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EFFECT OF ZINC SUPPLEMENTATION ON REPRODUCTIVE PERFORMANCE OF BARKI EWES UNDER PRACTICAL FIELD CONDITION

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SUMMARY

The study was conducted to investigate the effect of zinc supplementation on reproductive performance of Barki ewes fed practical basal ration under field condition. Zinc was supplemented to the practical basal ration as zinc sulphate one month premating, during mating and continued throughout gestation.

Although practical basal ration had approximately 23-25 ppm Zn, 100ppm Zn supplementation reduced the non-reproductive period in Barki ewes. Dry matter intake of ewes received zinc supplement was greater than dry matter intake of those fed practical basal ration. Lambing percent, litter size and prolificacy number percent were improved in zinc supplemented ewes. Twinning phenomenon was achieved as a result of zinc supplementation. Lambs born from ewes received 100 ppm zinc with their basal ration showed significant increase in both birth and weaning weight.

Colostral whey protein was increased significantly for supplemented group as compared with ewes fed practical basal ration without zinc supplement. However body weight change of ewes, body conditions and parturition problems, were not affected by zinc supplement. Zinc supplementation did not affect colostrum as well was milk proximate analysis. Zinc supplemented ewes had higher serum zinc than those fed practical basal ration.

It can be concluded that it is feasible to supplement ewes practical basal ration with zinc to optimize reproductive performance and to improve productive ability of their lambs under field condition.

INTRODUCTION

Middle Eastern fat-tailed sheep are characterized by low fertility (Hamadeh et al., 1996). Lamb production can be influenced by ewe nutrition during critical life cycle stage (Rattary, 1992).

Zinc plays an essential role in many biochemical reactions in the body (Emmert and Baker, 1995). It is involved in nucleic acid and carbohydrate metablism, cell division and multiplication (Underwood, 1981). It is alos a constituent of several metallo enzymes and essential in immunocompetency (McBean, 1991 and Hahn and Baker, 1993). Underwood (1981) reported that signs of low zinc intake are most apparent when cells are rapidly dividing, growing or synthesising. Consequently growth and reproduction may be impaired by inadequate zinc levels in different species; as in rat (O'Delletal 1977); chickens (Kidd et al., 1993) and pigs (Kavanagh 1992).

Little information is available on zinc requirements for reproduction in female sheep under practical field conditions. Although zinc is widely distributed in feed, a severe zinc deficiency in sheep under field condition has been reported in Greece (Papasteriadis, 1973) and Sudan (Mahmoud et al., 1983). In Egypt, zinc deficiency has also been reported in human (Sandsteard, 1968). Whether low zinc that recorded in field influenced pregnancy and parturition in sheep? It is considered unexplained reproductive problems (Masters and Moir, 1983). Egan (1972) obtained high conception rate when grazing ewes were given a diet supplemented with zinc. Zinc supplementation for grazing ewes has been shown to increase the number of lambs produced and improve fertility in sheep under field condition (Masters and Fels, 1980). Maintenance of pregnancy in ewes and lamb birth weight were apparently influenced by zin supplementation (Apgar and Fitzgerald, 1985 an King, 1990). Robinson (1993) concluded tha dietary zinc supplement improved conception ra and litter size in ewes. On the other hand, Maste (1981) and Masters and Moir (1983) found tha zinc content of the diet did not significantl influence the ability of ewes to become pregnan or maintain pergnancy.

The objective of the present study was to optimiz the productive performance of Barki ewes unde practical field condition in Egypt by dietary zin supplementation. For this purpose practical ratio of ewes was supplemented with 100 ppm zinc t study its effect on reproductivity and productivit of ewes and their lambs.

MATERIAL AND METHODS

Animal and Treatment

Twenty eight mature, 4-5 year old and average 40-50 Kg live body weight non pregnant Bar ewes were used for the current study. Animal were kept at Animal Production Research Farm El-Gharbia during November till May. Th experiment was carried out, one month befor mating, during mating and throughout pregnanc Ewes were reared on commercial concentra mixture, rice straw and green berseem througho the experiment as designed in Table (1). Th rations supplied the ewes with nutrie requirements as recommended by NRC (1985).

Table (1): Amount of ingredients fed throughout experiment *

Ingredients	Pre-mating and during mating	After-mating till 115 d of gestation	At 115d of gestation till parturition
Commercial concentrate mixture	0.75	0.5	1.0
Rice straw	0.5	0.5	0.5
Green berseem**	ad-libitum	ad-libitum	ad-libitum

* Kg per day per animal

** Amounts of berseem fed was calculated throughout experiment to determine average dry matter intake.

Crude protein percent of concentrate mixture and berseem were analysed (A.O.A.C., 1984). Zinc content of concentrate mixture, rice straw and berseem was determined by atomic absorption spectrophotometer (Mod. 3300, Perkin, Elemer USA Table (2). Calculated analysis of ewes rations throughout the experiment showed that their zinc content ranged from (23 to 25) ppm.

One month pre-mating, ewes were randomly divided into two groups: (1) ten ewes (control group) were reared on nonsupplemented practical basal ration (2) eighteen ewes received 100 ppm zinc with their practical basal ration (adequate to maintain serum Zn, (Apgar and Travis, 1979). Zinc was supplemented as zinc sulphate (22.3%) which is considered the most available inorganic source of zinc (Rajas et al., 1995).

At mating time, ewes were allowed to mate naturally for one month with two fertile rams for each gorup.

Table (2): Chemical analysis of protein and zinc on dry mater basis

Ingredients	CP %	Zn (ppm)
Commercial conc. mixture	16.4	43
Rice straw	-	3
Berseem	9.7	12

Measurements and sampling

Ewes were weighed at the beginning of the experiment and then monthly till parturition to determine body weight change (B.W).

Individual blood samples were collected from ewes via jugular vein puncture at the beginning of the experiment and then weekly throughout the mating period (one month) for progesterone determination to detect pregnancy. Ewes were considered to be pregnant showing continuous P4 profiles greater than 1.0 mg/ml over the whole sampling period (Hamadeh et al., 1966). Progesterone was assayed by radioimmunoassay kits supplied by Diagnonstic products corporation, Los Angelos USA (Coleman et al. 1984).

Fertility percent was recorded weekly during 4 weeks mating period (number of ewes pregnant/number of ewes exposed), as previously defined by Kleemann et al., (1991).

At lambing, ewes condition, parturition problems were observed. Number of lamb birth weights were recorded. Lambing percent (number of lambed ewes/number of ewes exposed), litter size (number of lambs born alive/number of ewes exposed) and prolificacy number (number of lambs born alive/number of lambed ewes) were calculated according to Hamadeh (1996). Lamb growth was followed up till weaning to determine weaning weight.

Serum zinc and copper levels of ewes were determined monthly throughout experiment by atomic absorption, spectrophotometer.

Colostrum samples were taken within 8 hour[s] after birth and milk samples were collected at 1[...] days post-partum. The colostrum samples we[re] centrifuged (3000 rpm for 30 minutes), and th[e] whey separated according to Akhtar et al. (1994[).] Whey protein percent (as an indicator of colostr[al] immunoglobulin, Hatfield et al., 1995), tot[al] colostrum protein and milk protein we[re] determined (A.O.A.C. 1984).

Colostrum and milk fat was estimated usin[g] Gerber method, lactose was determined b[y] Fehling solution method and determination of a[sh] was carried out using Muffle-Furnace (Davis a[nd] Macdonald, 1957). Zinc and copp[er] concentrations from either colostrum or milk we[re] analysed using atomic absorptio[n] spectrophotometer.

Statistical analysis

Statistical analysis of the obtained data w[as] performed according to Snedecor (1986).

RESULTS and DISCUSSION

Dry matter intake (DMI)

During the first month of gestation supplemented ewes consumed 9% more [dry] matter than those fed non-supplemented practi[cal] basal ration. At last month of gestation, DMI [was] increased 15% for the supplemented group compared with control (Fig. 1). The obtai[ned] result was in accordance with Masters and M[...] (1983) who found that Zn supplemented e[wes] consumed 25% more feed than those given low Zn ration. Hatfield et al. (1995) considered that Zn had a key role in regulating feed intake, since Zn supplementation might sufficiently increase the palatability of the diet (Masters and Moir, 1983). The present result indicated that ewes fed a practical ration were in a case of poor Zn status. Underwood (1981) suggested that food intake is well documented characteristic of low zinc intake.

Bod weight change (BW)

Fig. (2) shows that BW of pregnant ewes fed practical basal ration was slightly reduced compared with those received Zn in their ration, similar findings were obtained by Masters and Moir (1983) and Hatfield et al. (1995).

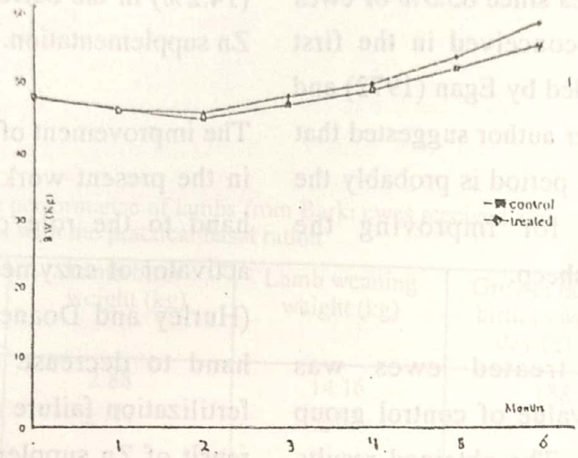

Fig. (1): DMI of Barki ewes received zinc supplement with the practical basal ration (1) during first month of gestation (2) during last month of gestation.

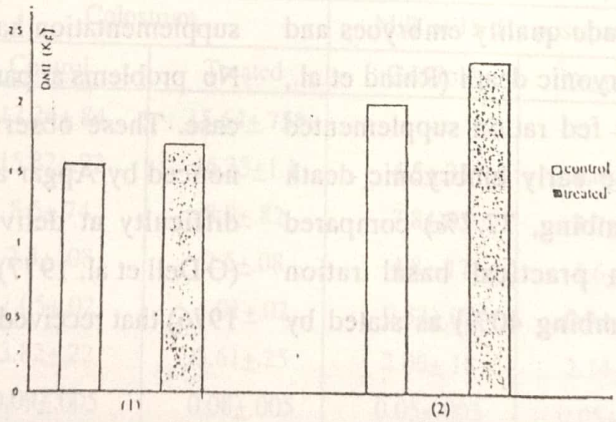

Fig. (2): Body weigh change during gestation period for Barki ewes received zinc supplement with the practical basal ration.

Reproductive performance of ewes:

The data present in Table (3) show a marked increase in fertility percent (83.3 - 88.8%) at first and second weeks of mating respectively for Zn supplemented ewes as compared with non supplemented group (50-60%). Fertility reached 100% at third week of mating for supplemented group, and at fourth week of mating for non supplemented one. It could be inferred that Zn supplementation may decrease the non reproductive period in ewes since 83.3% of ewes fed Zn supplementation conceived in the first week of mating as concluded by Egan (1972) and Robinson (1993). The latter author suggested that reducing non reproductive period is probably the most important area for improving the reproductive efficiency in sheep.

Lambing percent of treated ewes was approximately twice the value of control group (77.7 - 40%) respectively. The obtained results confirmed the study of Piper and Spears (1982) who found that heifers receiving Zn supplementation in their diet had higher calving rates (93%) than unsupplemented heifers (63%). The reduction obtained in lambing percent as compared with fertility (40%, 77.7. vs 100%) may be attributed to low grade quality embryoes and incidence of early embryonic death (Rhind et al., 1989). However, ewes fed ration supplemented with zinc showed little early embryonic death (ferility, 100% and lambing, 77.7%) compared with those reared on practical basal ration (fertility, 100% and lambing 40%) as stated by Minson (1990).

Results present in Table (3) revealed that 100 ppm Zn supplementation to ewes had a beneficial effect on litter size and prolificacy number. Similar findings have been recorded by Egan (1972) and Mastes and Fels (1980).. Robinson (1993) concluded that zinc supplementation improved litter size.

Altough Barki ewes are considered non-prolific with no incidence of natural twins (Aboul-Naga and Aboul-Ela (1986), twinning was achieved (14.2%) in the current study as a consequence of Zn supplementation.

The improvement of reproductive ability obtained in the present work may be attributed from one hand to the role of Zn as a component and activator of enzymes involved in steriodogenesis (Hurley and Doane, 1989), and from the other hand to decrease ova wastage, i.e., decrease fertilization failure and or embryo mortality as a reuslt of Zn supplementation (Rhind et al., 1989 and Minson, 1990).

Ewes condition and parturition problems

Observation of the pregnant ewes during late stage of gestation indicated that zinc supplementation had no effect on ewes condition. No problems at parturition were recorded for any case. These observations were similar to those noticed by Apgar and Fitzgerald (1985), whereas difficulty at delivery has been reported in rat (O'Dell et al. 1977) and pig (Palludan and Wegger 1976) that received a low zinc diet.

Table (3): Reproductive performance of Barki ewes received zinc supplement with the practical basal ration

Groups	Fertility during mating period % [a]								Lambing [b]		Litter size [c]		Prolificacy [d]	Twinning incidence [e]	
	1st W		2nd W		3rd W		4th W								
	N	%	N	%	N	%	N	%	N	%	N	%	number	N	%
Control group (n = 10)	5	50	6	60	8	80	10	100	4	40	4	44.4	0.40	0	00.0
Zn supplemented group (n = 18)	15	83.3	16	88.8	18	100	-	-	14	77.7	16	100	0.89	2	14.2

a: Number of pregnant ewes/number of ewes exposed x 100.
b: Number of lambed ewes/number of ewes exposed x 100.
c: Number of lambs born a live /number of ewes exposed. x 100.
d: Number of lambs born a live/number of lambed ewes.
e : Number of twinning /number of lambed ewes x 100.
a.b.c.d.e. according to Kleemann et al. (1991) and Hamadah et al. (1996).

Table (4): Productive performance of lambs from Barki ewes received zinc supplement with the practical basal ration

groups	Lamb birth weight (kg)	Lamb weaning weight (kg)	Growth rate from birth to weaning day (g) (@)
Control group	2.88 ±.21	14.16 ±.65	188
Zn supplemented group	4.02* ±.11	17.72* ±.63	228

± Means SE
* Means significance at P < 0.05 compared to control
*@ Lamb gain from birth to weaning/age of weaning

Table (5): Chemical analysis of colostrum and milk from Barki ewes received zinc supplement with the practical basal ration

	Colostrum		Milk at 15 day post-partum	
	Control	Treated	Control	Treated
Whey protein %	12.24±.84	15.64±.75*	-	-
Total protein %	15.82±.92	16.33±1.1	4.5±.31	4.4±.23
Fat %	8.6±.74	8.9±.82	7.8±.85	7.7±.91
Lactose %	2.5± .08	2.6±.08	4.8±.17	4.6±.12
Ash %	1.05±.02	1.01±.02	0.87±.02	0.94±.02
Zn mg/L	3.82±.22	3.61±.25	2.06±.18	2.14±.15
Cu mg/L	0.09±.005	0.08±.005	0.05±.003	0.05±.003

± Means SE
* Means significant at P < 0.05 as compared to control

Productive performance of lambs

Table (4) shows that under field condition 100ppm Zn supplementation in ewes ration achieved significant (P<0.05) increase in birth weight as reported in rats (Hurley and Cosens, 1974) and in grazing sheep (Apgar and Fitzgerald, 1985). Nevertheless, Apgar and Travis (1979) found that low Zn intake did not affect lamb birth weight. A significant $P < 0.05$ increase in lamb weaning weight recorded in the current study substantiated the work of Hatfield et al. (1995).

The possible beneficial effect of Zn supplementation on lamb weight may be due to its direct effect on growth, an indirect effect associated with increased food intake of pregnant ewes or a combination of both (King, 1990).

Milk composition

Data present in Table (5) indicate that chemical analysis of both colostrum and whole milk (at 15 day post-partum) were not affected by Zn supplementation. The obtained findings were in agreement with Hatfield et al. (1995). Whey protein, as an indicator of colostrum immunoglobulins showed an increase for ewes received 100 ppm with their ration which might indicate increase in immune response of newly born lambs. In accordance. (McBean, 1991 and Hahn and Baker, 1993) concluded that Zn has been associated with proper immune function.

Serum zinc and copper concentrations

Serum Zn and Cu concentrations are illustrated in Fig. (3). It was clear that dietary Zn supplement was associated with increasing in serum Zn concentration specially at late pregnancy as compared with control group, a similar finding was reported by Masters and Moir (1984). Serum Zn level for ewes received non-supplement practical ration obtained in the current study fall to < 0.4 mg/L which may indicate inadequent Zn status as suggested by Barge and Mazzacco (1992).

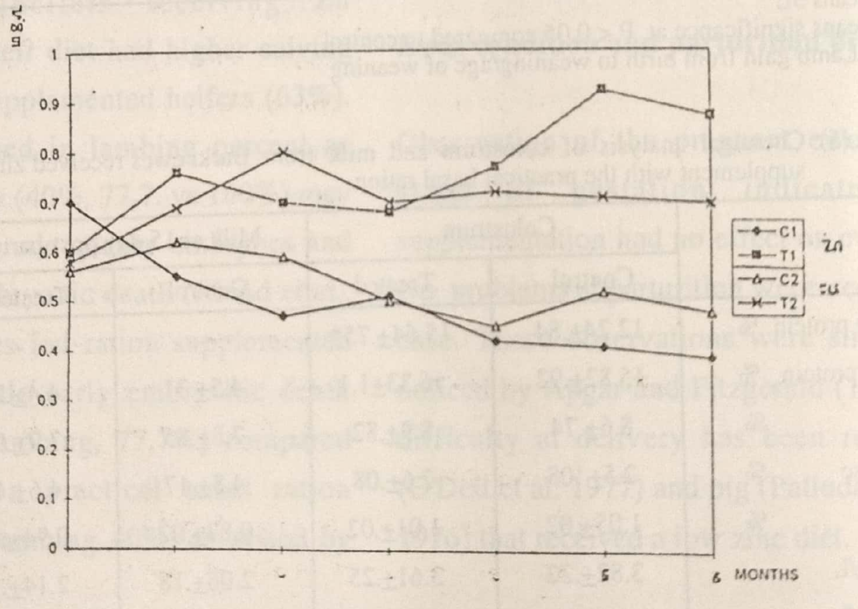

Fig. (3): Serum zinc and copper of Barki ewes receivea zinc supplement with the practical basal ration

Serum Cu level followed a similar pattern as serum Zn concentration in both treated and control gorups. Underwood (1981) suggested that low serum Cu resulted in low fertility and or reproductive failure in many farm animals.

The present results suggested that, eventhough the practical basal ration of Barki ewes contained about 23 to 25 ppm Zn, it was insufficient to supply the animals with enough Zn required for optimum reproduction under field conditions in Egypt. In this respect, Minson (1990) stated that in South Australia, ewes grazing feed containing between 12 and 21 mg Zn/kg showed reproductive failure. Hill et al. (1983) found that reproductive failure was manifested when sows fed a corn-soybean diet with 25 ppm zinc, but not by those that received zinc supplement above the basal level. High level of zinc used in the current study (100ppm) might face low availability of zinc as a result of some nutritional factors associated with practical ration, beside animals apparently don't have an effective mechanism for mobilizing Zn from body stores to meet their needs (Miller et al., 1970).

It can be concluded that, it is feasible to supplement ewes practical basal ration with zinc before mating time and throughout pregnancy to optimize their reproductive performance and to improve the productive ability of their lambs under field condition in Egypt.

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