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PRODUCTIVE AND REPRODUCTIVE PERFORMANCE OF MAGHREBI SHE-CAMELS FED WITH ORGANIC ZINC DIET UNDER SEMI-ARID EGYPTIAN CONDITIONS

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SUMMARY

Organic zinc-binding with probiotic (Biogen-Zn®; BZ) is a Zn-methionine combined with *Bacillus subtilis* capable of improving zinc bioavailability, animal health and ameliorating reproductive stress. The present experiment was performed to evaluate the effect of addition BZ to she-camels on their physiological status, reproductive and productive traits under semi-arid Egyptian conditions. Twenty pregnant Maghrebi camels (4–6 parities) with average body weight of 519.96±19.98 kg were randomly divided into four groups (n=5 in each) according to live body weight and parity. The 1st group, camels were fed basal ration and served as control (without supplementation). The 2nd, 3rd and 4th groups of camels were fed the basal ration supplied with BZ at doses of 5, 7, and 10 g BZ/head/day, respectively. BZ was added daily during a period from the first day of the 10th month of pregnancy period and continued up to seven months of lactation period. Blood samples were collected biweekly during different she-camels' reproductive stages at 10th monthly of pregnancy, at 1st day after calving, and during seven months of lactation period. The results indicated that BZ significantly increased glucose concentrations in serum, total protein, globulin in dose dependent manner. While, serum concentrations of cholesterol, triglycerides, low density lipoprotein and very low-density lipoprotein were decreased in treated groups compared to the control one. Liver and kidney functions were improved at different sampling stages with 10 g of BZ treatment. Moreover, camels treated with 10 g of BZ revealed a significant effect on placental characteristics fluids including, the shortest duration drop of placenta and the heaviest weights of placenta treated group. As well as, live body weight at 1st service,-number of services/conception and service period length during the post-partum period were improved by BZ supplementation. In conclusion, organic zinc-binding with probiotic (BZ) has a potential use for improving physiological status, reproductive and productive performance of she-camels, to particularly with a dose of 10g/h/d of BZ.

Keywords: *Organic zinc, blood constituents, productive, reproductive performance and she-camels.*

INTRODUCTION

No doubt that the pre-parturition period, means the transition period from late pregnancy to early lactation is the most important stage of the lactation cycle. It is noteworthy that female animals' difficulties traverse changing from the pregnant, non-lactating state to the non-pregnant, lactating state (Goff and Horst, 1997). Oxidative stress is generated during normal placental development and become exaggerated when the supply of antioxidant micronutrients is limited, resulting in a negative effects on pregnancy outcome (Mistry and Williams, 2011). Moreover, two factors were conflicted together and contributed to the development of complications in late pregnancy; the first factor is energy imbalance which generates oxidative stress and increase lipid peroxidation and the second is lack of antioxidant activity (Bernabucci *et al.,* 2002). The health problems could be continued after birth resulted from poor nutritional management immediately after calving (Bell, 1995).

Therefore, transition period needs more attentions as management, nutrition and health care. Thus, nutrition and management of camels during the transition period have received tremendous interest lately. In this concern, a number of micronutrients act as essential cofactors or as antioxidants. Especially, trace minerals have an positive effect to provide sufficient amounts for the developing fetus and defender from the risk of stress periods (Larson 2005).

One of such minerals, zinc (Zn) is an essential element required by ruminants for several biochemical functions. Zinc plays important roles in improvement growth and health in animals as it needed for energy and protein metabolism (NRC, 2001). Also, Soetan *et al.* (2010) reported that the need Zn for majoity animals based on its influence on activities of enzymes and proteins. Whereas, these enzymes and proteins affect vitamin A synthesis, carbon dioxide transport, collagen fiber degradation, free radical destruction, red blood cells membrane stability and metabolism of fatty acids, carbohydrate, protein and nucleic acids. Moreover, Zn demands for skin integrity, cell repair, development of the immune response and neurological function (Haase and Rink, 2014). Patel *et al.* (2017) also reported that supplementation of 80 and 120 ppm Zn in feed during pre-partum period to cows is effective in improving post-partum reproductive performance.

Trace elements connected with specific amino acids makes are bioavailable and have better retention than the inorganic source, (Pari-patananont and Lovell, 1997 and Nockels *et al.*, 1993). Zinc-methionine (Zn-Met) is unaffected by rumen microbes and absorbed to a similar amount as Zn oxide, but Zn-Met appears to be metabolized inversely after absorption with lower urinary excretion and a slower rate of decline in plasma Zn (Spears, 1989). Furthermore, organic Zn supplementation can enhance resistance to udder stress in dairy goats (Salama *et al.*, 2003). Mostafa *et al.* (2019) revealed that addition Zn-Met at a level of 50 mg/kg DM 3 month’s pre-partum up to 9 months post-partum, improved milk production, reproductive performance of female camels and growth performance of their offspring.

Furthermore, in terms of mixed zinc methionine with *Bacillus subtilis* (Biogen-Zn®), Abu El-Ella *et al.* (2014) confirmed that addition of BZ as 0.5 or 1.0 g/head/day during reproduction stages of goats able to improve reproductive performance through lowering the incidence of estrus, reducing the number of days to estrus, conception rate, fertility, fecundity and kidding rate and improve some blood components. Therefore, the current study aimed to evaluate the effect of Biogen-Zn® supplementation on productive, reproductive and blood biochemical constituents of she-camels throughout the different stages of reproduction including late pregnancy, at calving, post-calving and the continues to seven months of lactation.

MATERIALS AND METHODS

Animals and feeding management:

The experimental part of this study was carried out at Center of Studies and Development of Camel Production, belonging to Animal Production Research Institute, Agricultural Research Center, Matrouh Governorate- Egypt, during the period from April, 2018 to April, 2019. Determinations of serum constituents were performed at the laboratory belonging to Animal and Fish Production Department, Faculty of Agriculture (Saba Basha), Alexandria University, Egypt.

Twenty pregnant Maghrebi camels (4–6 parities) with average live body weight 519.96±19.98 kg were randomly divided into four groups (n=5 in each) according to live body weight and parity. The 1st group, camels were fed the basal ration and served as control (without supplementation). The 2nd, 3rd and 4th groups, camels were fed the basal ration supplemented with Biogen-Zn® at doses of 5, 7, and 10 g BZ /head/ day, respectively. BZ supplementation was started feed at the beginning of the 10th month of pregnancy period and continued up to the seven months of lactation period.

The basal ration was composed of 40% concentrate feed mixture (CFM), 30% berseem hay (BH), and 30% rice straw (RS). The camels were separately fed according to the recommendation of the Animal Production Research Institute, which meets maintenance, pregnancy, and milk production requirements. The specific feed amounts were about 3-4 kg CFM, 2-3 kg BH, and 2-3 kg RS /camel/day. The ration was offered twice daily during the trial period. The composition of CFM was soybean meal (44% CP, 80.00 g), corn yellow 250.00 g, barley 280.00 g, wheat bran 320.00 g, molasses 35.00 g, limestone 20.00 g, sodium chloride 13.0 g, vit.-min. premix 2.00 g. and the procimate analysis of CFM was 126 g crude protein and 233 g crud fiber. Water was delivered to camels *ad libitum* in water racks.

Serum biochemical constituents:

Blood samples were collected biweekly during different she-camels' reproductive stages, at the 10^{th} month of the pregnancy period, at 1^{st} day after calving, and every month during seven months of lactation period. Blood samples were collected from Jugular vein puncture without anticoagulant into plain test-tubes. Collected blood samples were centrifuged (3000 rpm, 15 min.) and the serum was carefully decanted into serum vials. Serum samples were stored in deep freezer (−20ºC) until being used for biochemical analysis.

The serum glucose, total protein and albumin Globulin concentration was calculated by the difference between total protein and albumin, cholesterol and triglycerides (TG) High-density lipoprotein-cholesterol (HDL) Low-density lipoprotein-cholesterol (LDL) was calculated according to Warnick *et al.* (1983) by the formula:

$$LDL = cholesterol- (HDL+VLDL).$$

Very low-density lipoprotein-cholesterol (vLDL) was calculated by dividing the values of TG by factor of 5 according to Warnick *et al.* (1983). Serum blood urea nitrogen (BUN, mg/dl), Creatinine, mg/dl, the activities of serum aspartate-aminotransferase (AST), alanine-aminotransferase (ALT), Alkaline phosphatase (ALP) activity, all determination were executed according to the colorimetrically determined by using commercial kits produced by Bio Diagnostic, Egypt.

Reproductive parameters:

Determinations of LBW at first service (kg), No. of services/ conception, service period length (day), conception rate (%, number of pregnant camels divided by inseminated camels), gestation period (day), placental drop (min), placental weight with fluids (kg) and placenta weight without fluids (kg) were recorded.

Body weight and feed intake:

Camels in all groups were individually weighed at the beginning of the experiment (at the 10^{th} month of pregnancy), after 1^{st} calving, after that they were monthly weighed for 7 months. The consumed amount of CFM, BH, and SR were separately recorded during the whole experiment.

Statistical analysis:

Data were statistically analyzed using the General Linear Model procedure of the Statistical Analysis System **(SAS, 2001)**. Data obtained were tested by analysis of variance with one-way design to test the treatment group differences at each sampling time during pre-, post-partum and 7 lactation months according to the following model:

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

where: Y_{ij}= observed values; μ= overall mean; P_i= trail group; e_{ij}= random error.

Values were given as mean. The significant differences among groups were detected to Duncan's multiple range test (Duncan, 1955).

RESULTS AND DISCUSSION

Biochemical traits:

Effects of addition she-camels with different levels of BZ (5, 7, and 10 g BZ /h/d) on serum glucose concentration and protein profile are presented in Table (1). Results showed that supplementation BZ at different levels caused significant or numerical increases in serum glucose concentration at 10^{th} month of pregnancy and 1^{st} month of post-partum compared with control group. Meanwhile, it is clearly to note that addition of 10 g BZ/h/d significantly or numerically increased serum glucose at first day after calving and during lactation period as compared with the other treated and control groups. Zeedan *et al*. (2014) Plasma glucose was significantly increased ($P<0.05$) with supplementing BZ within the two stages (late pregnancy and Lactation of sheep). The mechanism by which probiotic increased serum glucose could be attributed to increasing cellulolytic bacteria that act on cellulose fibers degradation and produce more glucose; increase the glucogenic precursor propionate in rumen, decrease plasma insulin and insulin-glucose ratio, indicating an increase in gluconeogenesis. These results concurred with Zeedan *et al.* (2008 and 2009a) who reported that addition BZ in sheep rations caused an increase in serum glucose during different physiological stages. Also, Abu El-Ella *et al.* (2014) indicated that feeding Damascus goats does on diets containing two levels of BZ (0.5 and 1.0 g/h/d) led to increase (P<0.05) glucose level during pregnancy and lactation periods.

Table (1): Blood serum glucose, protein profile (mg/dl) and albumin/globulin ratio of she-camels ration including different levels of Biogen-Zn®.

Item	Biogen-Zn® level (g/head/day)				SEM	*P* value
	0	5	7	10		
			Glucose			
10th month of pregnancy	60.27b	107.09a	111.89a	112.85a	3.162	0.0001
1st day after calving	96.95b	104.96b	099.04b	109.87a	2.196	0.0141
1st month post-partum	85.60b	095.84a	100.95a	102.73a	3.050	0.0089
During lactation period	89.03b	092.65b	092.15b	100.08a	1.291	0.0031
			Total protein			
10th month of pregnancy	7.17	7.14	7.37	7.05	0.15	0.6191
1st day after calving	7.12b	8.07a	7.53b	7.39b	0.13	0.0020
1st month post-partum	6.91b	7.77a	7.46ab	7.64ab	0.22	0.0455
During lactation period	7.06b	7.45ab	7.75a	7.95a	0.18	0.0265
			Albumin			
10th month of pregnancy	3.59	3.73	3.64	3.55	0.14	0.8258
1st day after calving	3.88	3.72	3.58	3.47	0.16	0.3804
1st month post-partum	3.91	3.47	3.57	3.24	0.19	0.1799
During lactation period	3.62	3.75	3.70	3.46	0.18	0.6954
			Globulin			
10th month of pregnancy	3.58	3.41	3.73	3.50	0.21	0.8109
1st day after calving	3.25b	4.35a	3.95ab	3.92ab	0.22	0.0384
1st month post-partum	3.00b	4.30a	3.89ab	4.39a	0.30	0.0316
During lactation period	3.44	3.70	4.05	4.49	0.27	0.1009
			A/G ratio			
10th month of pregnancy	1.00	1.09	0.98	1.01	0.09	0.7859
1st day after calving	1.19	0.86	0.91	0.89	0.06	0.0817
1st month post-partum	1.30a	0.81b	0.92b	0.74b	0.10	0.0012
During lactation period	1.05	1.01	0.91	0.77	0.11	0.0915

Means in the same row not sharing the same superscript differ significantly.

The present findings indicating that serum total protein concentration of she-camels was significantly (P<0.05) higher by adding 5g *BZ*/h/d at 1st day after calving and at 1st month post-partum as compared with the other groups and control. However, camels received 7 and 10 g of BZ/h/d (P<0.05) increased TP followed by those animal fed ration including 5g BZ during lactation period as compared with the control groups.

Effects of addition she-camels with different levels of BZ (5, 7, and 10 g BZ /h/d) did not significantly (P>0.05) change on serum albumin concentration.

At 1st day after calving and throughout the 1st month post-partum addition of 5 g BZ/h/d significantly (P<0.05) increased serum globulin in comparison with the control group. Furthermore, addition of 10 g BZ/h/d significantly (P<0.05) increased serum globulin at 1st month post-partum in comparison with the control group. However, albumin/ globulin ratio didn't affect by addition she-camels with different levels of BZ 10th month of pregnancy, 1st day after calving and during lactation periods of camels. However, at 1st month post-partum, A/G ratio significantly (P<0.05) decreased by addition different levels of BZ compared to the control group. Our results was proven early by Seleim *et al.* (2003) who reported that TP, AL and GL were in normal values (7.60, 3.3 and 4.32 mg/ dl), respectively in 2-12-years old of Egyptian camels. Also, the present results were in accordance with those obtained by Shams (2008) and Zeedan *et al.* (2008 and

2009b) who found that addition Zn-Met or BZ improved blood globulin compared to the control group. Recently Mostafa *et al.* (2019) found that TP and AL were ($P<0.05$) higher in camels fed ration containing 50 mg Zn-Met during pre-partum than control group, as well as, the concentration of TP was ($P<0.05$) increased with high doses of Zn-Met (40 and 50 mg) during post-partum as compared with the control and those of camel received low dose of Zn-Met (30 mg).

In conflict to the present results, Abd El-Hamid *et al.* (2019) found that serum TP, AL and GL levels didn't ($P>0.05$) differ by the supplementation of 2.7 g/h/d of trace elements (Cu, Zn, Mg and Co) in organic or inorganic forms during the pregnancy period of ewes. Abu El-Ella *et al.* (2014) concluded that the supplementation of BZ to basal ration at three doses (0.0, 0.5 and 1.0 g/h/d) significantly increased TP, AL and GL concentrations, and A/G ratio during the different physiological statuses as compared with the control group. In the otherwise, the concentrations of serum AL of dairy cows was ($P<0.05$) increased *vs* decreasing GL by adding two different kinds of probiotics as *L. acidophilus* and *Bifidobactrium bifidum* or *Saccharomyces cerevisiae* as compared to the control group during the lactation period (Mostafe *et al.* 2014).

Blood Lipid profile:

Parameters of serum lipid profile (mg/dl) of she-camels given different levels of BZ are presented in Table (2). Generally, the obtained data indicated that supplemented she-camels with ZB at levels 5, 7 and 10 g/head/day significantly or numerically improved these parameters during all the reproductive stages.

Table (2): Serum lipid profile (mg/dl) of she-camels fed ration containing different levels of biogen zinc®.

Item	Biogen-Zn® level (g/head/day)				SEM	*P* value
	0	5	7	10		
Total Cholesterol						
10th month of pregnancy	69.99	70.54	58.87	59.24	1.1	0.1294
1st day after calving	65.66^{a}	50.39^{b}	52.77^{b}	50.48^{b}	1.05	0.0012
1st month post-partum	61.96	58.98	58.35	57.47	3.49	0.0781
During lactation period	64.07	59.78	59.62	59.23	1.16	0.1012
Triglycerides						
10th month of pregnancy	44.05	41.50	43.95	43.50	0.84	0.1881
1st day after calving	43.68	43.58	43.90	41.83	0.84	0.3508
1st month post-partum	45.00^{a}	40.00^{b}	41.00^{b}	40.00^{b}	0.01	0.0001
During lactation period	42.75^{a}	37.75^{b}	39.50^{ab}	37.00^{b}	1.11	0.0193
High density lipoprotein (HDL)						
10th month of pregnancy	34.05	31.50	33.95	33.50	0.84	0.1881
1st day after calving	33.68	33.58	33.90	31.83	0.84	0.3508
1st month post-partum	34.25	32.50	33.50	30.77	0.80	0.0793
During lactation period	33.00	32.75	32.00	34.50	1.70	0.7710
Low density lipoprotein (LDL)						
10th month of pregnancy	21.05^{a}	16.05^{b}	20.20^{a}	17.15^{b}	0.84	0.0042
1st day after calving	20.68^{a}	18.13^{ab}	20.15^{a}	15.48^{b}	0.84	0.0047
1st month post-partum	21.25^{a}	17.05^{bc}	19.75^{ab}	14.42^{c}	0.80	0.0007
During lactation period	20.00	17.3	18.25	18.15	1.70	0.7279
Very low-density lipoprotein (VLDL)						
10th month of pregnancy	10.53^{a}	07.64^{c}	09.18^{b}	07.42^{c}	0.39	0.0004
1st day after calving	10.34^{a}	08.63^{b}	09.16^{ab}	06.70^{c}	0.38	0.0003
1st month post-partum	10.63^{a}	08.12^{b}	08.98^{b}	06.24^{c}	0.38	0.0001
During lactation period	10.00	8.24	8.30	7.86	0.79	0.2743

Means in the same row not sharing the same superscript differ significantly.

Results in Table (2) indicated that all levels of BZ significantly ($P<0.05$) decreased blood serum cholesterol only at 1st day after calving. Also, added she-camels with different levels of BZ resulted in significant decrease in serum triglycerides during lactation period and at 1st month post-partum. Similar observation was reported by; Turk (2013) who stated that serum triglycerides level was gradually increased at last month of gestation while after two months of parturition was downward. The present results disagreed with Zeedan *et al.* (2009b) who reported that diets of lactating buffaloes including BZ led to increase blood triglyceride during late pregnancy and postpartum periods. Antunovic *et al*. (2011) and Deghnouche *et al*. (2013) found higher concentration of triglyceride in the blood of ewes during pregnancy of ewes explained the importance of heavy transport of the lipoproteins or to energy deficiency in the meal. Also, Abu El-Ella *et al.* (2014) and Zeedan *et al.* (2014) found that addition different levels of BZ for Damascus does caused ($P<0.05$) an increase in serum cholesterol and triglyceride during pregnancy and lactation periods when compared with those of control animals. Ivan *et al.* (2016) suggested that cholesterol and triglycerides concentrations were upward during the late month of gestation than that at early gestation.

The addition of BZ did not affect HDL, however, LDL and vLDL were significantly ($P<0.05$) decreased by BZ addition at 10th month of pregnancy and 1st month post-partum and 1st day after calving compared with the control group. However, LDL was higher by the addition of 7 g/h/d of BZ at 10th day of pregnancy and 1st day after calving as well as the control group. The increase of cholesterol concentration during pregnancy period and thereafter tend to decrease discussed by Juma *et al.* (2009) who suggested That may be associated with greater progesterone synthesis in the placenta (Lin *et al.*, 1977). Then the concentration of cholesterol declines after parturition as a response of estrogen that decreased plasma LDL (Ganog, 1995).

Kidney and liver functions:

It is well known that concentrations of both Bun and creatinine in one hand, and activities of AST, ALT and ALP in other hand are good indicators for kidney and liver functions, respectively as confirmed by many workers. These biological markers are given in Table (3).

Table (3): Biological markers of Kidney and liver function in she-camels fed rations containing different levels of Biogen-Zn® at different reproductive stages.

Item	Biogen-Zn® level (g/head/day)				SEM	*P* value
	0	5	7	10		
Serum blood urea nitrogen (mg/dl)						
10th month of pregnancy	14.85	14.30	14.02	13.59	0.67	0.7459
1st day after calving	11.28	11.75	11.28	11.99	0.30	0.3142
1st month post-partum	11.80	11.20	11.80	11.20	0.26	0.3236
During lactation period	10.74^b	11.99^a	10.73^b	11.98^a	0.30	0.0123
Creatinine (mg/dl)						
10th month of pregnancy	01.89	01.88	01.35	01.51	0.17	0.1625
1st day after calving	01.57^a	01.30^b	01.17^b	01.26^b	0.07	0.0288
1st month post-partum	01.43^a	01.17^b	01.13^b	01.17^b	0.06	0.0336
During lactation period	01.16^b	01.13^b	01.06^b	01.30^a	0.03	0.0019
Alkaline phosphatase (IU/L)						
10th month of pregnancy	61.35^a	45.44^b	37.88^b	38.13^b	2.06	0.0001
1st day after calving	62.00^a	45.39^b	40.91^c	35.83^d	0.96	0.0001
1st month post-partum	54.69^a	48.31^b	38.75^c	38.25^d	3.52	0.0415
During lactation period	57.11^a	46.14^b	38.46^c	35.62^d	1.04	0.0001
Aspartate aminotransferase (IU/L)						
10th month of pregnancy	60.20	61.82	60.21	67.25	2.10	0.4987
1st day after calving	51.61	56.88	60.72	60.13	2.19	0.0586
1st month post-partum	52.22	64.69	57.23	59.89	3.07	0.0939
During lactation period	55.83^b	59.57^b	73.05^a	60.16^b	2.19	0.0009
Alanine aminotransferase (IU/L)						
10th month of pregnancy	15.68	14.60	15.50	15.58	0.73	0.7622
1st day after calving	12.88	13.13	10.47	10.00	0.86	0.0558
1st month post-partum	12.72^a	11.41^b	10.74^b	9.47^c	0.32	0.0001
During lactation period	11.33	10.78	09.43	10.27	0.68	0.4338

Means in the same row not sharing the same superscript differ significantly.

The current results showed that the addition of BZ significantly ($P<0.05$) decreased creatinine concentration at1st day after calving and at 1st month post-partum compared to the control group. However, the addition of BZ didn't affect BUN concentration compared to the control group. In parallel with the present findings, Zeedan *et al.* (2014) showed that addition of BZ significantly decreased plasma urea and creatinine concentration of goats as compared with non-supplemented group. This result may indicate the enhancement of kidney function with BZ addition

In the current study, the activity of serum ALP recorded the lowest value by addition BZ during different stages of the experimental periods compared to the control group. Moreover, the mean value of ALP activity was 35.62- 62.0 IU/l. The present results are supported by Al-Zamely (2011) who reported that the normal concentration of serum ALP in camel is ranged from 60 to 140 IU / Liter. However, NRC (2001) recommended that using ALP activity is not a suitable indicator of Zn concentration in the animal body. Moreover, the current findings indicated that AST activity was ($P=0.0009$) higher during lactation period by addition 7 g of BZ in camels ration as compared with control group. At the same manner, Abu El-Ella *et al.* (2014) who found that activity of AST affected ($P<0.05$) by BZ addition in Damascus goat does during different physiological stages. However, Tharwat *et al.* (2015) reported that AST activity was raised in 3 weeks after birth as compared to last 3 weeks before parturition in camels in camels.

The present results demonstrated that ALT activity didn't affect by addition different levels of BZ, except at 1st month post-partum, ALT activity tend to decrease ($P=0.0001$) with increasing the dose of BZ versus the control group. This was proved by, Zeedan *et al.* (2008 and 2009a) who reported that values of serum AST and ALT didn't affect by BZ supplementation. The present study revealed that the values of serum AST were relatively higher, whereas, the values of serum ALT were lower than the normal range attained in previous studies on she-camels. This difference may due to several reasons such as feeding, genetics differences, stress, age, liver activity and body weight (Talha *et al.*, 2009).

Live body weight:

Results presented in Table (4) showed the effect of given she-camels BZ on live body weight (LBW) and feed consumption of camel in different periods.

Table (4): Productive traits of she-camels with calves given diets including different levels of Biogen-Zn®.

Item	Biogen-Zn® level (g/head/day)				SEM	*P* value
	0	5	7	10		
Average body weight (Kg)						
10th month of pregnancy	564.00	518.50	467.50	529.85	55.13	0.07
1st day after calving	532.8^{a}	469.3^{ab}	424.5^{b}	482.0^{ab}	53.15	0.05
1st month post-partum	508.8^{a}	467.3^{ab}	419.3^{b}	469.0^{ab}	43.22	0.04
During lactation period	501.00	468.80	424.60	468.50	38.49	0.36
Average daily feed intake (Kg) during 10th month of pregnancy						
Concentrate feed mixture	7.55^{a}	6.48^{ab}	5.84^{b}	6.62^{ab}	0.13	0.05
Berseem hay	4.80	4.81	5.00	4.90	0.08	0.31
Rice straw	5.20	5.23	5.19	5.22	0.11	0.33
Average daily feed intake (Kg) during one-month post-partum						
Concentrate feed mixture	6.66^{a}	5.87^{ab}	5.31^{b}	6.03^{ab}	0.15	0.05
Berseem hay	4.90	4.80	5.00	5.07	0.09	0.11
Rice straw	5.00	5.01	4.30	5.10	0.12	0.09
Average daily feed intake (Kg) during lactation period						
Concentrate feed mixture	5.86	5.61	4.84	5.65	0.29	0.41
Berseem hay	4.55^{b}	5.00^{a}	5.10^{a}	5.30^{a}	0.17	0.05
Rice straw	4.76^{b}	4.90^{ab}	5.10^{a}	5.29^{a}	0.23	0.04

Means in the same row not sharing the same superscript differ significantly.

The current results showed that the addition of BZ didn't improve LBW and feed intake. However, BZ at dose of 7 g/h/d decreased live body weight at 1st day after calving and one month of post-partum versus control group. The same trends were observed in feed intake of concentrate feed mixture at month of pre- and post-partum. While, the intake of berseem hay and rice straw were significantly ($P<0.05$) higher than the control group during the lactation period.

The present results agreed with Mostafa *et al.* (2019) who showed that ingestion different doses of Zn-Met didn't affect live body weight and feed consumption during pre- or post-partum of she-camels. In the present study, there were improvements in BH and RS consumption during lactation periods may be referring to the existence of probiotic *Bacillus subtilis* incorporated in BZ. This probiotic stimulates the growth of certain types of rumen microbes and hence fiber digestion (Chademana and Offer, 1990).

Reproductive traits:

Data presented in Table (5) revealed to the reproductive traits of she-camels supplemented with BZ. The results indicated that body weight at 1^{st} service of camels supplemented 7 g of BZ was significantly ($P<0.05$) heavier than the treated and control groups. The current results were parallel with Mostafa *et al.* (2019) who found that body weight of she-camels before or after calving didn't affect by Zn-Met supplementation. It is noteworthy that camels supplemented with 10 g of BZ showed the least number of services/ conceptions, shortest service period length and highest conception rates as compared to other groups. These findings indicated that feeding ration including BZ had positive effects on reproductive performance of camels during the post-partum period

Table (5): Reproductive traits of She-camel given different levels of Biogen-Zn® during post-partum period.

Item	Biogen-Zn® level (g/head/day)				SEM	*P* value
	0	5	7	10		
Body weight at first service (kg)	471.6^{b}	490.4^{b}	529.5^{a}	465.3^{b}	14.97	0.001
No. of services/ conception	3.38^{a}	2.38^{b}	2.38^{b}	2.25^{b}	0.14	0.002
Service period length (day)	18.90^{a}	16.88^{b}	16.38^{b}	15.88^{b}	0.51	0.043
Conception rate (%)	33.30	66.60	66.30	100.0		
Gestation and placental characteristics						
Gestation period (day)	381.70	383.00	382.90	381.90	0.97	0.601
Placental drop (min)	178.95^{a}	170.63^{b}	173.38^{b}	164.10^{c}	2.14	0.002
Placental weight with fluids (kg)	10.71^{b}	11.15^{a}	11.91^{a}	12.19^{a}	0.15	0.043
Placenta weight without fluids (kg)	3.63	3.76	3.68	3.78	0.13	0.551

Means in the same row not sharing the same superscript differ significantly.

Similar results are recorded in cows by Mostafa *et al.* (2014) who showed that postpartum first service was earlier by about 22.5 - 25 d, number of services conception was less by about 0.5 and 0.75 and days open were shorter by about 21.0 and 36.5 d of cows fed ration including probiotic at 3 g of *Lactobacillus and Bifidobacterium*, and 20 g of commercial yeast culture (*S. cerevisiae*), respectively as compared with the control group. The gestation periods in the present study are within the normal range as well as Mostafa *et al.* (2016) who stated that pregnancy lasts from 12 to 13 months in the dromedary camel. However, in the present results, there were no differences in gestation period length of camels.

Moreover, addition of different doses of BZ showed significant effect on placental characteristics, whereas the camels treated with 10 g of BZ showed a significant shorter duration of placental drop and heavier weights of the placenta with fluids. While, placental weight without fluids didn't affect by experimental treatments. These results concurred with Mostafa *et al.* (2019) who found that the addition of different levels of Zn-Met caused significant reduction in days open and uterine involution interval of camels, as well as decreasing duration of placental drop and improving the first estrus post-partum. The effect of BZ on shortening the duration of placental drop may be due to the ability of zinc to improve the stability of oxytocin, besides, zinc is essential for the binding of oxytocin to its cellular receptor (Liu et al., 2005 and Avanti *et al*., 2013). While, the placental weight of BZ groups recorded the heaviest weight due to that zinc have ability to improve the placental vascular system (Wilson *et al*., 2017).

CONCLUSION

The results of this study showed that supply she-camels with graded levels (5, 7 and 10 g/h/d) of organic zinc-binding with probiotic (Biogen-Zn®) enhanced their physiological status, reproductive traits and may be used in ameliorating the stress of transition period of camels. Also, the better findings were achieved with the level 10 g BZ/head/day.

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أثر اضافة الزنك العضوى للنوق المغربيه على الخصائص البيوكيميائيه والتناسليه والانتاجيه تحت الظروف الشبه جافه

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ربط الزنك العضوي مع البروبيوتيك مثل ال (BZ ؛®Biogen-Zn) عبارة عن زنك ميثيونين مع Bacillus subtilis قادر على تحسين توافر الزنك الحيوي وصحة الحيوان وتخفيف الإجهاد التناسلي.

هذه التجربه اجريت لتقدير تأثير إعطاء البيوجين زنك للنوق وتأثيره على حالتها الفسيولوجية وأدائها الإنجابي في ظل الظروف المصرية شبه القاحلة. تم استخدام 20 من النوق المغربية الحامل, (4-6 موسم) بمتوسط وزن للجسم 519.96 كجم عشوائياً إلى أربع مجموعات (5 جمال لكل مجموعه). المجموعه الاولى تم تغذية الجمال فيها على العليقه الاساسيه (المجموعه الضابطه), المجموعه الثانيه والثالثه والرابعه تغذت على العليقه الاساسيه مع اضافه جرعات البيوجين زنك 5و 7و 10 جرام لكل ناقه/يوميا

أعطيت جرعات البيوجين زنك يوميا خلال الفترة من اليوم الأول من الشهر العاشر من فترة الحمل واستمرت إلى سبعة أشهر لفترة الرضاعة. تم جمع عينات الدم كل أسبوعين خلال المراحل التناسلية المختلفة للجمال في الشهر العاشر من الحمل ، في اليوم الأول بعد الولادة ، وخلال سبعة أشهر من فترة الرضاعة.

أشارت النتائج إلى أن اضافة البيوجين زنك ادى الى زيادة الجلوكوز ، البروتين الكلي ، الجلوبيولين في مصل الدم بناء على مستوى تركيز البيوجين زنك بينما انخفضت تركيزات كل من الكوليسترول والجليسريدات والبروتين الدهني منخفض الكثافة (LDL) والبروتينات الدهنية منخفضة الكثافة للغاية (vLDL) في المجموعات المعاملة مقارنة بالمجموعة الضابطة. ظهورتحسين فى وظائف الكبد والكلى في مراحل أخذ العينات المختلفة مع مجموعة الجمال المضاف اليها 10 جرام من البيوجين زنك. علاوة على ذلك ، اظهرت النتائج ان النوق المزودة بـ 10 جم من بيوجين زنك ادت الى حدوث تأثير كبير على صفات سوائل المشيمة ، بما في ذلك تأخر فترة سقوط المشيمة وزيادة وزن المشيمة للمجموعة المضاف اليها البيوجين زنك. بالإضافة إلى ذلك، حدوث تحسن فى وزن الجسم الحي للمره الاولى من التهيئه للتلقيح ، وتحسن فى عدد مرات التهيئه للتلقيح / حمل وطول فترة التهيئه خلال فترة ما بعد الولادة من خلال إضافة البيوجين زنك.

نستنتج من هذا ان استخدام الزنك العضوى المرتبط بالبروبيتك فى صورة البيوجين زنك عمل على تحسين الاداء التناسلى والانتاجى وصفات الدم للنوق المغربيه الكرباه فى ظل ظروف بيئيه شبه قاحله خاصه مع النوق التى تغذت على علائق تحتوى على 10جرام بيوجين زنك