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EFFECT OF ZINC AND EDTA AS ADDITIVES ON PRODUCTIVE PERFORMANCE AND CARCASS TRAITS OF BUFFALO MALE CALVES

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SUMMARY

Twenty male buffalo calves ranged between 8-12 months of age with an average body weight (194.5±6.85 kg) were used to study the effect of adding Zn and EDTA as additives on growth performance and carcass characteristics. Animals were divided randomly into four groups (n=5) according to their average weight, the 1st group, (T_1) fed on basal diet +1g zinc (Several zinc) /calf/day, the 2nd (T_2) fed on basal diet which supplemented with 1g EDTA /calf/day, the 3rd (T_3) fed on basal diet +1g zinc +1g EDTA /calf/day, and the 4th (C, control group) fed on basal diet only. Calves of T_1 and T_3 were gained more weight than (C) by 15.8 and 4.0%, respectively while T_2gained less by 4.1% as compared with control. The average daily gain, feed intake and gain: feed ratio were not affected significantly by adding Zn or EDTA additives during the feeding trial. Dressing percentage (hot carcass weight basis), head, legs weight and edible meat weight did not differ among groups, while the weight of lunges, spleen and tests were differed significantly ($P<0.05$). The highest value of edible meat content was detected of EDTA, zinc and EDTA+zinc groups by 27.15, 21.47, and 11.09%, respectively compared with control group. Zinc group had attained the highest meat ($P<0.05$) of high priced cuts than EDTA, EDTA+zinc and control groups. Results revealed that the differences among groups in best ribs components were insignificant. The carcasses of (T_1) and (T_3) groups recorded higher boneless meat percentage; (T_1) group was higher for coefficient of meat ratio. The differences among treated groups in chemical composition and physical traits of L. dorsi muscle (9-10-11th rib) were significant in fat%, ash%, and pH value and non-significant for protein%, tenderness, and water holding capacity. Rib eye area was higher ($P<0.05$) in calves fed zinc compared with the other groups. The increasing rib-eye areas in calves fed zinc may be explained by the greater carcass weights in the zinc treated group relative to the other groups.

Keywords: Zn, EDTA, Buffalo, performance and carcass characteristics

INTRODUCTION

Improving meat production from buffalo male calves are an important target to cover shortage in meat production in Egypt. The animal's performance depends on the influence of heredity and environmental factors. The main aim of better calves' management is to obtain optimum growth rate and to improve feed efficiency. Meat is produced in the form of gained in body weight by promoting the biological responses, to manipulate rumen fermentation by the dietary addition of a large variety of feed additives. Zinc (Zn) could hypothetically become an alternative growth promoter to ionophores when added in the diet at a higher concentration than the animal's requirement, and improved growth rate (Phiri *et al.*, 2009), Zn deficiency in cattle causes parakeratosis, anorexia, growth failure, defective cell-mediated immunity and impaired reproductive function. Znic a component of numerous metal-enzymes and transcription factors (O'Dell, 2000), which plays significant roles in the metabolism of essential nutrients in ruminants (Jia *et al.*, 2008). This metal is the second most abundant trace element in the body and it is not stored in the body, a continuous dietary intake is essential for body appropriate physiological functions (Zalewski *et al.*, 2005). Zn could increase the concentration of rumen propionate and feed efficiency (Arelovich *et al.*, 2000), and decrease the acetate: propionate ratio (Bateman *et al.*, 2004). Ethylene diamine tetra acetic acid (EDTA) has been approved by the food and drug Administration as a food additives generally recognized safe. Additionally, EDTA is safety used as a chelating agent with heavy metals or mercury poisoning, a high dose of EDTA administered to someone in good health could have toxic effects, improve growth rate and mineral metabolism by EDTA havebeen shown by (Hakwins, 2014)

The aim of the present study is to investigate the effect of dietary zinc and EDTA as additives on animal performance and carcass characteristics measurements in male buffalo calves.

Materials and Methods

This study was carried out at Mehalet Mosa Station, Animal Production Research Institute, Agriculture Research Center, Ministry of Agriculture, Egypt. The experimental period was extended for six months. Twenty buffalo male calves (*Bubals bublus*) with an age averaged between 8-12 months and have 194.5±6.85 kg initial live body weight (LBW) are divided into four random groups (n=5/each) based on their initial weight and age. T_1 group was fed the basal diet +1g zinc (several zinc) /calf/day. Several zinc was produced by Egyptian United Company (EUC),Egypt. The ingredients of this compound are; 10 million IU/kg Vit A, 20 million IU/kg Vit D3, 10000 mg/kg Vit A and 50000 mg/kg zinc bacitracin. The ingredients in the product were carried by calcium carbonate up to 1 kg.T_2 group was fed the basal diet which supplemented with 1g EDTA /calf/day, T_3 group was fed the basal diet +1g zinc +1g EDTA/calve/day, the EDTA produced by ADWIC United Company (El-Nasr Pharmaceutical Chemical), Egypt. Control group animals (C) were fed the basal diet without adding additives. Calves were housed in semi-open shad yards and feeding according to NRC allowances for fattening animals (NRC, 2000),The basal diet contain (concentrate mixture, berseem hay and rice straw), the concentrate feed mixture consists of 35.5% wheat bran, 31.5% undecorticated cotton seed cake, 15% yellow corn, 10% sun flower seed cake, 3.5% vinous, 3% limestone and 1.5% salt (NaCl). Animals received the same feeding twice daily in the morning and afternoon in amounts adequate to allow *ad-libitum* access to feed after *ad libitum* watering system. Calves were weighed biweekly and average daily gain was calculated. At the end of experiment, three animals from each group were chosen randomly to be slaughtered after 16 hr fasting period. After complete bleeding, animals were skinned and dressed out, weight of the following parts were recorded,

- Carcass offal's (liver, heart, lungs, kidneys, spleen and tests).
- Non carcass components (NCC) (head, hide, four legs, full and empty digestive tract).
- Residuals (RSC) (diaphragm, tail, gall bladder, and penis).
- Body fat (BF) (kidneys fat, heart-fat, and coal fat).

Each carcass was split into two halves, each half was divided between the 8^{th} and 9^{th} ribs into fore and hind-quarter, each quarter was weighed. Hot carcass weight (HCW) was recorded by the sum of four quarters. The two quarters of the left side of hot carcass were dissected into bone and boneless meat and weighed.

- Dressing percentage was estimated as percentage of hot carcass weight.

High priced cuts weight calculated as described byAwadalla (1993). The percentages of carcass cuts were calculated as percentage of carcass weight. *Longissimu dorsi* at 9, 10, 11^{th} ribs cut weight was separated from the left side then dissected into lean, fat and bone, then weighed, meat included fat: bone ratio (coefficient of meat) was determined, eye muscle area was measured by plan-meter in square centimeters. Samples from *L .dorsi* muscle were used to determine meat physical characteristics as follow:

- pH value was measured 12 h. after slaughtering by using Micro-computer pH-vision model 6007 (Jenco)
- Water holding capacity (WHC) was determined according to Soloviev (1966) after 24 h. chilling period at 4^oC,using Digital planimeterplanix 5.6.
- Color intensity of meat-water extract and drip was determined according to the method described by Husaini *et al.* (1950).It was measured by using (Spectronic 21D absorbents at 542 nm weave length). 10 gm of sample was shaken with 22.5 ml distilled water in dark room for 10 min., filtered and the color intensity was estimated.
- Two samples each of about 100g *from L.dorsi*were weighed to determined cooking loss and put in boiling water for 45 minutes from the time that the water boils again after that samples were removed from water and left to reach room temperature, and then reweighed to calculated the cooking loss as percentage from initial weight according to (El-Asheeri 1984).
- Chemical analysis was done also on *L. dorsi* samples at Sakha meat laboratory according to A.O.A.C (1990).

Statistical Analysis

Data were analyzed by a completely randomized One-way analysis of variance; all data are presented as least squares means. All calculations are completed using SAS (SAS Institute Inc., 1990). Duncan's multiple range tests (Duncan, 1955) is used for comparison among means, considering ($P \leq 0.05$) as a significant level.

$Y_{ij} = \mu + T_i + e_{ij}$

Y_{ij} = Experimental observation

μ = The overall mean.

Ti = Effect of treatment (I=1-4) where, 1= zinc Bacitracin, 2= EDTA, 3= zinc+EDTA and 4= control (no additives),

eij = Experimental error assumed to be randomly distributed (0, $\sigma 2$)

RESULTS AND DISCUSSION

Results in Table (1) showed the effect of dietary Zn and EDTA supplementation on feed intake as DM intake kg/day/head (FI), average DM intake per 100 kg body weight, DM consumption per unit of metabolic body size (W0.75), average daily gain (ADG) and feeding efficiency. Results indicated that feed intake, ADG and feed efficiency increased with Zn supplementation (T1 & T3 groups). However, the differences were insignificant among test groups. Mean daily DM intake ranged between 9.5 to 10.1 kg/head/day. Corresponding figure for the consumption of DM as kg/100kg body weight was 5.2± 0.09 to 5.9± 0.1 and 181.97 to 193.7gm/w0.75 which was in accordance with the expected feed intake of similar BW for calves. The average daily gain (kg) for the animals fed EDTA ration (0.89 kg) was lower than those of animals fed zinc (1.09kg) and for control group (0.93kg) during the feeding period. Average relative growth rate was found in T1 and T3 groups was higher by 15.8 and 4.0%, respectively, and lower by 4.1 % in T2 compared with control group (C).

Feed efficiency improved by Zn inclusion may be attributed to high levels of Zn altered rumen fermentation to capture increased feed energy as VFA and decrease the acetate: propionate ratio (Bateman et al., 2002). In cattle,adding250 to 400 mg Zn/kg-1DM of low-quality forage altered rumen fermentation by retarding ammonia accumulation and increasing molar proportions of propionate (Arelovich *et al*., 2000). These results would be in agreement with those reported by (Spears and Kegley, 2002;Bateman *et al*., 2004 and Jia *et al*., 2008). Zinc improving antibiotic and body metabolism by reduce accumulation of high level of blood heavy metal atoms from an enzyme and formation of complexes of less toxic metals which are biologically less activation in liver, kidneys and therefore affects the water and feed intake (Szakva *et al*., 2009). On contrary to the present results, Malcolm-Callis *et al*., 2000; Salama *et al*., 2003; Mandal *et al*., 2007; Fadayifar *et al*., 2012 and Khalil *et al*., 2013 reported that they did'nt identify any effect of adding 300 ppm Zn on feed consumption, feed efficiency and ADG in weaning calves.

Adding EDTA with zinc for animals feed decreased the performance characteristics, this may be due to the interaction between EDTA and zinc and formation complex of metals which are biologically less active. Serge *et al*. (1992) reported that adding EDTA caused a significant depression in serum Zn availability with no significant effect on average daily gain, feed intake or efficiency of feed utilization in veal.

Results in Table (2) showed that the empty body weight was higher (P<0.05) in T1 (354.3 kg) compared to T3, T2 and C groups (335.7, 321.8 and 325.7 kg), respectively. Also full digestive tract weight was significantly higher (P<0.05) for T1 than C groups than T2, T3 and C groups.

Table 1. Feed intake and efficiency (LSM±SE) of buffalo calves fed on zinc and EDTA as food additives

Item	C	T_1	T_2	T_3
Initial weight(kg)	194.6±7.4	195.1±5.2	194.9±8.55	194.5±6.27
Final weight(kg)	362.2±17.1	391.3±14.6	355.1±16.19	369.2±18.01
Daily gain (kg)	0.9±0.08	1.089±0.10	0.89±0.09	0.97±0.07
Relative growth rate % (basis on daily gain)	0.48±0.11	0.558±0.09	0.46±0.06	0.49±0.07
Average daily feed intake (FI):				
Daily DM intake kg/day/head	9.6±0.48	9.8±0.4	9.5±0.38	10.1±0.5
DM kg/100 kg/day	5.9±0.13	5.6±0.06	5.7±0.13	5.16±0.08
DM g/$w^{0.75}$/day	183.6±2.08	188.4±2.6	181.97±1.65	193.65±3.01
Feed conversion (kg)				
Kg DM intake / kg gain	10.3±0.77	9.03±0.59	10.68±0.60	10.4±0.7
Feed efficiency (FE)				
Kg gain / Kg DM intake	0.09±0.00	0.1±0.00	0.09±0.00	0.09±0.00

C,control group fed on a basal diet only, T_1, fed on basal diet +1g zinc /calf/day, T_2, fed on basal diet with 1g EDTA /calf/day, and T_3, fed on basal diet +1g zinc +1g EDTA /calf/day.
Within the same row, means with different superscripts a,b&c are significant at (P<0.05)

Results in Table (2) showed that hot carcass weight was heavier in calves fed zinc compared with those fed EDTA, animals showed a tendency to gain more and consumed more feed. There was a slight increase in T1 and T3 groups by 1.04 to 1.01% compared with control group, although the differences among groups were insignificant. El-Basiony et al. (2001) observed similar DP% ranged from 51.6 to 52.1 for buffalo males (Spears and Kegley, 2002;Galyean et al. (1995); Malcolm-Callis et al. (2000) and Paulk (2015) conducted that increasing dietary Zn didn't improve hot carcass weight, dressing percentage and carcass characteristics in beef steers.

Bone percentage (relative to hot carcass weight)was higher (23.5%) in control group, while T1 group recorded the lowest value (19.99%). Boneless meat% showed the opposite trend. Also, the highest meat: bone ratio in buffalo carcass were found inT1 group (4.00). Meat coefficient was lower than that obtained El-Basiony *et al*. (2001) for buffalo males, while slaughter weight was not affected by adding EDTA in veal (Serge *et al*., 1992).

Table 2.Carcass characteristics and dressing percentage (LSM±SE) of buffalo calves fed on zinc and EDTA as food additives

Item	C	T1	T2	T3
Number of animals	3	3	3	3
Fasting body weight (FBW) kg	362.2±19.0	391.3±26.1	355.1±17.8	369.2±23.5
Empty body weight (EBW) kg	325.7±15.0 [b]	354.3±16.4 [a]	321.8 ±21.3 [b]	335.7±24.0 [b]
Full digestive tract (FDT) kg	63.9 ±9.9 [a]	64.3±11.7 [a]	58.2±10.1 [c]	60.3 ±9.5 [b]
Empty digestive tract (EDT) kg	26.5±0.3	27.1±0.5	24.4±0.4	25.9±0.6
digestive tract content kg	37.5±6.8 [a]	37.2±7.7 [a]	33.8±4.5 [c]	34.4±5.1 [b]
Hot carcass weight (HCW)kg	180.4±6.7	202.2±8.4	173.5±6.3	185.1±5.2
Dressing percentage**				
HCW/FBW	49.8±0.3	51.7±0.3	48.9±0.3	50.0±0.2
Boneless meat weight (MW)	138.0±3.6	161.8±5.4	135.5±3.1	142.5±4.8
MW/HCW	76.5±0.5	80.0±0.6	78.1±0.4	77.0±0.7
MW/EBW	42.4±0.2	45.7±0.2	42.1±0.3	42.**4**±**0**.2
Bone weight kg	42.5±1.5	40.4±1.8	38.0±2.0	42.6±1.1
Bone/HCW	23.5+0.2	20.0+0.2	21.9+0.3	23.0+0.2
Meat Coefficient (M:B ratio)***	3.3+0.3	4.0+0.9	3.6+0.5	3.4+0.3

C,control group fed on a basal diet only, T_1, fed on basal diet +1g zinc /calf/day, T_2, fed on basal diet with 1g EDTA /calf/day, and T_3, fed on basal diet +1g zinc +1g EDTA /calf/day.
Within the same row, means with different superscripts a,b&c are significant at(P<0.05)
** Dressing % based on fasting wt = Hot carcass wt / fasting wt ×100
*** Meat: Bone ratio

Table 3.Edible meat, offals and non-carcass components (LSM±SE) of buffalo calves fed on zinc and EDTA as food additives.

Item	Control	T1	T2	T3
Offal's weights (kg)				
Liver	3.37±0.1	4.66±0.3	5±0.2	4.35±0.1
Heart	1.27 ±0.0	1.77 ±0.0	1.84 ±0.0	1.2 ±0.0
Kidneys	1.1 ±0.0	1.33 ±0.0	1.4 ±0.0	1.3 ±0.0
Lunges+ trachea	4.53 ±0.0 [b]	4.7 ±0.0 [a]	4.83 ±0.0 [a]	4.5 ±0.0 [b]
Spleen	0.75 ±0.01 [c]	0.83 ±0.01 [b]	0.97 ±0.02 [a]	0.90 ±0.02 [a]
Testes	0.25 ±0.0 [b]	0.4 ±0.0 [a]	0.29 ±0.0 [b]	0.27 ±0.0 [b]
Total offal's weight	11.27±0.2	13.69±0.4	14.33±0.3	12.52±0.1
Non Carcass Components (NCC)				
Head weight	21.15±1.6	22.5 ±1.8	21 ±2.1	21.77 ±1.2
Hide weight	36 ±0.1 [b]	37.90±0.3 [a]	36.43±0.2 [b]	36.12±0.2 [b]
4 legs weight	12 ±1.3	12.6 ±1.7	11.5 ±1.4	11.9 ±2.0
Gall bladder weight	0.39 ±0.0	0.37 ±0.0	0.34 ±0.0	0.41±0.0
Tail weight	1.64 ±0.0	1.7 ±0.0	1.48±0.0	1.91 ±0.0
Total NCC weight	71.18± 3.2	75.07±3.9	70.75±4.0	72.11±3.5

C,control group fed on a basal diet only, T_1, fed on basal diet +1g zinc /calf/day, T_2, fed on basal diet with 1g EDTA /calf/day, and T_3, fed on basal diet +1g zinc +1g EDTA /calf/day.
Within the same row, means with different superscripts a,b&care significant at(P<0.05)

The average weights of different carcass components are shown in Table (3). Offals weight was almost similar in all groups except the average weight of liver and heart which was heavier for T_2group (5&1.8 kg, respectively).The differences in lunges, spleen and tests weights among groups were significant (P<0.05). The total edible meat weight was higher for T_2, T_1 and T_3 groups by 27.15, 21.47 and 11.9%, respectively compared with C group. Non-carcass components weight (e.g. head, legs, hide and tails) didn't show a remarkable difference among treated groups. Gregory (2006) indicated that carcass measurements not affected by feeding steers on 90 ppm of zinc supplementation. Hiers*et al*. (1967) showed that no consistent treatment effects on relative size of hearts, kidneys, or spleen of the animals when fed on 300 ppm of EDTA. On the other hand, Malcolm-Callis *et al*. (2000) observed high percentage of kidney, pelvic and heart fat by feeding steers on 30 ppm zinc supplement.

Concerning the high priced cuts (Table 4), significant differences (P<0.05) were observed among tested groups in round and high priced cut weight (HPCW), the highest weight was detected in T_1 group (89.21kg) compared with T_3, T_2 and C groups (79.91, 75.94 and 73.95kg, respectively), also T_1 group tented to be higher HPCW percentage (on HCW basis) (44.11%) compared with the other groups and similar for T_2, T_3 and C groups. The present results were lower than what obtained by Awadalla (1993) for buffalo calves.

The results of *best ribs* physical components were presented in Table (5).C group had the lowest lean% (65.0), while the 3 tested groups (T_1, T_2 and T_3) were similar in lean percentage (68.25, 68.96 and 69.49%, respectively).The differences in fat % among tested groups were insignificant. The control group scored the highest percentage of fat (13.3%), while T_1 had the lowest value (11.1%). Meat coefficient of best ribs (9-10 and 11th) in T_3 and T_2 groups was higher (3.73 and 3.48) compared with T_1 and control groups (3.31 and 3.00) respectively). The results were in agreement with the results reported by Omar (1997) and El-Kholy *et al*. (1999) using buffalo calves aged 18 months.

Table 4.The average weight and percentage of high priced cuts (HPC) (LSM±SE)of buffalo calves fed on zinc and EDTA as food additives.

Item	C	T_1	T_2	T_3
Hot carcass weight (HCW)kg	180.4±6.7	202.2±8.5	173.5±6.4	185.1±5.2
Sirloin (kg)	10.5±0.39	11.7±0.5	10.0±0.4	10.7±0.3
inside round (kg)	12.97 ^{b}±0.5	16.5 ^{a}±0.6	12.5 ^{b}±0.5	13.3 ^{b}±0.4
Topside (kg)	16.8 ^{b}±0.6	19.9 ^{a}±0.8	16.2 ^{b}±0.6	17.3 ^{b}±0.5
eye of round +silverside (kg)	18.7±0.7	22.1 ±0.9	18.9±0.7	21.3 ±0.6
prime rib (kg)	7.1±0.1	7.9±0.2	6.8±0.1	7.3±0.1
Short loin (kg)	6.03±0.3	6.8±0.3	5.8±0.3	6.2±0.2
Tenderloin (kg)	3.9±0.2	4.3±0.3	3.7±0.2	3.9±0.2
Total HPCW (kg)**	75.9 ^{c}±2.9	89.2^{a}± 3.6	73.9 ^{c}±2.7	79.9 ^{b}±2.2
HPCW/HCW %	42.1	44.1	42.6	43.2

C,control group fed on a basal diet only, T_1, fed on basal diet +1g zinc /calf/day, T_2, fed on basal diet with 1g EDTA /calf/day, and T_3, fed on basal diet +1g zinc +1g EDTA /calf/day.
Within the same row, means with different superscripts a,b&c are significant at(P<0.05)
** HPCW = high price cut weight. Cuts' weight, High price cuts= Fore ribs+round+sirloin+ tenderloinas reported byAwadalla (1993).

Table 5. Average weight and percentage of best ribs (9-10 and 11th) physical components (LSM±SE) of buffalo calves fed on zinc and EDTA as food additives.

Item	C	T_1	T_2	T_3
Best ribs (9-10-11th) weight				
Weight of best ribs (kg)	6.0±0.23	6.3±0.24	5.8±0.237	5.9±0.193
Lean weight (kg)	3.9±0.2	4.3±0.1	4±0.2	4.1±0.1
Lean (%)	65.0±1.2	68.25±0.8	68.96±1.0	69.49±0.7
Bone weight (kg)	1.3±0.1	1.3±0.1	1.15±0.1	1.1±0.1
Bone (%)	21.67±0.7	20.63±0.4	19.83±0.7	18.64±0.5
Fat weight (kg)	0.80±0.0	0.70±0.0	0.65±0.0	0.70±0.0
Fat (%)	13.33±0.1	11.11±0.1	11.21±0.1	11.86±0.1
Meat Coefficient (lean:bone) ratio	3.0±1.6	3.31±2.8	3.48±1.3	3.73±2.1

C,control group fed on a basal diet only, T_1, fed on basal diet +1g zinc /calf/day, T_2, fed on basal diet with 1g EDTA /calf/day, and T_3, fed on basal diet +1g zinc +1g EDTA /calf/day.
Within the same row, means with different superscripts a,b&c are significant at(P<0.05)

The consumer demand of meat are depends on too much water holding capacity, less cooking loss and high juiciness (Manafiazar *et al*., 2007). Chemical composition of *L.dorsi* muscle of buffalo calves feed EDTA or zinc as additives was illustrated in Table (6),a higher percentage of protein (on DM% basis) was higher for T_3 and T_1 groups compared with those in T_2 and control (82.2 and 81.4*vs*. 80.5 and 80.6%, respectively), however the difference in protein% among groups was insignificant. The differences in fat percentage were significant among the studies groups (T_2 than T_1, T_3 and C group recording (14.5*vs*. 13.5, 13.0 and 13.7 respectively). Ash percentage was higher in C group (5.7%) which was significant (P<0.05),while T_3 group had the lowest value (4.8%).

Physical properties of meat including pH-value, water holding capacity, cooking loss percentage and color intensity are presented in Table (6). There was a significant difference (P<0.05) among treatment groups in pH values which ranged from 6.28 to 6.64. Soheir *et al*. (1999) indicated that the pH values of meat from fattening buffalo calves ranged 5.46 to 5.58. On the other hand, Kessler *et al*. (2003) reported that adding10 ppm of zinc in Red Holstein bulls rations didn't affect significantly carcass characteristic and meat quality.

Adding EDTA or zinc had a significant effect on color intensity of meat among the experimental groups Table (6). Adding EDTA to the diet reduced Zn availability and liver Fe concentration and increased urine Fe, caused a decline in the blood Hb which used as an indicator of a mild state of anaemia which may account for the reduction in DM intake so that adding EDTA effectively lightened muscle color without affecting animal performance (Serge *et al*., 1992). Excessive concentration of zinc in the diet may be competed with the absorption of other bivalent metals such as Ca, Fe and Cu as antagonists, the concentration of these elements in blood would change as reported by (Garg*et al*., 2008)

No significant difference was detected among the studied groups in the percentages of cooking loss and water holding capacity (Table 6).This result might be due to the little variation in moisture and connective tissue content and the positive relationship between protein percentage and WHC since proteins are the principal water-binding constituents in meat, this was agree with the finding obtained by Soheir *et al*. (1999) that found that water holding capacity for buffalo calves ranged from (6.29 to 8.12 cm^2).Other researchers report that adding zinc to a control diet increased quality grade, yield grade, marbling, and backfat of the finishing steers (Malcolm-Callis *et al*., 2000;Huerta*et al*., 2002; Spears and Kegley, 2002 and Gregory, 2006).

Table 6.Chemical composition and physical characteristics (LSM±SE) of buffalo calves fed on zinc and EDTA as food additives.

Item	C	T_1	T_2	T_3
<u>Chemical composition(Fresh basis)</u>				
Moisture %	72.6±0.3	72.7±0.2	72.9±0.4	72.7±0.5
Crude protein (CP)%	22.1±0.3	22.2±0.2	21.8±0.2	22.5±0.4
Ether Extract %	3.8±0.2^b	3.7±0.2^b	3.9±0.3^a	3.6±0.2^b
Ash %	1.6±0.2^a	1.4±0.2^b	1.4±0.2^b	1.3±0.1^b
<u>Chemical composition (DM basis)</u>				
DM %	27.4±0.3	27.3±0.2	27.1±0.3	27.3±0.4
Crude protein (CP)%	80.6±0.2	81.4±0.2	80.5±0.1	82.2±0.3
Ether Extract %	13.7±0.1^b	13.5±0.1^b	14.5±0.2^a	13.04±0.1^b
Ash %	5.7±0.13^a	4.9±0.1^b	5.0±0.0^b	4.8±0.0^b
<u>Physical characteristics</u>				
Cooking loss %	40.4 ±0.8	44.0±1.4	42.6±1.3	43.0 ±1.3
Eye muscle area (cm^2) *	105.7±4.9^b	114.5±6.4^a	104.2±5.3^b	109.3 ±1.1^b
WHC (cm^2)*	6.8±0.4	6.9 ±0.5	7.5±0.2	7.7 ±0.4
color intensity**	0.4±0.0^a	0.2±0.0^b	0.2 ±0.0^b	0.2±0.0^b
pH***	6.6 ±0.0^a	6.3±0.0^b	6.4±0.0^b	6.6±0.0^a

C,control group fed on a basal diet only, T_1, fed on basal diet +1g zinc /calf/day, T_2, fed on basal diet with 1g EDTA /calf/day, and T_3, fed on basal diet +1g zinc +1g EDTA /calf/day.
Within the same row, means with different superscripts a,b&c are significant at($P<0.05$)
* Eye muscle and water hold capacity was measured after chilling (24 h.) at 4°C by using the instrument "Digital planimeterplanix 5,6
**The color intensity was determindusing the instrument "Spectronic 21D Absorance" at wave length 542 nm
***pH value was determined by Microcomputer pH-Vision model 6007 (Jenco).

Eye muscle area was higher ($P<0.05$) in T1 compared to T3, control and T2 groups (114.52 vs. 109.34, 105.72 and 104.24 cm2, respectively) (Table 6). Increasing eye muscle area in calves fed zinc may be due to higher carcass weight in this group (Galyean et al., 1995). The similar trend was reported by Spears and Kegley (2002).On the other hand, Malcolm-Callis et al.(2000) found a significant decrease ($P<0.05$) in Rib eye area of beef steers fed on Zn supplementation compared to control group.

CONCLUSION

Thepresent results indicate that zinc supplementation make animalstended to gain weight more efficiently, achieve little increase in carcass weight and meat quality than calves supplemented with EDTA.

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أثر إضافة الزنك والإديتا على كفاءة النمو وخصائص الذبيحة في عجول الجاموس المصري

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تم إجراء هذه التجربة لقياس تأثير إضافة كلاً من الزنك والإديتا على كفاءة نمو وخصائص الذبيحة لعشرين عجل جاموسي يتراوح متوسط أعمارهم بين ٨-١٢شهر، متوسط وزن٥,١٩٤+٩,٦كجم . تم تقسيم الحيوانات عشوائياً إلى أربعة مجاميع تبعاً لمتوسط وزن الجسم إلى: مجموعة (١) الكونترول بدون إضافات والثانية مضاف إليها ١جم زنك لكل حيوان يومياً والثالثة مضاف إليها ١جم إديت الكل حيوان يومياً والرابعة مضاف إليها ١ جم زنك مع١ جم إديتا لكل حيوان يومياً وأستمرت التجربة مدة ستة أشهرتم خلالها تقديرأوزان الحيوانات ومعدلات النمو وكميات الغذاء المأكول. وفى نهاية التجربة تم ذبح ثلاث حيوانات من كل مجموعة وتم دراسة صفات الذبيحة، وقد تبين عدم وجود تاثير معنوي على معدلات النمو والمأكول وكفاءة إستخدام الغذاء بين المجاميع وأظهرت مجموعة الزنك والزنك مع الإدتيا زيادة فى معدل النمو بنسبة ١٥,٨و.,٤% بينما إنخفضت مجموعة الإدتيا بمعدل ٤,١% عن مجموعة المقارنة .ولم تكن هناك إختلافات معنوية بين المجاميع التجريبية ومجموعة الكونترول في نسبة التصافى ووزن الرأس والأرجل وكذلك بعض الأجزاء المأكولة ماعدا وزن الرئة والطحال والخصتين كان هناك إختلافات معنوية عالية نتيجة إستخدام الزنك والإدتيا والزنك والإدتيا معاً حتى أن مجموع الأجزاء المأكولة كانت أعلى من الكونترول بنسبة ٢٧,١٥و٤٧, ٢١و١١,٠٩% على التوالي .أما القطعيات الممتازة فكانت مجموعة الزنك هي الأعلى مقارنة ببقية المجاميع وإن كانت الفروق غير معنوية . كذلك نسب اللحم والدهن والعظم للعضلة العينية كانت غير معنوية وإن أظهرت مجموعة الزنك والزنك مع الإدتيا أعلى كفاءة لنسبة اللحم للعظم بالمقارنة بالإدتيا ومجموعة المقارنة . وقد أتضح وجود إختلافات معنوية عالية في نسبة الدهن ومستخلص العناصر المعدنية ودرجة تركيز أيون الهيدروجين عند التحليل الكيميائى للعضلة العينية .بينما لم توجد إختلافات معنوية في نسبة البروتين ودرجة الطراوة ودرجة الاحتفاظ بالماء بين المجاميع . وكانت مساحة العضلة العينية كبيرة في مجموعة الزنك مقارنة بالمجاميع الأخرى وربما يرجع ذلك إلى الإختلاف فى وزن الذبائح بين المجاميع .وتظهر النتائج أن لإضافة الزنك تاثير محسن على كفاءة النمو ووزن الذبيحة وخواص اللحم بالمقارنة بإستخدام الإدتيا.