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EFFECT OF SUPPLEMENTAL ZINC AND VITAMIN A ON PERFORMANCE OF LACTATING COWS.

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ABSTRACT

This study was carried out to study the effect of zinc or zinc plus vitamin A supplementation on nutrients digestibility of adult rams (61 kg in average) and on milk production of seven lactating Friesian crossbred cows (447 kg in average) using "Swing Over" method to evaluate the following experimental rations:

Control ration (C) : Concentrate feed mixture (C.F.M.) + Rice straw (R. S.).
1st tested ration (T_1) : C.F.M. + 50 mg Zn/kg DM (as zinc sulphate) + R. S.
2nd tested ration (T_2): C.F.M. + 50 mg Zn/kg DM + 10000 IU vitamin A/100 kg body weight + R.S.

The main results showed that the DM and OM digestibility of sheep fed ration (T_2) were significantly (P<0.05) higher than rations (T_1) and control (C). Also, the previous items of T_1 ration were significantly (P<0.05) higher than ration C. The total digestible nutrients (TDN) and starch equivalent (SE) of the three tested rations were responded simillary as that of DM and OM digestibility.

The differences in daily DM intake of cows fed C, T_1 and T_2 rations were not significant. The daily milk yield as fat corrected milk (FCM) was higher by 10.08 and 15.57% in cows fed T_1 and T_2 than the control ration. Also, fat yield was higher by 11.23 and 16.05 % in cows fed T_1 and T_2 than C ration.

Total solid and lactose of milk of lactating cows fed ration T_1 and T_2 were significantly (P<0.05) higher than control ration. Additionally, feed efficiencies (as kg TDN and SE/kg FCM) were better (P<0.05) of cows fed ration T_2 than others.

The economical efficiencies and return/kg FCM were the best for cows fed the rations supplemented zinc with or without vitamin A.

INTRODUCTION

The nutritional essentiality of zinc was demonstrated first in 1934 in mouse. Subclinical occurrence of zinc deficiency connected with lower feed consumption and lower nutrients utilization efficiency with consecutive reduced immune response, growth retardation, lower milk yield and fertility disorders are true function, (Oresnik, 1996). Zinc is foremost in this respect, being associated with at least 10 different enzymes, affecting such diverse functions as protein digestibility respiration and bone mineralization, (Rook and Thomas 1983). Zinc methionine supplement in the lactating ewes diets resulted 19% more milk yield than control. Although the higher level of zinc is responsible for more persistence in milk production. On the other hand, the zinc methionine supplement had no effect on milk composition, (Hatfield *et al* 1995). Zinc deficiency was obvious in high yielding sheep that had twin and high milk yield in the first phase of lactation, (Pavlicevic *et al* 1997).

Generally, such premixes contain from 0.5 to 10 % Zn. A complete free-choice mineral supplement for cattle consuming approximately 50 g / day should contain 1-2 % Zn to provide a significant proportion of the Zn requirement (McDowell, 1992).

Vitamin A has many functions, including maintenance of epithelial cells, vision, gene regulation, and immune cells function (Chew, 1987). Improved milk production better, mammary gland health, and immune function were found when dry cows were fed additional vitamin A. These data support increasing the requirement for vitamin A about 50 % to reach100 IU/kg of B.W. (Weiss, 1998). Oldham *et al*. (1991) reported that cows fed approximately 170.000 IU/day of vitamin A starting 60 days prepartum and continuing until 42 days postpartum produced more milk (40.2 Vs. 35.8 kg/day) than did cows fed 50.000 IU/day. Conversely, Michal *et al.* (1994) reported no difference in milk production between cows fed 0 and 120,000 IU of supplemental vitamin A/day. The current NRC (1989) requirement for vit A is not adjusted for milk production. However, DM intake usually increases as milk production increase. Also, vitamin A intake increases with the milk production increase. The NRC did not have a specific requirement for vit A for dairy cattle.

Zinc is necessary to maintain normal concentrations of vitamin A in plasma and may be required for mobilization of vitamin A from the liver, (Harper *et al.*, 1979 and Berzin, 1988).

The aim of this study was to determine the effect of either supplementation with Zn or Zn plus vitamin A of the diets of dairy cows on milk production and its composition of lactating Friesian crossbred cows.

MATERIAL AND METHODS

This work was carried out at Gemiza Experimental Station, Animal Production Research Institute, Agriculture Research Center, Ministry of Agriculture, Egypt.

Three digestibility trials were carried out on Rahmany rams, as well as feeding trials on a basal diet not supplemental (as control) or supplemented Zn or Zn with vitamin A were conducted with lactating Friesian crossbred cows.

Digestibility trials:

Three digestibility trials were carried out using three adult Rahmany rams about three years old weighing 61 kg in average to evaluate the following experimental rations:

Control ration (C) : concentrate feed mixture (C.F.M) + Rice straw (R. S.).

1st tested ration (T_1): C.F.M. + 50 mg Zn as zinc sulphate, $ZnSO_4 . 7H_2O$ /kg DM +R. S.

2nd tested ration (T_2): C.F.M. + 50 mg Zn / kg DM + 10000 IU vitamin A/100 kg body weight (as palmitate in gelatin capsules) + R. S.

The basal diet were formulated to meet the dairy cattle nutrients requirements according to Shehata (1970) with the exception of Zn which was added as recommended by NRC (1989). Chemical composition of ingredients and tested rations are presented in Table 1.

Each digestibility trial lasted 21 days, of which 14 days were used as a preliminary period followed by 7 days as collection period. The rams were put individually in metabolic cages during the digestion trials. The rams were fed twice daily at 8.0 am and 4 p.m. and water was offered after feeding as desire, while R.S. was fed *ad libtum* after feeding concentrate at a level of 1.5% of L.B.W.

Table 1. Chemical composition of feedstuffs and calculated composition of the consumed experimental rations by sheep.

Items	DM	On DM basis %									
		OM	CP	CF	EE	NFE	Ash	Ca%	P%	Zn ppm	Cu ppm
Concentrate feed mixture (CFM)*	92.20	92.75	17.35	16.48	3.76	55.16	7.25	0.62	0.56	38.02	9.99
Rice straw (RS)	89.94	83.52	3.75	37.82	1.39	40.56	16.48	0.17	0.10	-	3.99
Calculated composition of the tested rations:											
C(CFM +RS)	91.54	90.11	13.46	22.58	3.08	50.99	9.89	0.49	0.43	27.18	8.29
T1 (CFM added Zinc +RS)	91.56	90.19	13.57	22.41	3.10	51.11	9.81	0.50	0.43	63.71	8.09
T2 (CFM added Zinc + vit A +RS)	91.46	89.85	13.08	23.20	3.02	50.55	10.15	0.48	0.41	60.42	8.09

*** CFM composed of wheat bran 36%, undicorticated cotton seed meal 28%, yellow corn 14%, rice bran 12.5%, molasses 5%, limestone 3% and sodium chloride 1.5%.**

Dairy feeding trials :

Seven lactating Friesian crossbred cows were used in “Swing Over” method (El.Serafi, 1968 and Abd El. Baki, 1970). Cows were chosen after passing the lactating peak on the above rations. Swing over method is more applicable because the comparison of the different rations could be done with each individual animal. The control ration was given in the first period, followed by the two tested rations, then back to the control ration in the last period (Fig.1).

A transition period of 10 days preceded each experimental period which lasted for 15 days. The daily milk yield during each period was considered as a fairly valuable average representing the milk yield at the middle days of the period. By calculating the milk yield at the two middle days of control periods and length of the period between the two middle days, the natural daily decrease in milk yield could be calculated. Milk samples were represented 0.5 % from the milk production during the main period of milk production collection. The milk yield at any day between the two middle days could be also calculated assuming that the control rations was given throughout the whole experimental period and that the lactating curve between the two middle days was a straight line with a negative slopes. The slope of such curve would the rate of daily decrease. When comparing the actually produced milk at the middle days of the tested periods with the calculated milk yield from the curve at that date, one compare the effect of two tested rations by studying the difference of milk yield at that date. The absolute difference in milk yield varies between individuals owing to the variation in milk yield among them and at the start of the experiment. Therefore, the relative difference in milk yield was obtained as a percentage from the average milk yield at middle day of the initial control.

Fig 1

Maintenance and milk production requirements as SE and DCP of the animals fed control ration were calculated according to Shehata, (1970).

The proximate analysis for the composite samples of the rations and feces were carried out according to A.O.A.C, (1980). Also, milk samples were analyzed for total solids (T.S.), solids non-fat (S.N.F.), total protein and ash but their lactose contents were estimated by difference. Daily feeds samples were composite for Ca, P, Zn and Cu analyses using Atomic Absorption spectrophotometer, SP9, (PYE UNICUM).

Statistical analysis was carried out after transforming the percentage number into Arcsin values, using F-test (Sendecor and Cochran, 1982) and the differences among treatments means were tested using Duncan's multiple range test (Duncan, 1955).

RESULTS AND DISCUSSION

Digestibility trials:

The daily total DM intake (Table 2) as g per kg $W^{0.75}$ of sheep feed ration plus zinc (T_1), or Zinc + vitamin A (T_2), or control (C) was nearly similar. The same trend was obtained by daily Ca, P and Cu intake as g/ h/day or g/ kg $W^{0.75}$ (Table 3), but daily Zn intake as mg/h/day or mg/kg $W^{0.75}$ were significantly ($P<0.05$) higher by sheep fed T_1 and T_2 rations than control due to Zn supplementation. The same trend was obtained by Abd El-Rahim *et al*. (1995) who reported that, feed intake by rabbits

Table 2. Feed intake, digestibilities and nutritive values of experimental rations supplemented with zinc or zinc with vitamin A by sheep.

Items	CFM + RS Control (C)	CFM added Zinc + RS (T1)	CFM added Zinc with vit. A + RS (T2)
Animal Weight (kg)	62. 7± 4.3	62.3 ±4.1	58.3 ± 4.1
Daily DM intake:			
CFM g/h/d	866.7 ±60.0	866.7 ±60.0	806.8 ± 56.2
RS g/h/d	345.5 ± 14.9	330.8 ±8.5	368.5 ± 4.3
Total DM intake g/h/d	1212.2±74.3	1197.5±53.8	1175.2 ± 51.9
Total DM intake g/kg $W^{0.75}$	54.4 ± 0.5	54.1 ± 0.5	55.8 ± 0.5
Digestion coefficients %			
DM	62.7^{c}±1.0	66.9^{b} ± 1.3	73.5^{a} ± 0.8
OM	64.9^{c} ± 1.3	69.2^{b} ± 1.2	73.7^{a} ± 0.5
CP	67.8 ± 0.8	69.5 ± 1.9	73.5 ± 1.6
CF	43.7^{b} ± 4.2	52.6^{ab} ± 1.0	57.3^{a} ± 1.1
EE	78.9 ± 2.7	83.1 ± 2.2	75.0 ± 5.8
NFE	73.2 ± 2.3	75.5 ± 1.8	81.2 ± 1.7
Nutritive value %			
TDN	61.8^{b} ± 1.5	65.6^{ab} ± 1.3	69.0^{a} ± 0.5
SE	47.8^{b} ± 1.5	51.3^{ab} ± 1.6	54.7^{a} ± 0.6
DCP	9.3 ± 0.1	9.4 ± 0.4	9.61 ± 0.4

a, b means in the same raw with different superscripts differ significantly (P <0.05).

Table 3. Mineral intake of experimental rations supplemented with zinc or zinc with vitamin A by sheep.

Items	CFM + RS Control (C)	CFM added Zinc + RS (T1)	CFM added Zinc with Vit.A + RS (T2)
Mineral intake:			
Daily Ca intake g/h/d	5.96 ±0.40	5.93 ± 0.36	5.63 ± 0.34
Daily Ca intake g kg $W^{0.75}$	0.27 ± 0.003	0.27 ± 0.003	0.27 ± 0.003
Daily P intake g/h/d	5.15 ± 0.35	5.14 ± 0.32	4.84 ± 0.31
Daily P intake g/ kg $W^{0.75}$	0.23 ± 0.003	0.23 ± 0.003	0.23 ± 0.003
Daily Zn intake mg/h/d	32.95^{b}± 2.28	76.29^{a} ± 5.28	71.01^{a} ± 4.94
Daily Zn intake mg kg $W^{0.75}$	1.48^{b} ± 0.003	3.41^{a} ± 0.06	3.36^{a} ± 0.06
Daily Cu intake mg/h/d	10.05 ± 0.66	9.99 ± 0.58	9.51 ± 0.52
Daily Cu intake mg kg $W^{0.75}$	0.45 ± 0.005	0.45 ± 0.004	0.45 ± 0.003

a, b means in the same raw with different superscripts differ significantly (P <0.05).

was not affected by level of zinc supplementation. Also, Hatfield *et al*. (1994) reported that daily dry matter intake was higher by ewes during last 30 days of gestation with Zn methionine supplement than control. It is aggravated by increased calcium levels in the diet and decrease by reduced calcium and increase phosphorus levels. The trouble can be prevented by adding small amount of Zn (40-100 ppm) to the diet usually as zinc sulphate or zinc carbonate.

Digestion coefficients of DM and OM of T_2 ration (zinc + vitamin A) were significantly (P<0.05) higher than T_1 (zinc ration) and control rations. Also, DM and OM digestibility of T_1 (zinc ration) were significantly (P <0.05) higher than control ration. CP and NFE digestibility of T_2 and T_1 were insignificantly (P <0.05) higher than C ration. CF digestibility of T_2 ration was significantly (P <0.05) higher than C ration, but the difference not significant between T_2 and T_1 ration or T_1 and C ration. The same trend was obtained by Abd El-Rahim *et al*. (1995), they found that digestibility of all nutrients were significantly (P<0.05) increase by supplement with 170mg Zn /kg DM of rabbit diet. Digestibility and absorption were equal improved by added zinc sulphate or zinc carbonate to the diet (Helali, 1986).

The nutritive values as TDN and SE of ration T_2 (Zn +vit. A) were significantly (P<0.05) higher than that of control ration, but the difference between T_1 (Zn ration) and IC were not significant. While DCP values of rations C, T_1 and T_2 was similar. Similar results were obtained by Abd El Rahim *et al*. (1995) revealed that nutritive values were improved by supplemental zinc to rabbit diets.

Performance of lactating cows:

Feed intake:

Data of Table 4, show no significant (P<0.05) differences of the daily DM intake (as kg/h/day or kg/kg $w^{0.75}$) among the three experimental rations.

The feed units intake as TDN and SE kg/h/day or kg/kg $w^{0.75}$ of cows fed ration T_2 (Zinc + Vit A) were significantly (P<0.05) higher than cows fed control ration, but the difference between cows fed T_1 (Zinc) and C ration was not significant. However, no significant differences (in DCP intake as kg/h/day or g/kg$w^{0.75}$) among the different rations were recorded.

Table 4. Feed intake from the experimental rations supplemented with zinc or zinc with vitamin A by Friesian crossbred lactating cows.

Items	CFM + RS Control (IC)	CFM added Zinc + RS (T1)	CFM added Zinc with Vit.A + RS (T2)
Initial body weight kg	444 ±17.35	448 ±17.66	449 ±18.41
Daily DM intake:			
CFM kg /h/d	6.93±0.38	7.10±0.34	7.60±0.31
R S kg /h/d	4.64±0.28	4.74±0.24	4.72±0.20
Total DM intake kg /h/d	11.57±0.65	11.84±0.58	11.86±0.55
Total DM intake kg / kg $W^{0.75}$	0.120±0.01	0.122±0.01	0.121±0.01
Daily feed units intake:			
TDN kg /h/d	7.15^{b}±0.40	7.77^{ab}±0.38	8.14^{a}±0.36
TDN g / kg $W^{0.75}$	74.04^{b}±4.01	79.83^{ab}±3.89	83.57^{a}±3.38
SE kg /h/d	5.54^{b}±0.31	6.08^{ab}±0.30	6.44^{a}±0.28
SE g / kg $W^{0.75}$	57.32^{b}±3.11	62.44^{ab}±3.04	66.15^{a}±2.68
DCP kg /h/d	1.06±0.06	1.12±0.05	1.13±0.05
DCP g/kg $W^{0.75}$	10.94±0.59	11.48±0.56	11.63±0.47

a, b means in the same raw with different superscripts differ significantly (P <0.05).

It was noticed that the feed units intake increased with added zinc or zinc + Vit A in the rations, this may be due to improve nutrients digestibility of tested rations as a result of supplementation.

Milk yield:

The average daily actual milk yield (Table 5) of lactating cows was 8.93 kg for initial control (IC), while, the average daily milk yield as calculated for cows fed T_1 (zinc) and T_2 (zinc + Vit A) tested rations were 9.8) and 10.25 kg, respectively. The milk yield were increased by 10.25% and 15.56% for T_1 and T_2 rations than control, respectively. These results showed that, the calculated milk yield of T_1 and T_2 rations was insignificantly ($P<0.05$) higher than that of the control ration. The same trend was obtained for calculated fat corrected milk (FCM) of cows fed all rations (IC, T_1 and T_2) as shown in Table 5. Similar trend was obtained by Hatfield *et al*. (1995) and Pavlicevic, *et al*. (1997) with lactating ewes since diets supplemented with zinc had high milk yield. Also, Oldham *et al*.(1991) reported that cows fed diet supplemented with 170,000 IU/ day of Vit. A gave more milk yield.

Fat yield:

The average daily milk fat yield of control ration was 337.3 g, but the average calculated milk fat of the caws fed T_1 and T_2 tested rations were 345.3 and 358.6 g, respectively (Table 5). The rate of increasing milk fat was 11,23% in T_1 and 16.05 % in T_2 tested rations comparing with the initial control (IC), but such increase were not significant. It was noticed that, added zinc or zinc + vitamin A to tested rations improved milk yield and Fat yield compared with control one.

Table 5

Chemical composition of milk:

Milk T.S. and lactose contents of cows fed T_1 and T_2 tested rations showed the highest ($P<0.05$) value than average two control rations (Table 6), but, the other milk composition were not affected by supplemented zinc or zinc + vitamin A. In this respect, Hatfield *et al*. (1995) showed that zinc methionine supplement in the lactating ewes diets had no effect on milk composition.

Table 6. Effect of Feeding rations supplemented with zinc or zinc with vitamin A on milk chemical constituents (%) of lactating cows.

Items	Initial control ration (IC)	Zinc ration (T_1)	Zinc + vitamin A ration (T_2)	Final control ration	Average two control rations
Moisture	90.04 ±0.36	88.38^b±0.22	88.68^b±0.29	88.68± 0.23	89.36^a±0.23
TS	9.96 ±0.36	11.62^a±0.22	11.32^a±0.29	11.32± 0.23	10.64^b±0.23
Fat	3.48± 0.02	3.53 ± 0.01	3.51 ± 0.01	3.51 ± 0.01	3.50± 0.01
SNF	6.85± 0.15	8.10± 0.22	7.81± 0.29	7.81± 0.22	7.33± 0.17
Protein	3.13± 0.04	3.21± 0.09	3.19± 0.06	3.17± 0.04	3.15± 0.03
Lactose	3.22± 0.15	4.27^a± 0.17	4.11^a± 0.20	4.03± 0.18	3.63^b± 0.15
Ash	0.52± 0.04	0.61± 0.02	0.52± 0.04	0.62± 0.01	0.57± 0.02

TS = Total solid
SNF = Solid non fat
a , b means in the same raw with different superscripts differ significantly ($P <0.05$).

Feed conversion and economical efficiency:

Feed conversion expressed as kg of DM, TDN, SE and g of DCP per 1kg of FCM above maintenance requirements (Table 7) of lactating cows fed T_2 ration (added zinc + vitamin A) were better than those fed the other tested rations, but, the differences were significant ($P<0.05$) only in case of TDN and SE. The feed cost/1kg FCM yield was 62.15, 53.61 and 56.51 (PT) for lactating cows fed ration C, T_1 and T_2, respectively. It was noticed T_2 ration showed the cheapest feed cost.

The values of economical efficiency were 1.25, 1.42 and 1.54 for rations IC, T_1 and T_2, respectively. The corresponding values as return/1kg FCM were 17.85, 26.39 and 30.65 (PT) for ration IC, T_1 and T_2, respectively. These results showed that, rations supplemented with zinc + vitamin A or zinc alone were the best, due to increasing milk yield, compared with the control.

Table 7. Feed conversion and economical efficiency of lactating cow as affected by supplemented with zinc or zinc with vitamin A.

Items	CFM + RS Control (IC)	CFM added Zinc + RS (T1)	CFM added Zinc with Vit. A + RS (T2)
Feed /1 kg FCM:			
DM kg/ 1kg	0.64 ± 0.03	0.63± 0.03	0.68 ± 0.04
TDN kg/ 1kg	0.39^{b}± 0.02	0.42^{b} ± 0.02	0.50 ^{a} ± 0.02
SE kg/ 1kg	0.30^{b} ± 0.01	0.33^{b} ± 0.01	0.39^{a} ± 0.02
DCP g/ 1kg	87.52 ±3.62	85.47 ± 4.31	90.13 ± 4.24
Cost of feed intake (PT) :			
CFM	563.34	563.36	524.49
RS	17.28	16.54	18.42
Total input	580.62	579.90	542.91
Average daily production:			
FCM kg	8.24	9.11	9.49
Gain kg	0.137	0.183	0.149
Price of weight change(PT)	- 68.5	- 91.5	- 74.5
Total cost of feed for milk production:	512.12	488.40	468.41
Feed cost/ 1kg FCM product	62.15	53.61	49.36
Price of milk (PT)	659.20	728.80	759.20
Total output (PT)	727.70	820.30	833.70
Economical efficiency	1.25	1.42	1.54
Return (PT)	147.08	240.40	290.79
Return /1 kg FCM (PT)	17.85	26.39	30.64

CFM ton= 650 PT , R.S. ton = 50 PT, meat kg = 5.0 PT, milk kg = 0.8 PT, Zn 50 mg = 0.017 PT and Vit A 10.000 IU =0.016 PT.
a, b means in the same raw with different superscripts differ significantly (P <0.05).

In conclusion, added zinc or zinc + vitamin A to milk rations could be used economically and successfully to improve digestibility coefficient and nutritive values of most nutrients of tested rations and also improved performance of lactating cows in terms of feed units intake, milk and fat yields, milk composition and feed efficiencies.

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تأثير إضافة الزنك أو الزنك وفيتامين أ على مظاهر أداء أبقار اللبن

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تهدف هذه الدراسة إلمعرفة تأثير إضافة الزنك والزنك + فيتامين أ على معاملات الهضم للقيم الغذائية باستخدام ذكور غنم رحماني بمتوسط وزن 61 كجم وكذلك على إنتاج اللبن باستخدام 7 بقرات فرزيان خليط حلابة بمتوسط وزن 447 كجم بطريقة العودة لذي بدء لتقييم العلائق الآتية :

1-علف مصنع مخلوط + قش أرز (عليقة مقارنة).
2-علف مصنع مخلوط مضاف إليه 50 مليجرام زنك لكل كجم مادة جافة + قش أرز.
3-علف مصنع مخلوط مضاف إليه 50 مليجرام زنك لكل كجم مادة جافة و 10000 وحدة دولية فيتامين أ لكل 100 كجم وزن حي + قش أرز .

وكانت أهم النتائج :

- أظهرت النتائج أن معاملات الهضم للمادة الجافة والعضوية بواسطة الأغنام كانت مرتفعة معنويا للعليقة 3 بالمقارنة بالعليقة 2 ، 1 ، بينما العليقة 2 كانت مرتفعة معنويا عن العليقة 1 (المقارنة) . معاملات الهضم للألياف للعليقة 3 أظهرت ارتفاع معنوى بالمقارنة بالعلائق الأخرى – أعطت القيم الغذائية في صورة مركبات كليه مهضومة ومعادل نشا نفس اتجاه معاملات الهضم للمادة الجافة والعضوية للعلائق الثلاثة.
- لا توجد فروق معنوية للمادة الجافة المأكولة بواسطة الأبقار المغذاة على العلائق الثلاثة المختلفة . بينما ارتفع إنتاج اللبن على العليقتين الثانية والثالثة بنسبة 10.08 و 15.75 % عن عليقة المقارنة .
- زادت نسبة الجوامد الكلية واللاكتوز للأبقار الحلابة المغذاة على العليقة الثانية والثالثة معنويا عن عليقة المقارنة .
- تحسنت كفاءة استخدام وتحويل الغذاء للأبقار المغذاة على العليقة الثالثة مقارنة بالعلائق الأخرى .
- أظهرت العليقتين الثانية والثالثة المضاف إليها الزنك أو الزنك + فيتامين أ كفاءة اقتصادية وعائد محسن مقارنة بعليقة المقارنة .

Table 5. Effect of feeding rations supplemented with zinc or zinc plus vitamin A on average daily milk yield, fat corrected milk (FCM) yield and fat yield with lactating cows.

Items		1st tested ration			2nd tested ration				
	Initial yield of the control (a) kg	Actual yield (b) kg	Calculated yield b + F (43-18) (g) kg	Difference g-a/ ax 100 %	Actual yield (c) kg	Calculated yield b + F (68-18) (h) kg	Difference h-a/ ax 100 %	Final yield of control (d) kg	Daily decrease a-d/ 93-18 (f) g
Milk yield kg/h/day	8.93 ± 0.68	9.29 ± 0.64	9.81 ± 0.71	+ 10.08	9.21 ± 0.52	10.25± 0.64	+ 15.57	7.36 ± 0.50	+ 20.71
FCM yield kg/h/day	8.24 ± 0.64	8.63 ± 0.60	9.11 ± 0.66	+ 10.85	8.54 ± 0.48	9.49 ± 0.60	+ 16.00	6.82 ± 0.46	+ 19.0
Fat yield g/h/day	337.3± 25.9	327.9± 22.8	345.3± 25.1	+ 11.23	323.7± 18.2	358.6±22.5	+ 16.05	258.4± 17.7	+ 0.70