blood biochemical and immune indices related to growth performance in growing calves. Proc. of First Conf. on Anim. Prod. and Health. In Semi-Arid Areas, El-Arish. North Sinai, Egypt. P: 139.

El-Shinnawy, M.M. (1989). The efficiency of feeding buffalo calves on low level of concentrates. 3rd Egypt. British. Conf. on Anim., Fish and Poult. Prod. Alex., Egypt. P: 571.

Etman, K.E.I. and S.M.M. Ahmed (1996). Performance of buffalo calves fed ammonia treated poor quality roughage. Int. Symp. Buffalo Resources and Production Systems. Cairo, Egypt. P. 59.

Etman, K.E.I., A.M.M. Zeid and T.I. El-Monyer (2001). Effect of feeding two carbohydrate sources in rations of buffalo calves on feed utilization and growth performance. Egypt. J. Nut. and Feeds, 4:633.

Fouad, R.T., T.A. Deraz and Kh. M. Mousa (2003). Nutritive value of Abo-Rukba (*Digitaria sanquinalis* L.) hay compared with urea treated and untreated roughages. J. Agric. Sci. Mansoura Univ., 28: 1701.

Freeman, B.M. (1983). Physiology and Biochemistry of Domestic Fowel. Vol. 4, p. 181. Acadamic Press, New York and London.

Froetschel, M.A., A.C. Martin, H.E. Amos and J.J. Evans (1990). Effects of zinc sulfate concentration and feeding frequency on ruminal protozoal numbers, fermentation pattern and amino acid passage in steers. J. Anim. Sci., 68: 2874.

Geay, Y. (1992). Nutritional and biological factors of meat quality in cattle. 43rd Annual Meeting of the EAAP, 14-17 Sept. Madrid, Espain.

Goetsch, A.L., G.E. Murphy, E.W. Grant, L.A. Forster, Jr., D.L. Galloway, Sr., C.P. West and Z.B. Johnson (1990). Effects of animal and supplement characteristics on average daily gain of grazing beef cattle. J. Anim. Sci., 69: 433.

Gornal, A.G., C.J. Bardawil and M.M. David (1949). Determination of serum proteins by means of the biuret reaction. J. Biol. Chem., 177:751.

Grings, E.E., R.B. Staigmiller, R.E. Short, R.A. Bellows and M.D. MacNeil (1999). Effects of stair-step nutrition and trace mineral supplementation

on attainment of puberty in beef heifers of three sire breeds. J. Anim. Sci., 77: 810.
Gross, R.L., N. Osolin, L. Fong and P.M. Newberne (1979). Depressed immunological function in zinc deprived rats as measured by nitrogen response of spleen, thymus and peripheral blood.AM. Clin. Nutr. 32:1260.
Hahn, J.D. and D.H. Baker (1988). Growth and plasma zinc responses of young pigs fed pharmacological levels of zinc. J. Anim. Sci., 71: 3020.
Hanafy, M.A., A.M. Abd El-Gawad and K.M.M. Mussa (1996). Economical fattening of buffalo calves using different sources of non-protein nitrogen. Egyptian J. Anim. Prod., 33, Suppl. Issue. 133.
Homsher, R. and B. Zak (1985). Spectrophotometric investigation of sensitive complexing agents for the determination of zinc in serum. Clin. Chem., 31: 110.
Izhboldina, S.I. (1994). Trace elements during rearing and fattening of young bulls. Zootekhniya, 33(3): 14.
Kaneko, Jiro. J. (1989). Clinical Biochemistry of Domestic Animals. 4th Ed. Academic Press, Inc. San Diego, California, USA.
Kegley, E.B. and J.W. Spear (1994). Effect of zinc supplementation on performance and zinc metabolism of lambs fed forage based diets. J. Agric. Sci., 123(2): 287.
Lu, J and G.F. Combs (1988). Effect of excess dietary zinc on pancreatic exocrine function in the chick. J. Nut., 118:681.
Madson, A. (1983). Metabolism in liver. In: P.M. Riis (Ed), Dynamic Biochemistry of Animal Production, p: 62., Elsever, Sci., Publ Company, New York.
Malcolm-Callis, K.J, G.C. Duff, S.A. Gunter, E.B. Kegley and D.A. Vermeire (2000). Effects of supplemental zinc concentration and source on performance, carcass characteristics, and serum values in finishing beef steers. J. Anim. Sci., 78 : 2801.
NRC (1984). Nutrient Requirements of Beef Cattle (6th Ed.). National Academy Press, Washington, DC.
NRC (1990). Nutrient Requirements of Dairy Cattle. 7th Ed., National Academy of Sciences, National Research Council, Washington, D.C.
Nunnery, G.A., G.E. Carstens and L.W. Greene (1996). Feedlot performance and carcass characteristics in steers fed different sources and levels of supplemental zinc. J. Anim. Sci., 74 (Suppl. 1): 294 (Abstr.).
Ragheb, E.E., A.Z. Basiony and A.Y. El-Badawi (1989). Fattening performance of buffalo calves fed two rations of different energy ratios 3rd Egypt. British. Conf. on Anim., Fish and Poult. Prod. Alex., Egypt. P. 563.
Riordan, J.F. and B.L. Vallee (1976). Structure and function of zinc metallo-enzymes. In: Trace Elements in Human and Diseases. Prased A.S., 1:227.
Rust, S.R. and M.L. Schlegel (1993). Effect of dietary zinc level and source on steer intake, growth and carcass characteristics. J. Anim. Sci., 71: 249.
Salama, M.A.M., T.M. El-Bedawy and L.H. Bedeir (1989). Effect of early weaning on productive performance of buffalo calves up to six months of age. 3rd Egypt British. Conf. on Anim. Fish and Poul. Prod. Alex., P: 535.

Salem, F.A. (2003). Effect of dietary silage source on feed intake, nutrients digestibility, some blood constituents and milk production in lactating buffaloes. Egypt. J. Nut. and Feeds, 6:5.

SAS.(1988).User`s Guide (Release 6.03) SAS Inst., Inc.,Cary. NC,USA..

Satter, L.D. and L.L. Slyter (1974). Effect of ammonia concentration on rumen microbial protein production *in vitro*. Br. J. Nutr., 32: 199-208.

Spears, J.W. and E.E. Hatfield (1978). Nickel for Ruminants. I. Influence of dietary nickel on ruminal urease activity. J. Anim. Sci., 47: 1345.

Valdes, C., M.D. Carro, M.J. Ranilla and J.S. Gonzulez (2000). Effect of forage to concentrate ratio in complete diets offered to sheep on voluntary food intake and some digestive parameters. J. Anim. Sci., 70: 199.

Van Keulen, J. and B.A. Young (1977). Evaluation of acid-insoluble ash as a natural marker in ruminant digestibility studies. J. Anim. Sci., 44:282.

Ward, J.D., J.W. Spears and E.B. Kegley (1992). Effect of trace mineral source on mineral metabolism, performance and immune response in stressed cattle. J. Anim. Sci., 70 (Suppl. 1): 300 (Abstr.).

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تأثير إضافة مستويات مختلفة من الزنك على معدل الاستفادة من المواد الآزوتية غير البروتينية والأداء الإنتاجى للعجول الجاموس

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يهدف هذا البحث إلى دراسة تأثير مستويات مختلفة من الزنك على معدل الاستفادة من اليوريا ومدى تأثير هذه الدراسة على الأداء الإنتاجى للعجول الجاموسى وذلك باستخدام عشرين عجل جاموس بمتوسط وزن ٢١٦,٠ كيلو جرام ± ١,٥ كيلو جرام فى أربع مجاميع وتم تغذيتها على علائق تحتوى على علف مركز بنسبة ٢% من وزن الجسم مضاف إليه ١% يوريا بجانب ١% من وزن الجسم قش ارز وتم إضافة الزنك فى صورة كبريتات بتركيزات (٠، ٤٠، ٨٠، ١٢٠ ملليجرام/كجم مادة جافة مأكولة) للعلائق.

وقد أدت إضافة الزنك إلى زيادة معاملات الهضم المختلفة والقيمة الغذائية للعلائق ومعدلات النمو والكفاءة التحويلية للغذاء ومساحة العضلة العينية. بينما إضافة ٤٠ ملليجرام زنك/كيلو جرام مادة جافة مأكولة أدت إلى زيادة البروتين الكلى والجلوبيولين والزنك فى الدم ولكنها أدت إلى خفض نسبة اليوريا فى الدم. وأيضاً قد أدت إلى نقص وزن الأعضاء ودهن الكلية. وبوجه عام أدت إضافة الزنك إلى تحسين الكفاءة الإقتصادية ولم يكن لها تأثير على صفات الذبيحة.