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Feed Intake, Antioxidant Properties and Litter Performance Affected by Multi-Nutrient Block Additive of Rabbit Does during Prevailing Heat Stress in Egypt

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ABSTRACT

A total number of 48 New Zealand White rabbit does (6-7 months old; 3068.33±29.56g) were randomly assigned into two groups (24 rabbits in each group of treatments). The 1st group was received a concentrated diet and the 2nd group received on a concentrated diet supplied with multi-nutrient block (MNB). The length of the experiment persisted for 16 weeks. The MNB group had significantly lower feed intake during pregnancy and lactation when compared to the fed concentrated diet only. As well as, data on plasma antioxidant, constituents followed the same trends as in these concerning pregnancy periods, where MNB plus concentrated diet group surpassed the concentrated diet group and favored the parameters evaluated. Also, during pregnancy constantly plasma antioxidant capacity and endogenous antioxidant enzymes in terms of glutathione peroxidase and superoxide dismutase were significantly higher in the MNB group compared to the concentrated diet group. Litter size and weight at both birth and weaning, total litter weight gain and pre-weaning survival rate% significantly improved for MNB plus concentrated diet compared to the control cluster. It concluded that MNB in rabbit cages with feed concentration improved feed intake during pregnancy and lactation period also enhanced antioxidant status during pregnancy period additionally, better litter performance. Also, the best results were obtained from supplementing MNB on the first day from the mating.

Keywords: Multi-nutrient block, Feed intake, antioxidants, litter performance, rabbit does.

INTRODUCTION

Recent trends in rabbit production in developing nations such as Egypt used fibrous feeds – primarily low-quality pasture and plant residues – that are deficient in nitrogen, minerals, vitamins, and easily fermented energy. Multi-nutrient block (MNB) containing vitamins and essential nutrients can, therefore, be used to supply rabbits with their requirements, boost the digestion and consumption of fibrous feeds enabling the animal to maintain, and often boost production and reproduction effectiveness. In the earlier, mini-blocks for rabbits have been prepared (Perez, 1986; Cheeke and Raharjo 1988).

Various hundred formulas were developed and tested with molasses according to the quality of local availability and ingredient cost. Molasses may be a liquid feed derived from the extraction of disaccharide from sugar cane. It is typically the inexpensive source of energy for livestock in countries wherever sugar cane is a chief crop (Hulman, 1989). It is opulent in minerals and insoluble sugars (fructose, sucrose, and glucose). It comprises neither lipids nor fiber and also the nitrogenous fractions are low, soluble, and in a non-protein form (Huque and Stem, 1994; Perez, 1997). Its vitamin substance is not terribly high, although, it does contain a series of water-soluble vitamins. It is additionally a source of trace elements like copper and cobalt (Paturau 1985; Preston, 1995). It is often a very important source of sulfur once this component is employed within the method of elucidation of the sugar cane juice. Salt is a necessary nutritional component, however, at the five percent level, acts to discourage livestock from intake an excessive amount of the block at any assumed time (Huque and Stem 1994). Proper integration to cement is needed not to exceed with molasses to obtain more resistant and solid blocks so as to limit their consumption and to attempt a more balanced intake of required nutrients (Binh *et al.*, 1991; Filippi *et al.*, 1992). The main ingredients of standard cement, according to Arora and Bindra (1996), are silica and lime with lesser quantities of oxides of sodium, potassium, iron, aluminum, magnesium, and sulfur. Aluminum oxide gives cement the "gelling" characteristic which makes it an important ingredient in MNB. To a major degree, the hardness of MNB can be controlled by varying the proportion of cement (Amici and Finzi, 1995). However, Mini-blocks can be a complete feed for rabbits by including a source of forage in the formulation (Perez, 1990).

An availability indicator of reduction agents in blood plasma is the TAC, and thus plasma's ability to scavenge free radicals of oxidation (Kambayashi *et al.*, 2009). Antioxidant enzymes such as SOD can stop the oxidation either by scavenging the mainly reactive free radical in vivo or by steadying move metal radicals such as Cu^+ or Fe_2^+ (Afolabi and Oloyede, 2014). Superoxide dismutases (SOD) and glutathione peroxidase remove 02 and H202 within cells before approaching accessible Fenton chemistry promoters (Halliwell, 1987). SOD is regarded as one of the most powerful antioxidants and stimulates the dismutation of the superoxide anion to molecular oxide and hydrogen peroxide. Glutathione peroxidase (GPx) acts a key role in arranging the equilibrium between reductant and oxidant stress through the enzymatic decrease of lipid soluble hydroperoxides, hydrogen peroxide and peroxynitrite, and its compulsory oxidation of glutathione in the process may additionally impact the cellular redox state. In addition, GPx impacts the generation of other ROS obtained from hydroperoxides via reducing hydroperoxides (Flohé, 2010 and 2019).

The aim of the current study was to evaluate the impacts of supplementing MNB on feed intake, antioxidant status and litter performance under prevailing heat stress in Egypt beside a diet for rabbit does.

MATERIALS AND METHODS

The current research was conducted at the El-Nobaria Experimental Station, Institute for Animal

Production Research, Agriculture Ministry, Egypt; it began in April and lasted for 16 weeks. During the experimental period, the minimum and maximum temperatures of the rabbitry, relative humidity and temperature-humidity index (THI) were 26.5 - 32.5°C, 62 - 75% and 87.5 - 93.5, respectively, under Nobaria Experimental Station, El-Beheira, Egypt.

Multi-nutrient blocks Preparation:

During the MNB preparation operation, the sequence of blending the components was discovered to be very essential. The MNB is made of components such as olive cake, palm kernel cake, grape pomace molasses, cement, and salt elements; the method was as follows for the preparing of 15 mini-blocks (each block weighing 200 g):

All the parts were put in numerous vessels and weighed independently according to the formulations. For mixing were used three additional vessels of various volumes (5 liters, 2 liters, and 250 ml).

1) Cement was mixed in a small vessel (250 ml) with half of the famous salt. This would help in averting mass formation later on.
2) In the second vessel (2 liters), the remaining popular salt, the olive cake, grape pomace, and palm kernel cake were mingled completely.
3) The third vessel was large adequate to have all the parts (5 liters). Mixtures (1) and (2) above also, molasses were mingled together. Finally, to get homogeneous products, all the parts were totally mingled.
4) Furthermore, the molds were protected against insects and rodents to maintain them in a dry and shady location.
5) The molds were shifted into and wrapped in plastic buckets.

Experimental design, management, housing and diets:

A factorial scheme of 2 x 3 was carried out. Rabbits were split into two groups, fed on a concentrated diet by the 1st group and fed on a concentrated diet by the 2nd group and provided with MNB. Each of the two groups was split into three subgroups 1st mating on one day, 2nd mating on 15 day and 3rd mating on 30 days of experimental diet feeding, respectively. In this regard, 48 primiparous rabbit does from New Zealand White (NZW) type were randomly split into six similar groups, aged 6-7 months with average body weight, 3068.33±29.56 g. All rabbits were fed on a basal pelleted ration (Tables 1). Mating between does and fertile bucks was performed at random. Ten days later, each doe was palpated to identify pregnancy.

All kindling kits remained in the nests with their dams for suckling from birth up to weaning at 28 days of age.

The basal ration was formulated in one of the feed mills to meet the nutrient requirements of rabbits according to NRC (1977). The ration was offered to rabbits *ad libitum*. The pelleted ration and MNB components and chemical composition are shown in Tables 1 and 2. The weight of a block was 200 g. The samples of pelleted ration and MNB were analyzed for crude protein (CP), crude fiber (CF), ether extract (EE), nitrogen-free extract (NFE) and ash according to A.O.A.C. (2003). Acid detergent fiber (ADF), acid detergent lignin (ADL) and neutral detergent fiber (NDF) were also defined in the experimental rations in accordance with Goering and Van Soest (1970). Gross energy (kilocalories per kilogram DM) was calculated according to Blaxter (1968), where, each g of ether extract (EE) = 9.40 kcal, each g of crude protein (CP) = 5.65 kcal, and each g nitrogen-free extract (NFE) and crude fiber (CF) = 4.15 kcal.

Table 1. Formulation of experimental diets and Multi-nutrient block.

Diet		Multi-nutrient block	
Ingredients	**%**	**Ingredients**	**%**
Alfalfa hay	34.55	Molasses	30
Wheat bran	32.00	Palm kernel cake	20
Barley grain	12.00	Olive cake	5
Soybean meal (44%)	16.00	Grape Pomace	5
Molasses	3.00	Salts elements	30
Limestone	1.50	Cement	10
Sodium chloride salt	0.35		
Dl- Methionine	0.20		
L-Lysine	0.10		
Vit. and Min. mix.[1]	0.30		
Total	100	Total	100

Notes: 1Provided per kilogram diet: vitamin D3, 450 IU; vitamin A, 6000 IU; vitamin K3, 1 mg; vitamin B1, 1 mg; vitamin E, 40 mg; vitamin B2, 3 mg; vitamin B12, 2.5 mg; niacin, 180 mg; vitamin B6, 39 mg; biotin, 10 mg; folic acid, 2.5 mg; choline chloride, 1200 mg; iodine, 0.2 mg; pantothenic acid, 10 mg; zinc, 35 mg; iron, 38 mg; selenium, 0.1 mg; manganese, 15 mg; copper, 5 mg.

Table 2. Chemical composition of diets and multi-nutrient block (g/kg DM).

Nutrient groups	Con†	MNB‡
Dry matter	91.07	81.09
Organic matter	84.18	58.36
Crude protein	17.88	10.43
Crude fiber	13.4	19.87
Ether extract	2.85	1.63
Ash	6.89	22.73
Nitrogen free extract NFE	50.05	26.43
Neutral detergent fibre	37.72	29.17
Acid detergent fibre	16.1	11.4
Acid detergent lignin	4.95	2.31
Lysine	0.87	0.1
Methionine	0.63	0.09
Ca	12.3	15.7
P	0.6	2.1
Gross energy (Kcal/kg)	3911	2664

†Con= Concentrated diet; ‡MNB=Multi-Nutrient Block

Experimental traits

Feed intake of each rabbit does at 1st, 2nd, 3rd and 4th week of pregnancy and lactation period were recorded weekly.

Biomarkers of antioxidant status

Blood samples were collected from the ear vein of each rabbit doe treatment group and immediately placed on ice in heparinized tubes. Blood plasma samples were withdrawn weekly during the pregnancy period. Plasma was separated from the blood by centrifugation at 860 rpm for 20 min, and stored at -60°C. Total antioxidant capacity (TAC; mmol/l) was determined according to Diamond Biodiagnostic, Egypt. Superoxide dismutase (SOD; units / L (u/l)) activity was assayed according to Misra and Fridovich (1972). Blood plasma glutathione peroxidase (GPx; u/l) activity assayed using the method of Chiu *et al.* (1976).

Litter performance

Litter traits were recorded or calculated and included that litter size at birth (LSB) and at weaning

(LSW), litter weight at birth (LWB) and at weaning (LWW), total litter weight gain (TLWG) and Preweaning survival rate %(PWSR%).

Statistical Analysis:

Data of each experiment were analyzed using two-way ANOVA of General Linear Means of SAS (2001). The main effects were addition blocks and mating days. Student-Newman-Keuls test was used to test mean differences at P ≤ 05.

RESULTS AND DISCUSSION

Feed intake of does:

Results of the means and the interaction of feed intake during pregnancy and lactation periods, in NEW rabbit does fed on concentrated diets plus MNB through different periods of mating days 1st, 15th and 30th day from were shown in Table (3). Irrespective of mating days 1st, 15th and 30th; results showed that there was (P=0.0001) reduction in feed intake of rabbits fed on concentrated diet plus (MNB = 405.1g during pregnancy period) compared to those fed concentrated diet only during pregnancy period.

When the effect of addition MNB was overlooked, the results indicated that feed intake was affected by the time of mating at 1st, 15th and 30th days of rabbit does. During pregnancy and lactation period (P=0.004 and 0.0014) significantly increased in feed intake of MNB were dictated for group mating 1st compared with those groups mating at 15th and 30th days of rabbit does. As well as, during lactation period feed intake from concentrated diet was (P= 0.0373) higher of rabbits mating at 1st day than those mating at 15th and 30th days of rabbit does.

Table 3. Effect addition feed multi-nutrient block on feed intake of does during pregnancy and lactation periods

Items	Feed Intake (g)			
	During pregnancy period		During lactation period	
	Con†	MNB‡	Con†	MNB‡
Main effect of treatment				
Control	3426.3a		3466.0a	
Block	3138.7b	405.1	3251.6b	1001.1
SEM	56.70		66.11	
P-value	0.0001		0.0001	
Main effect of mating time				
1 day	3301.7	265.0a	3422.3a	516.0a
15 day	3293.8	194.5b	3374.9ab	459.0b
30 day	3251.9	148.2c	3279.2b	460.6b
SEM	45.60	12.24	56.14	22.5
P-value	0.6879	0.004	0.0373	0.0014
Treatment by mating time interactions Treatment × Time				
Control × 1	3440.4a		3564.0a	
Control × 15	3432.0a		3470.8a	
Control × 30	3406.4a		3363.2ab	
Block × 1	3163.0b	530.0	3280.6b	1032.0
Block × 15	3155.6b	389.0	3279.0b	918.0
Block × 30	3097.4b	296.4	3195.0c	1053.2
SEM	50.14		56.60	
p-value	0.0005		0.0005	

a-c, Means within a column at each item, not sharing similar superscripts are significantly different; †Con: concentrated diet; ‡MNB: Multi-Nutrient Block; SEM: standard error of the mean.

The interaction effects between addition MNB and mating day on feed intake was differences in rabbits groups. In comparison with the control group, feed intake was (P=0.0005) less in the group of rabbit does fed on concentrated diets plus MNB and mating at 1st, 15th and 30th day. While rabbits were consumed about 530, 389 and 296.4g of MNB at 1st, 15th, and 30th of mating days, respectively. In this respect, the best value of all feed intake from concentrated diets plus MNB were dictated for rabbit does mating at the 1st day as compared with other interaction of rabbit does, during pregnancy and lactation period.

However, during the lactation period rabbits consumed from MNB was 1032, 918 and 1053.2g at 1st, 15th and 30th at mating days, respectively. For this reason, all feed intake from concentrated diets and MNB were favorable higher than those fed concentrated diet only.

The multi-nutrient block already being palatable and consumed ad libitum, the animal won't be able to exceed its gastric capacities of food intake even if it contains molasses which makes it more sweetened and more palatable. This would explain the similarity of the effect of the block which contains molasses on the performances of growth, feed ingestion in the present study. MNB supplementation can increase total consumption. Rabbits were supplemented MNB reduce the consumption of concentrate diet, otherwise rabbits unsupplemented MNB increase the consumption of concentrate. In this connect, Bagiarta *et al.* (2017) used different levels 0, 15, 30 and 45 g/head/day of MNB include (pollard flour, fermented tofu, molasses, coconut oil, tapioca flour NaCl and calcium hydro phosphate) and found that MNB supplemented to rabbits reduce the consumption of grass, if rabbits did not supplement MNB caused increase in consumption the grass. Rabbits fed on 75% concentrate diet as pellet plus 25% lablab forage plus molasses mini-blocks (MMB) which include (molasses (50.1%), alfalfa hay (17.2%), crimped oats (24.7%), and cement (8.0%), the feed intake from MMB was lower and equal 19 g DM/d compared with those rabbits fed on concentrated diet only (Mudunuru *et al.*, 2008).

A content of 3% of molasses is generally recommended in rabbits and insertion up to 10% of the diet, remains without effect on the performances of growth (Sanchez *et al.*, 1984 and Kpodékon *et al.* 2008). The molasses incorporation of 4-6% in the diet improved also pellets quality (Mendez *et al.*, 1998), which is an in a citation to introduced molasses even in absence of effects on growth performances. Beside, Hidalgo *et al.* (2009) reported that vinasse has probiotic properties, the carrier in premixes, palatability and include organic acids which improve nutrient use, digestion, vitamin D synthesis, vitamin C, and mineral absorption, which facilitate the food metabolism. The presence of mineral in MNB of our study tend to improve the feed intake and accepted to our results Zerrouki *et al.*, (2008) who reported that the presence of mineral blocks to rabbits, induced to a significant increase of pelleted feed intake (+16%) resulting in a proportional increase of growth rate. Nevertheless, MNB that including palm kernel meal and molasses may are a good synergism for improving the utilization block consumption which reflects the increase productive performance when compared with the control group (Sanchez *et al.*, 1984).

Biomarkers of antioxidant status:

Irrespective of mating days 1st, 15th and 30th; data showed the effects of addition MNB on blood antioxidant constituents and lipid peroxidation; TAC, SOD, and GPx during the experimental periods of rabbit does are presented in Table (4). In the present study, an opposite effect was noticed regarding TAC, SOD, and GPx where the values were significantly (p=0.0001) increased with supplementation MNB in comparison with the control group. The results presented in Table (4) showed that, the interaction between addition blocks and mating day in the effect on biomarkers of antioxidant of does.

Significantly (P=0.0001) increased in TAC and SOD values of basal diet were dictated for rabbits mating rabbits at 1st day of addition MNB compared with other interaction of rabbit does during the experimental period, respectively. While, GPx values were (p=0.0001) increased with supplementation MNB multiply 1st and 15th mating day of rabbits in comparison with other interaction of rabbit does during the experimental period, respectively. Pregnancy is a period in life when oxidative stress can be expected due to high energy demand and increased oxygen requirement (Ganong, 2005). A height of many indicators of oxidative stress thru the physiological path of pregnancy has been shown (Arikan *et al.*, 2001; Djordjevic *et al.*, 2004; Little and Gladen, 1999). During pregnancy, oxidative stress has been associated with reproductive problems such as pre-eclampsia and abortion (Poston and Raijmakers 2004). In our study feed supplementation blocks as (palm kernel cake, olive cake, grape pomace) provide various nutrients – N, some carbohydrates, minerals, vitamins and phenolic compound that work as the antioxidant activity and reduce‒oxidation (redox) reactions and chemical structure (Christaki, 2012). Moreover, Sgorlon *et al.* (2005) noticed that adding grape polyphenols in diets of NZW rabbits at 0.03 and 0.15 mg/kg increased ($p \leq 0.05$) total glutathione, reduced glutathione and oxidized glutathione under heat stress. The importance of these antioxidant enzymes is due to their involvement in the clearance of superoxide and H_2O_2 to maintain the structure and function of biological membranes (McCord, 2000). SOD plays a role in an antioxidant defense system (Khan, 1999). The findings reveal that TAC and GPx of blood plasma of rabbit does with MNB were significantly augmented (Table 4), indicating boosted scavenging capacity of glutathione-dependent the antioxidant defensive system against elevated oxidative stress processes in this group. Our results regarding antioxidant enzymes (SOD, TAC, and GPx) are in good agreement with those of Dal Bosco *et al.* (2007) who reported that rabbits fed a high quality of by-product as olive cake result more protected against oxidative damage.

Litter performances of rabbit does

Performance and survival rate (%) of litters as affected by studied addition MNB are displayed in Table (5). Results show that LSB, LSW, LWB, LWW and TLWG were significantly affected by supplemented MNB compared with those fed on basal diet with irrespective of mating rabbits at 1st, 15th and 30th days of the traits. When the effect of addition MNB was overlooked, data showed that LSB, LWB, LSW, LWW, and TLWG were not significantly affected by addition MNB plus concentrated diets.

Table 4. Effect addition feed multi-nutrient block on blood plasma antioxidant enzymes of does during pregnancy periods.

Items	TAC	SOD	GPx
Main effect of treatment			
Control	1.27[b]	23.56[b]	452.73[b]
Block	2.29[a]	33.76[a]	609.27[a]
SEM	0.10	1.15	21.96
P-value	0.0001	0.0001	0.0001
Main effect of mating time			
1 day	1.82	29.42	537.00
15 days	1.75	27.80	532.20
30 days	1.71	28.01	516.20
SEM	0.06	1.04	4.70
P-value	0.120	0.1235	0.1490
Treatment by mating time interactions Treatment × Time			
Control × 1	1.36[c]	24.12[c]	454.4[c]
Control × 15	1.24[c]	23.10[c]	446.0[c]
Control × 30	1.21[c]	23.46[c]	457.8[c]
Block × 1	2.40[a]	36.04[a]	640.25[a]
Block × 15	2.26[ab]	32.51[b]	618.40[a]
Block × 30	2.20[b]	32.56[b]	574.60[b]
SEM	0.03	1.27	9.92
P-value	0.0001	0.0001	0.0001

a - c, Means within a column at each item, bearing different superscripts are significant; TAC= Total Antioxidant Activity; SOD= Superoxide Dismutase; GPx= Glutathione Peroxidase; SEM= standard error of the mean.

The results presented in Table (5) showed that, the interaction between addition MNB and mating day of rabbits in the effect on the performance of litter at birth and weaning. Significantly (P=0.0009, 0.0004, 0.0002, 0.0001 and 0.0001) increased in that LSB, LWB, LSW, LWW, and TLWG were dictated for rabbits mating at 1st day of the experimental supplemented with MNB compared with other interaction of rabbit does during the experimental period, respectively. These improvements tend to increase the feed intake from MNB during the nurse kit rabbits. MNB is considered rich in calorie, carbohydrate and made a balances ratio calorie/ carbohydrate and also raises the milk production (Abdel-Azeem, 2019).

While, Ruknuzzaman *et al.* (2018) found that the addition urea molasses multi-nutrient cake for rabbit does reduced ($P < 0.05$) the kit mortality but did not effect on litter size, litter weight and individual kit weight at birth. The significant higher litter weight may be due to the link metabolic status and neuro-endocrine improves of growth and reproduction that may be altering by endocrine function during periods of supplementation, feed additives and lactation (Barb *et al.*, 2001). Litter size at weaning was (P=0.0001) higher in experimental feed multi-nutrient block when compared with the control group. The same trends were observed in weight gain of litters does fed diets supplemented with different feed additives. Thus, litter weight at this time would expect to be a useful index for lactation performance (Knight *et al.*, 1989).

Thus, the enhancing in their weight gain may be due to the rise in milk yield (Table 3). In this connection, Lebas *et al.* (1986) found a close correlation between rabbit weight at 21 days and milk production between day 0 and day 21 (r = 0.92). On the other hand, Afifi *et al.* (1973) and El-Kelawy (1993) postulated that the mean bunny weight at birth or at weaning decreased with the increase of litter size at birth. The apparent increase in litter weight may be due to the increase of growth rate of offspring during lactation.

Table 5. Performance of litter at birth and weaning of doe's rabbits affected by addition MNB.

Treatments	LSB	LWB (g)	LSW	LWW (g)	TLWG (g)	PWSR %
Main effect of treatment						
Control	4.47^{b}	186.67^{b}	4.20^{b}	1918.1^{b}	1731.4^{b}	95.32
Block	6.47^{a}	278.00^{a}	6.27^{a}	2845.9^{a}	2567.9^{a}	97.22
SEM	0.66	27.46	0.51	236.9	212.5	3.63
P-value	0.0014	0.0006	0.0003	0.0002	0.0002	0.47
Main effect of mating time						
1 day	5.4	225.7	5.0	2323.5	2097.8	93.99
15 day	5.3	230.2	5.3	2456.2	2226.0	100.0
30 day	5.7	241.1	5.4	2366.2	2125.1	94.82
SEM	0.51	24.43	0.51	228.23	204.88	0.001
P-value	0.83	0.855	0.78	0.8756	0.8506	0.142
Treatment by mating time interactions						
Treatment Time						
Control × 1	5.0^{ab}	209.4^{b}	4.6^{b}	2082.0^{b}	1872.6^{c}	93
Control × 15	4.0^{b}	172.4^{c}	4.0^{b}	1839.6^{b}	1667.2^{d}	100
Control × 30	4.4^{b}	178.2^{c}	4.0^{b}	1832.6^{b}	1654.4^{d}	92
Block × 1	5.8^{ab}	242.0^{ab}	5.4^{ab}	2565.0^{ab}	2323.0^{b}	94
Block × 15	6.6^{a}	288.0^{a}	6.6^{a}	3072.8^{a}	2784.8^{a}	97
Block × 30	7.0^{a}	304.0^{a}	6.8^{a}	2899.8^{a}	2595.8^{a}	100
SEM	0.45	17.06	0.37	95.90	98.16	2.50
p-value	0.0009	0.0004	0.0002	0.0001	0.0001	0.4755

$^{a-d}$, Means within a column at each item, not sharing similar superscripts are significantly different; LSB: litter size at birth; LWB: litter weight at birth; LSW: litter size at weaning; LWW: litter weight at weaning; TLWG: total litter weight gain; PWSR%=Pre- weaning survival rate % SEM: standard error of the mean.

The results of antioxidants (Table 4) indicate an improvement in the health status of rabbit does supplemented MNB compared with those fed on basal diet as well as improvement in the litter performance. It can be linked to the quality of rabbit does health status and enhanced immunity, which is positively reflected on litter performance and may be explains one of the mechanisms of improving the performance of litter.

CONCLUSION

The results of the current research demonstrated that the existent multi-nutrient block in rabbit cages with feed concentration improved feed intake during pregnancy and lactation period of rabbit does. Moreover, the multi-nutrient blocks which including molasses, protein, and minerals balance are good antioxidant properties especially for stressed rabbit does during pregnancy and better litter performance. In the present study on rabbits, the best results were obtained supplementing multi-nutrient block on the first day from the mating.

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الغذاء المأكول والخصائص المضادة للأكسدة وأداء الخلفات بإناث الأرانب المتأثرة بمجموعة مغذيات متعددة خلال الإجهاد الحراري السائد في مصر

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ثمان وأربعون انثي أرنب من النيوزيلاندي الأبيض عمر حوالي 6-7 أشهر متوسط الوززن 3068.33 جم ± 29.56 تم تقسيمها بشكل عشوائي إلى مجموعتين (24 أرنب في كل مجموعة). تم تغذية المجموعة الأولى على نظام غذائي مُركّز، بينما تمت تغذية المجموعة الثانية على نظام غذائي مُركّز مُزوَّد بمجموعة مغذيات متعددة (MNB). استمرت المدة التجريبية لمدة ستة عشر أسبوعًا. كانت مجموعة الإناث المغذاة بنظام غذائي مُركّز مُزوَّد بمجموعة مغذيات متعددة MNB أقل معنويا في الغذاء المأكول أثناء فترة الحمل والرضاعة عند مقارنتها بالإناث المغذاة بنظام غذائي مركّز فقط. إضافة إلى ذلك ، فإن البيانات المتعلقة بمضادات الأكسدة في البلازما خلال فترة الحمل اتبعت نفس التوجه. أيضا، حيث تفوقت وكانت المفضلة لقيم مضادات الاكسدة في مجموعة الأناث التي تتغذى على علف مركز مُزوَّد بمجموعة مغذيات متعددة MNB عن تلك القيم بمجموعة التي تتغذى على علف مركز فقط. ايضا, خلال فترة الحمل دائما كانت القدرة الاجمالية لمضادات الأكسدة في البلازما والإنزيمات المضادة للأكسدة الداخلية كالجلوتاثيون بيروكسيديز (GPx) و انزيم دِيسمُوت الفائق (SOD) كانت أعلى معنويا في مجموعة الأناث التي تتغذى على علف مركز مُزوَّد بمجموعة مغذيات متعددة MNB مقارنة بمجموعة الأناث التي تتغذى على علف مركز فقط. تحسن بشكل معنوي عدد ووزن الخلفة عند الولادة والفطام، والزيادة الاجمالية لوزن الخلفة ومعدل البقاء على قيد الحياة قبل الفطام٪ بالنسبة لمجموعة الأناث التي تتغذى على علف مركز مُزوَّد بمجموعة مغذيات متعددة MNB مقارنة بمجموعة الأناث التي تتغذى على علف مركز فقط. وفي الختام يمكن التوصية بوضع مجموعة مغذيات متعددة MNB في أقفاص الأرانب مع الأعلاف لتحسين الأداء الإنتاجي، و مضادات الأكسدة، خلال فترة الحمل والرضاعة لإناث الأرنب. أيضا، تم الحصول على أفضل النتائج عند دعم الإناث عند عمر اليوم الأول من التزاوج.

الكلمات الدالة: مجموعة مغذيات متعددة، الغذاء المأكول، مضادات الأكسدة، اداء الخلفات، إناث الأرانب.