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EFFECTS OF ZINC, MANGANESE METHIONINE COMPLEX AS FEED, SUPPLEMENT ON THE YIELD, COMPOSITION AND QUALITY OF COW'S MILK AND ITS PRODUCTS.

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ABSTRACT

Twelve Local breed lactating dairy cows in early lactation were selected to investigate the effect of feeding supplemented with a combination of organic trace minerals Zinc (Zn) and manganese (Mn) tied with methionine (Met.) on milk yield, its components, the gross chemical composition, pH, rate of acid production, Zn and Mn concentrations and their activities on starter culture for processing plain yoghurt. Cows were randomly divided into four experimental groups (3 each) using 3 × 3 Latin Square design for 35 days periods. Treatments were: T1 (control): concentrate feed mixture (60% CFM) + berseemhay (20% BH) + rice straw (20% RS), T2: control ration plus 40mg Zinc-Methionine/head /day, T3: control ration plus 40mg Manganese-Methionine/ head/ day, T4: control ration plus 20mg Zn- Methionine plus 20mg Mn-Methionine / head/ day (as total diet DM). Milk samples were collected daily from each cow morning and evening for the estimation of milk yield production. Pooled milk from each period was used in the manufacture of yoghurt. Yoghurt samples were stored at refrigerator (6±1C°) for 10 days. Results showed that the addition of organic minerals Zinc and Manganese -methionine to the cow diet significantly increased ($P< 0.05$) milk yield, milk fat percentage and 4% fat-corrected milk (FCM) compared with the control treatment. Also, fat, solids not fat (SNF), ash and total protein (TP) were significantly increased in treated group. Milk produced from cows fed on Zn- Methionine and Mn-Methionine did not significantly affect, Ts, Fat, protein and Ash of resultant plain yoghurt through the storage period. Reduction in pH values, lactose content and the rate of synersis with treated yoghurt samples compared to the control. Whereas, an opposite trend was noticed for acidity, curd tension. While, the concentrations of these organic trace minerals in different treatments of plain yoghurt increased, the ratio of Mn remained in the curd plain yoghurt was increased, and the ratio of remained Zn in the curd was decreased. Viscosity of fresh samples of both control and treatments were significantly increased then, significantly decreased till the end of storage. The incubation time was shorter in treated yoghurt with Zn Met. than the other treatments. The inhibition effect of Zn Met. on the yoghurt bacteria was stronger than those other treatments. Sensory properties values revealed that flavor , body and texture were significant increased with containing yoghurt Zn - methionine when compared with the other treatments.

INTRODUCTION

The benefits of supplementation organic trace minerals in dairy diets have been demonstrated in research and in the field of feeding. Traditionally in organic forms of trace minerals rapidly dissociation in the rumen and are free to interact with antagonists, resulting in the loss of the trace minerals prior to absorption by animal. However, in recent years, there has been considerable interest in feeding ruminants organic trace minerals that increase the bioavailability of the mineral above that of soluble inorganic forms (Ward *et al.*, 1996; Miles and Henry, 1999; Bailey *et al.*, 2001).

A metal amino acid (AA) complex results from complexing a soluble metal salt with an AA in a ratio of 1 mol of metal to 1 mol of AA to form coordinate covalent bonds. In addition to vitamin, protein and energy requirements the dairy cows also needs certain trace elements including Zinc and Manganese plus the microelements magnesium and Potassium for lactation and reproduction concurrent with growth and maintenance of body tissues (Zin *et al.*, 1993).

Milk and its products are considered of the most important sources of nutrients for human diets along his life. However, milk is rich in lipids, proteins carbohydrates, and some minerals such as calcium, magnesium, phosphorus but it is poor in some other elements, particularly, zinc and iron (Jayasekar *et al.*, 1992). Also, in this line Jarrstt (1979) reported that milk is considered to be deficient in zinc, therefore, consumers need to obtain their sufficient requirements of this trace element form products other than milk.

Yoghurt can be a good source of essential nutrients as minerals in the human diet. Mineral ions play an essential role in regulating enzyme activities, maintaining acid-base balance and osmotic pressure, facilitating membrane transfer of essential nutrients and maintaining nerve and muscular irritability (Achanta *et al.*, 2007). Zinc is a component of many enzymes and biomembranes. It is involved binding many transcription factors and stabilizes hormone-receptor complexes.

Zinc deficiency is characterized by growth retardation, loss of appetite, impaired immune function, hair loss, diarrhea, impotence, hypogonadism in males, eye, skin lesions, delayed healing of wounds and impaired taste (Maret an Sandstead, 2006).

Manganese is involved in enzyme activation and is a component of several metallo enzymes.

Manganese deficiency causes impaired growth, skeletal abnormalities, disturbed or depressed reproductive function and defects in lipid and carbohydrate metabolism (Nielsen, 1994).

Yoghurt is considered as a good fermented dairy product for health, therefore, its production have become widely increased (Tamime and Death, 1980). Despite the importance of yoghurt as a fermented dairy product it is made as natural candidates as source of zinc in human diets. Dael *et al.*, (1993). found that yield yoghurt significantly increased Zn availability (12.5%) compared with raw milk (6.3%).

The objective of this study aimed to the effect of supplement Zinc, Manganese- Methionine or both of them to the cows diet, on milk yield, its chemical composition and to detect the concentrations of Zn and Mn in plain yoghurt, whey and the effect of this minerals on, physicochemical characteristics, acid rate production and activity of starter culture in plain yoghurt and whey.

MATERIALS AND METHODS

This study was carried out at Sids Animal production Research Station (Beni-Sweif Governorate) that belongs to Animal production Research Institute (APRI), Ministry of Agriculture, Egypt. Twelve Local breed Lactating dairy cows in early lactation were selected in this trail with an average 350.50kg live boy weight. Cows were randomly divided into four experimental groups (3 each) using 3×3 Latin Square design for 35 days periods (105 days).

The experimental treatment diets were as follows:

Treatment (1) control: concentrate feed mixture (60%CFM) berseemhay (20% BH) + rice straw (20 %RS).

Treatment (2) control ration plus 40mg Zinc Methionine/ head/ day.

Treatment (3) control ration plus plus 40mg Manganese Methionine/ head/ day.

Treatment (4) control ration plus 20mg Zinc Methionine + 20mg Manganese Methionine/ head/ day.

The chemical composition of feed ingredients and diets are shown in **Table (1).**

All cows were fed the same diets during the experiment: concentrate fed mixture (CFM), berseemhay (BH), rice straw (RS) and mineral-vitamin mixture. The daily rations of feed covered cows maintenance recommended requirements according to NRC (2001). and requirement for the production of 10kg milk.

Daily diets was a mixed of CFM, BH and rice straw with 60%, 20% and 20% respectively, without supplement (Group 1) or supplemented with mineral mixtures which contained Zn and Mn in methionine forms given to the animals at a dose of 4g/day/head (Group 2, 3, 4). Clean water was available at all time. Milk samples were taken daily from each cow evening and morning for estimation of milk yield. Pooled milk form each period was used in the manufacture of plain yoghurt.

Manufacture of plain yoghurt:

Yoghurt was manufactured according to Tamime and Robinson (1999). Control and treated milk produced from cows fed diets supplemented with different levels organic trace minerals Zn and Mn Met. Were separately heated in a water bath at 85C° for 10 min., cooled to 45C° and inoculated with commercial yoghurt culture were added at the level of 2% (w/v). The milk was divided to four portions as one control and three treatments, samples were incubated at 43C° until pH of 4.7 was reached (3 hours fermentation time), the coagula was cooled and stored in a refrigerator at 4°C for one night. Yoghurt was mainly 1 day old then, it was drained to remove some whey using a cloth bag. The prepared yoghurt was kept in refrigerator (6±1°C) for 10 days. Samples of yoghurt were analyzed when fresh and during 3, 7 and 10 days of storage.

Table (1): chemical composition of ingredients used in feeding trial (% on DM basis).

Item	CFM*	Berseem hay	Rice straw
Dry matter	92.09	91.3	91.81
Organic matter	88.20	84.10	91.51
Crude fiber	14.11	38.20	38.41
Crude protein	13.01	12.00	3.66
Ash	11.35	14.60	1.25
EE	1.44	1.03	11.55
NFE	60.09	34.17	45.13

***CFM: contains per 3kg Vit. A1000000 IU; Vit. D3 200000 IU; Vit. E, 10000 mg; Vit. B1, 1000 mg; Vit. B2 5000 mg; B6, 1500 mg; Vit. B121, 10 mg; Biotin, 50 mg; Colin chloride, 250000 mg; Pentothenic, 10000 mg; Niacin, 30000 mg; Folic acid, 1000 mg; Manganese, 60000 gm; Zink, 50000 mg; Iron, 3000 mg; Copper, 4000 mg; Iodine, 300 mg; Selenium, 100 mg; and, Cobalt, 100 mg.**

Methods of analysis:

Chemical analysis:

Milk and yoghurt samples were analyzed for percentages of milk fat, total solids (TS), and ash contents and titralable acidity as described by ling (1963). Protein was determined according to A.O.A.C. "Official Methods of Analysis (2000)". lactose content was determined by the method of calorimetrically according to (Bernett and Abd El-Tawab 1957), using spectrophotometer at 490nm wavelength type Shimadzu µV 240. pH values was measured using digital pH meter (M 41150, USA) equipped with glass electrodes.

Viscosity:

Apparent viscosity of yoghurt was measured using Brookfield DVE Viscometer, using spindle 0.5at 50 rpm in 200 ml of yoghurt sample, the temperature was maintained at 25C°. data were collected using Wingather soft ware, one hundred data points were averaged per replication.

Rate of syneresis:

Syneresis (released whey) was measured by placing a 300g yoghurt sample on a cheese cloth placed on top of a funnel. After 2h of drainage, the volume of whey collected in a graduated cylinder was measured after 120 min. and used as an index of syneresis (Kalafalla & Roushdy 1996).

Curd tension: of plain yoghurt. Was assessed by using Effagi firmness measurements (Effagi, Al bonsine, Italy). The penetration depth was 50mm using a flat ended stainless steel plunger with diameter of 5mm. five readings were taken for each yoghurt treatment.

Incubation time:

The coagulation of inoculated milk with starter culture and the different ratios of organic minerals Zn and Mn Met. was measured for pH during the incubation period until pH 4.6 was attained.

Determination of Zn and Mn Met. concentrations in plain yoghurt and whey:

Data were measured by flame Atomic Absorption Spectrophotometer (Perkin Elmer 2380). Maximum absorbance was obtained by adjusting the cathode lamps at specific slit and wave lengths. Zn was measured at 319.9

nm, and Mn at 279 nm. Standard Zn and Mn solution were fresh prepared from 1000 mg/L stock solution and a linear calibration curve was used.

The samples digestion in an electric muffle furnace at the temperature up to 450°C.

The validity of this method was cheeked by a parallel analysis of certified reference material (CRM 063) Skimmed powder milk).

Sensory evaluation:

The sensory evaluation was done according to Kebary and Hussein (1999). By 15 panalists from the staff members of Dairy Technology and Dairy Science Department, Animal Production Research Institute (APRI). Samples were scored for flavour out of (50 points), body and texture out of (40 points) ,color and appearance (10 points).

Statistical Analysis:

Data were statistically analyzed on three replicates on the plain yoghurt and whey by using General Linear Model procedure of SAS program (1996) according to the following model:

$Y_{ijk}\ldots = \mu + T_i + S_j + TS_{ij} + e_{ijk}$

Where:

Y_{ijk} = The observation, μ = General mean,

T_i = Fixed effect of i^{th} Zinc and Manganese supplementation,

i = 1, 2, ….4, S_j = Fixed effect of j^{th} storage period (j= 0, 3, 7 and 10 days)

TS_{ij} = the fixed effect of interaction between Zn and Mn supplementation and storage period, and e_{ijk} = Error of the model. Significance of the differences in result tested by Duncan's new Multiple range test (Duncan, 1955).

RESULTS AND DISCUSSION

Milk yield and composition:

The yield and composition of milk used in plain yoghurt manufacture are presented in Table (2). Milk yield was not significantly affected by treatments. However, the T_2 treatment tended to increase milk yield at week 13 (37.7±0.8 compared with control (35.1 P=0.073) and increased milk yield at week 14 (37.9+0.8 compared with control 35.5 P = 0.032) of lactation, several results have been reported when dairy cows were supplemented with organic trace minerals (Formigoni *et al.*, 1993) observed that an increase in average milk (1.9kg/day P < 0.01),when cows fed supplemented feeds.

4% Fat corrected Milk (FCM) was significantly increased (P < 0.05) for cows fed supplemented feeds with Zn-Met and Mn-Met. (35.7±1.1kg/d) compared with control (33.5±1.3kg/d) (P= 0.38).

In the present experiment, milk components affected by treatments, milk fat percentage, protein and ash content were significantly higher with experimental treatments compared with control. Whereas milk pH was significantly lower with experimental treatments compared with control. Other milk parameters were not affected by treatments.

Table (2): Effect of Zn-Met. and Mn-Met. Supplementation of feeds on milk yield and milk composition lactating cows.

Item	Treatments*				
	T_1	T_2	T_3	T_4	±SE
Milk yield kg/day					
Week 3 to 12	34.5^b	36.9^a	36.2^a	36.6^a	±1.1
Week 13	35.1^b	37.7^a	37.00^a	37.2^a	±1.4
Week 14	35.5^b	37.9^a	37.01^a	37.39^a	±1.4
4% FCM*	33.5^b	35.6^a	35.01^a	35.30^a	±1.4
Milk composition (%)					
Total solids %	11.62^b	11.94^a	11.82^a	11.92^a	±0.54
Solids not fat %	7.99^b	8.20^a	8.09^a	8.20^a	±0.25
Fat %	3.63^b	3.74^a	3.73^a	3.72^a	±0.28
Protein %	3.18^b	3.32^a	3.22^a	3.29^a	±0.16
Lactose %	4.25	4.25	4.25	4.25	±0.16
Ash %	1.08^b	1.13^a	1.12^b	1.14^a	±0.06
pH values	6.77^a	6.60^b	6.65^b	6.65^b	±0.021

a,b,…means with different superscripts in the same row or column within different significantly (P < 0.05). *4% FCM was calculated as: 0.4 X milk yield (kg) + 15 × fat yield (kg) (Noeek. *et al.*, 2006).

***T_1= Plain yoghurt made from milk produced from cows fed diets. 60% concentrate feed mixture +20% berseemhay +20% rice straw.**

T_2= Control + 40 mg Zinc- Methionin (Zn-Met.).

T_3= Control + 40 mg Manganes -Methionin (Mn-Met.).

T_4= Control + 20 mg (Mn-Met.) + 20 mg (Zn-Met.).

Physicochemical determination:

Chemical composition of plain yoghurt:

Data of the composition of the plain yoghurt are summarized in **Table (3).**

Total fat, total protein and ash content of all plain yoghurt treatments made from milk produced from cows fed diets supplemented with different levels Zn-Met. or Mn-Met. were not significantly affected as storage periods progressed (Table 3).

Table (3): Effect of experimental treatments and storage periods (days). on total fat, total protein and ash content of plain yoghurt.

Treatment*	Storage periods (days)				
	0	3	7	10	± SE
	Fat content %				
T_1	3.0	3.0	3.0	3.0	0.029
T_2	3.1	3.1	3.2	3.2	0.029
T_3	3.0	3.0	3.1	3.1	0.029
T_4	3.1	3.1	3.2	3.2	0.029
	Protein %				
T_1	3.54	3.62	3.75	3.79	0.09
T_2	3.46	3.52	3.61	3.78	0.09
T_3	3.42	3.40	3.51	3.62	0.09
T_4	3.44	3.55	3.66	3.70	0.09
	Ash %				
T_1	1.01	1.01	1.01	1.04	0.06
T_2	1.04	1.04	1.06	1.09	0.06
T_3	1.02	1.03	1.04	1.06	0.06
T_4	1.03	1.03	1.05	1.07	0.06

a,b,…means with different superscripts in the same row or column within different significantly (P < 0.05).

*** See footnote Table (2).**

Total fat content in plain yoghurt treated was nearly similar to their control throughout the storage periods of 10 days. Similar results were reported by Badawi *et al.*, (2008); Kebary *et al.*, (2009).

Total protein and ash contents in plain of yoghurt treatments were not significant difference of fresh and during storage periods tended to slight increase as shown in Table (3). The apparent increase of protein is due to the increase of total solids because of the lose in moisture content.

Total solids of all plain yoghurt treatments made from milk produced form cows fed diets supplemented with different levels Zn-Met. or Mn-Met. were not significantly affected of fresh and throughout refrigerated storage periods till the 10 days. Table (4). No significant differences in their total solids of fresh and throughout the storage periods progressed ($P < 0.05$) tended to slight increase.

This increase may be attributed to the natural evaporation of moisture. Similar results were reported by A-assar *et al.*, (2005).

For all Treatments as the storage period progressed, the lactose content gradually decreased because of the hydrolysis of lactose. On the other hand yoghurt produced from cows fed on supplemented feeds showed less content ($p < 0.05$) Table (4). This due to the effect of Zn or Mn supplementation on yoghurt bacterial growth. These results are in agreement with those reported (Degheide, 1998) and (Ezzat Abd El-Fattah *et al.*, 2008).

Table (4): Effect of experimental treatments and storage periods (days) on total solids and lactose content of plain yoghurt.

Treatment*	Storage periods (days)				
	Fresh	3	7	10	± SE
	Total solids %				
T_1	12.99	13.01	13.21	13.32	0.14
T_2	12.89	12.92	12.92	12.94	0.14
T_3	12.80	12.82	12.90	12.92	0.14
T_4	12.84	12.89	12.92	12.93	0.14
	Lactose content %				
T_1	4.21^{a}	3.7^{b}	3.4^{b}	3.1^{bc}	0.06
T_2	4.21^{a}	3.6^{b}	3.4^{b}	3.0^{c}	0.06
T_3	4.23^{ab}	3.6^{b}	3.3^{bc}	3.1^{bc}	0.06
T_4	40.22^{ab}	3.5^{b}	3.2^{bc}	3.0^{c}	0.06

a,b,…means with different superscripts in the same row or column within different significantly ($P < 0.05$).
*** See footnote Table (2).**

The apparent viscosity values are presented in **Table (5).** The highest viscosity values were in fresh plain yoghurt samples made from milk produced from cows fed diets supplemented with 40mg Zn-Met., followed by 20mg Zn-Met. + 20 mg Mn-Met. and then 40mg Mn-Met., as compared with control.

Whereas, throughout the storage periods values viscosity of plain yoghurt samples of treatments showed significant reduction ($P < 0.001$) till the end of storage, on contrast, control sample behaved in an opposite trend.

These results may be attributed to the different nature of organic minerals and interaction between organic minerals and protein (Faten *et al.*, 2010).

Table (5): Effect of experimental treatments and storage periods (days) on viscosity of plain yoghurt.

Treatment*	Storage periods (days)				
	0	3	7	10	± SE
	Viscosity (poise)				
T_1	401^{d}	482^{cd}	601^{bc}	709^{a}	2.52
T_2	785^{a}	644^{bc}	501^{c}	390^{e}	2.52
T_3	569^{c}	537^{c}	502^{c}	390^{e}	2.52
T_4	682^{b}	542^{c}	370^{e}	276^{f}	2.52

a,b,…means with different superscripts in the same row or column within different significantly (P < 0.05).
*** See footnote Table (2).**

Data in Table (6) show the changes in titratable acidity and pH value of plain yoghurt treatments made from milk produced from cows fed diets supplemented with different levels Zn-Met., or Mn-Met., during storage. Results revealed that titratable acidity was significantly increased ($P < 0.05$) of all plain yoghurt treatments in fresh or during refrigerated storage periods compared with their control.

The highest rate of acid development was recorded in treatment with 40mg Zn-Met (T_2), the lowest level was noted in control (T_1). The increase in acidity could be due to the simulative acidic effect of trace elements (Zn-Met. or Mn-Met) on the growth and acid production by lactic acid bacteria which developing acidity throughout 10 days of storage and reduction of lactose content. These results are in agreement with those of Badawi *et al.*, (2008), Farag *et al.*, (2010) and Kebary *et al.*, (2010). Conversely, pH values decline of all plain yoghurt samples during the storage periods Table (6).

Table (6): Effect of experimental treatments and storage periods (days) on titratable acidity and pH values of plain yoghurt.

Treatment*	Storage period (days)				
	Fresh	3	7	10	± SE
	Acidity %				
T_1	0.90^{f}	0.98^{de}	1.03^{d}	1.11^{bc}	0.008
T_2	0.95^{e}	1.06^{c}	1.19^{b}	1.22^{a}	0.008
T_3	0.92^{f}	1.01^{d}	1.09^{c}	1.18^{b}	0.008
T_4	0.94^{e}	1.05^{c}	1.16^{b}	1.20^{a}	0.008
	pH values				
T_1	4.78^{a}	4.72^{b}	4.69^{bc}	4.57^{d}	0.016
T_2	4.64^{c}	4.60^{cd}	4.50^{d}	4.39^{g}	0.016
T_3	4.69^{bc}	4.66^{bc}	4.51^{de}	4.49^{e}	0.016
T_4	4.66^{bc}	4.61^{c}	4.58^{cd}	4.44^{f}	0.016

a,b,…means with different superscripts in the same row or column within different significantly (P < 0.05).
*** See footnote Table (2).**

Rate of syneresis and curd tension:

The syneresis (released whey) values are presented in **Table (7).** The use of organic trace minerals Zn-Met. or Mn-Met., or Zn + Mn-Met. In feeding cows, had significant decrease effect on the wheying off the amount of whey in fresh yoghurt and throughout storage period. These results are in accordance to those obtained by Mehanna and Hefnawy (1990); Mansoour *et al.*, (1994) and Khalafalla and Roushdy (1996) when they reported that the effect of Zn-Met., or Mn-Met., during manufacturing plain yoghurt might enhance the water binding capacity of yoghurt coagulum thereby influencing the rate of synersis characteristics.

Conversely, curd tension results revealed an opposite trend of the rate of synersis value **Table (7).** Curd tension values of all plain yoghurt treatments had significant increased effect compared with their control in fresh or throughout storage periods.

The highest values were with 40 mg Zn-Met. (T_2) followed by 20 mg Zn-Met. + 20 mg Mn-Met., (T_4) and then 40 mg Mn-Met. (T_3).

Table (7): Syneresis and curd tension of yoghurt as affected by the type of feeds .

Treatment*	Storage periods (days)				
	Fresh	**3**	**7**	**10**	**± SE**
	Rate synersis (ml)				
T_1	27^{d}	33^{c}	39^{b}	43^{a}	2.08
T_2	24^{de}	30^{cd}	35^{bc}	37^{b}	2.08
T_3	22^{e}	26^{d}	33^{c}	35^{be}	2.08
T_4	22^{e}	27^{d}	33^{c}	35^{bc}	2.08
	Curd tension (gm)				
T_1	16.93^{e}	16.98^{e}	17.01^{e}	17.09^{e}	0.18
T_2	20.22^{a}	19.95^{b}	19.97^{b}	19.77^{b}	0.18
T_3	18.84^{d}	18.89^{d}	19.03^{c}	19.09^{c}	0.18
T_4	18.89^{c}	18.93^{c}	19.07^{c}	19.23^{c}	0.18

a,b,…means with different superscripts in the same row or column within different significantly ($P < 0.05$).
*** See footnote Table (2).**

Incubation time:

Data in Table (8) show that the incubation time values of plain yoghurt milk treatments or control, which recorded the lowest pH value 4.6 and decreased the time (150 min) with treatment with 40 mg Zn-Met. (T_2). followed by treatment with 20mg Zn + 20 mg Mn (T_4) and then treatment with 40mg Mn-Met. (T_3) compared with control (T_1), which recorded pH4.6 after (180 min). Table (8). These obtained results revealed that the incubation effect of Zn-Met., on the microorganism of plain yoghurt was stronger than that of Mn., (Momeilovic and Kello, 1979); (Vak *et al.,* 1989).

Table (8): Effect of experimental treatments on the pH values during incubation time (minutes) of plain yoghurt.

Treatment*	Incubation Time (minutes)						
	0	30	60	90	120	150	180
	pH values						
T_1	6.63	6.43	6.25	5.80	5.69	5.45	4.64
T_2	6.60	6.07	5.70	5.32	4.96	4.60	=
T_3	6.62	6.22	5.80	5.39	4.86	4.72	4.63
T_4	6.60	6.21	5.69	5.20	4.86	4.69	=

a,b,…means with different superscripts in the same row or column within different significantly (P < 0.05).
*** See footnote Table (2).**
= not estimated

Distribution of organic minerals:

Table (9) shows the distribution of zinc (Zn) and manganese (Mn) in different treatments between analyzed milk from cows, plain yoghurt and whey. From these results it could be noted that the association of Zn or Mn in analyzed milk, plain yoghurt curd and whey were not the same for different treatments. These values revealed that the average contents of Mn in analysed milk were (25.09, 27.01, 34.0, 32.0µg/kg) for T_1, T_2, T_3, and T_4 respectively. higher contents of Mn in analyzed milk were observed by (Zapletal and Bon czar, 1993) 36.8µg/kg. Also, the ratio of Mn-Met. bound to the casein fraction in pellet plain yoghurt significant increased (P < 0.01). (Table, 9) whereas, the ratio of Mn bound to the whey significant decreased (P < 0.05). this could be due to the Mn which is very strongly bound to organic matter. These results are in the line with that reported by Abollino *et al.*, (1998) who found that, manganese is mainly distributed between the serum of cationic and the casein-bound fraction, probably associated with some enzymes or other proteins and stated that about 53.7% of Mn was bound to casein while 44.7% of Mn was in the whey.

Considering, the concentration of Zn in analyzed milk in different treatments. It was that the average contents of Zn in analyzed milk produced from cows fed diets supplemented with Zn-Met. were 3.7±0.1mg/kg^{-1} and were similar to Zn concentration of 3.73mg/kg^{-1} fresh milk. by (Szkoda and Zmudzki (2002)). Higher contents of Zn in milk rang of 4.1 to 5.28mg/kg^{-1}, by (Rodrigues *et al.*, 2001). While, in pellet plain yoghurt the ratio of Zn bound to whey significant increased (P < 0.01). (Table,9). Conversely, the ratio of Zn bound to the casein fraction significant decreased (P < 0.01). these results are in agreement with those of Singh, *et al.*, (1989) and Pabon and Lonnerdal (2000) reported that the most of Zn directly bound to casein is readily removed when pH decreased to low values this is due to high levels of soluble Zn bound to low molecular weight and non micellar-Zn levels increased.

Table (9): Distribution of Zn and Mn in analyzed milk, plain yoghurt curd and whey after 7 days .

Treatment*	Analyzed milk	Plain yoghurt	Whey
	Zn (mg/kg)	%	
(T_1)	3.70	43.32[b]	56.68[a]
(T_2)	3.92	40.75[b]	59.25[a]
(T_3)	3.75	46.09[b]	53.91[a]
(T_4)	3.87	42.55[b]	57.45[a]
	Mn. (µg/kg)	%	
(T_1)	25.09	45.09[b]	54.91[a]
(T_2)	27.01	57.32[a]	42.68[b]
(T_3)	34.00	68.57[a]	31.43[b]
(T_4)	32.00	57.64[a]	42.36[b]

a,b,…means with different superscripts in the same row or column within different significantly ($P < 0.05$).
*** See footnote Table (2).**

Sensory evaluation:

Results in **Table (10)** showed the changes in sensory evaluation of fresh or stored yoghurt samples made from milk produced from cows fed diets supplemented with different levels Zn-Met., or Mn-Met., Form these results it could be noted that the sensory properties of plain yoghurt were significantly affected ($P < 0.05$) by Zn-Met., or Mn-Met., throughout storage periods.

No dectable changes were observed in color and taste of fresh or stored samples which gained 8:10 points.

Table (10) shows significant differences in the scores for flavour and body and texture received from different treatments of fresh or stored plain yoghurt. Samples of plain yoghurt treatments with 40mg Zn-Met., (T_2) had significant increased in scores flavour, body and texture compared with control and other treatments.

Total acceptability points revealed that samples of plain yoghurt made from milk produced from cows fed diets supplemented with 40mg Mn-Met., had been recorded weak body and wheying off increase the amount of whey. Whereas, samples of plain yoghurt treatment with 40mg Zn-Met., had been recorded the highest points for their acceptable flavour, body and texture and no wheying off up to 7 days of storage and then decreased after that. **Table (10).** These results are in agreement with (Kebary *et al.*, 2008 and Kebary *et al.*, 2010).

Table (10): Sensory evaluation of plain yoghurt made from different milks through storage periods (days) 6±1°C.

Treatment*	Storage period (days)			
	0	3	7	10
	Color and Appearance (10)			
T_1	10^a	9^a	9^a	8^b
T_2	10^a	10^a	10^a	9^a
T_3	10^a	9^a	9^a	8^b
T_4	10^a	8^b	8^b	8^b
Body and Texture (40)				
T_1	40^a	38^b	38^b	37^b
T_2	40^a	39^b	39^b	38^b
T_3	40^a	33^c	32^c	32^c
T_4	40^a	38^b	35^c	35^c
Flavour (50)				
T_1	48^a	45^b	44^b	44^b
T_2	48^a	47^a	45^b	45^b
T_3	47^a	40^c	35^a	35^d
T_4	40^c	38^c	37^c	40^c
Total score (100)				
T_1	98^a	92^b	90^c	89^c
T_2	98^a	96^a	93^b	92^b
T_3	97^a	82^b	76^c	75^c
T_4	97^a	87^b	81^c	80^d

a,b,…means with different superscripts in the same row or column within different significantly ($P < 0.05$).
*** See footnote Table (2).**

CONCLUSIONS

From these results, it could be concluded that zinc or Manganese methionine supplementation at the level of 40 mg per head daily to lactating cows improved the quality, yield of the milk and it's components. When the level of zinc or Manganese in diets plain yoghurt had relatively high Zinc retention. They improved acidic effect of trace minerals on the growth and acid production by lactic acid bacteria throughout 10 days of storage and reduction of lactose content, decreased the time for incubation period, less wheying off, and gained the highest scoring points for their acceptable flavour, body and texture.

Generally, this increase could be significant if these products were included in a daily diet. Therefore, the need for increasing these minerals in raw milk could be recommended.

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تأثير إضافة الزنك والمنجنيز المرتبط كل منهما بالمثيونين إلى علائق الأبقار على إنتاج وصفات اللبن و بعض منتجاته.

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تهدف الدراسة إلى تأثير إضافة الزنك والمنجنيز المرتبط كل منهما بالمثيونين إلى علائق الأبقار على إنتاج وصفات اللبن وبعض منتجاته.

استخدم فى هذه الدراسة ١٢ بقرة حلابة (من النوع المحلى) قسمت إلى أربع مجموعات بنظام المربع اللاتيني بكل مجموعة (٣ بقرات) لمدة ١٠٥ يوم (٣٠يوم/مرحلة). وكانت المعاملات كالتالي:-

١- المعاملة الأولي (المقارنة):غذيت على مقررات NRC 2001 وتتكون من علف مركز + دريس برسيم + قش أرز.
٢- المعاملة الثانية: تتكون من عليقة المقارنة + ٤٠ ملجم زنك مرتبط بالمثيونين/ رأس/ يوم.
٣- المعاملة الثالثة: تتكون من عليقة المقارنة + ٤٠ ملجم منجنيز مرتبط بالمثيونين / رأس/ يوم.
٤- المعاملة الرابعة: تتكون من عليقه المقارنة + ٢٠ملجم زنك مرتبط بالمثيونين + ٢٠ملجم منجنيز مرتبط بالمثيونين / رأس/ يوم.

وكانت العليقه تقدم صباحاً ومساءاً وقد استمرت تجربة إنتاج اللبن لمدة ١٥ أسبوع وتم تقييم إنتاج اللبن وتحليل مكوناته وقد تم تجميع عينات اللبن، أخر ٣ أيام من كل شهر وتم خلط عينات كل معاملة وتصنيعه زبادي من هذه المعاملات وتم تخزينه في الثلاجة على فترات ٥، ٣، ٧، ١٠ أيام على ٦م°±١.

وكانت أهم النتائج المتحصل عليها كما يلي:

١- ارتفع إنتاج اللبن معنوياً فى الأسبوع الثالث عشر والرابع عشر وكذلك اللبن المعدل ٤% دهن في العينات المعاملة مقارنة بالكنترول.
٢- أرتفع دهن اللبن والبروتين والرماد ارتفاعا معنويا بإضافة الزنك والمنجنيز المرتبط كل منهما بالميثونين. بينما انخفضت قيم الـ pH في عينات اللبن الناتج من المعاملات مقارنة بالكنترول وكذلك خلال فترات تخزين الزبادى.
٣- أظهرت نتائج التحليل الكيماوى للزبادي الناتج من عينات المعاملات انخفاض في قيم الـ pH وكذلك محتوى اللاكتوز والتشريش مقارنة بالكنترول.
٤- إرتفاع نسبة الحموضة وقوة تماسك الخثرة في عينات المعاملات مقارنة بالكنترول.
٥- زيادة اللزوجة للزبادي الطازج في عينات المعاملات مقارنة بالكنترول وحدوث إنخفاض معنوي لها خلال فترة التخزين في عينات المعاملات مقارنة بالكنترول والتي يحدث بها ارتفاع معنوى خلال فترات التخزين.

٦- أدى إضافة الزنك المرتبط بالمثيونين للعليقة إلى أعلى زيادة في نسبة الحموضة وانخفاض ال pH مقارنة بالكنترول والمعاملات الأخرى ويعزى هذا إلى تأثير الزنك المعروف بزيادة نشاط بكتيريا حمض اللاكتيك وبالتالي زيادة إنتاج الحموضة ، كما حقق أعلى نتائج من حيث أنها قللت من الوقت اللازم للتجبن وأقل قيم للـ pH، كما أعطت أعلى درجات تقييم حسى في كلا من النكهة وتماسك قوة الخثرة مقارنة بالمعاملات الأخرى.

من هذه النتائج يتضح أن إضافة الزنك المرتبط بالمثيونين بمستوى ٤ ملجم/بقرة/ يوم إلى علائق الأبقار الحلابة حقق أفضل النتائج حيث أدى إلى زيادة إنتاج اللبن ومكوناته وتحسين خواص الزبادي الناتج.

قام بتحكيم البحث

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