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Body Weight Response, Milk Production and Lipid Peroxidation of Rabbit Does to Multi-Nutrient Block Supplementation during Summer Conditions

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ABSTRACT

Forty-eight New Zealand White rabbit does about 6-7 months old (3068.33±29.56g) were randomly allotted into two groups (24 rabbits in each treatment group). The first group was consumed a concentrated diet and the second group consumed a concentrated diet supplied with multi-nutrient block (MNB). The experimental duration continued for sixteen weeks. Live body weights of does after parturition days and during lactation periods were improved in rabbits fed on a concentrated diet with MNB as compared to those fed on concentrated diet only. During the lactation period weekly and total milk yield was higher in the group fed on a concentrated diet plus MNB. On the other hand, lipid peroxidation whence of thiobarbituric acid-reactive substances was significantly decreased in MNB supplemented groups compared to the concentrated diet. It concluded that MNB in rabbit cages with feed concentration improved body weight, milk production and lipid peroxidation during pregnancy and lactation period of rabbit does. Also, the best results were obtained from supplementing MNB on the first day from the mating.
Keywords: Multi-nutrient block, lipid peroxidation, milk yield, body weight, rabbit does.

INTRODUCTION

Supplementation blocks that supply with different nutrients as some carbohydrates, nitrogen, vitamins, and minerals are now more frequently referred to as multi-nutrient blocks (MNB). Leng, 1984; Sansoucy, 1986; Garcia and Restrepo 1995 indicated that in ruminants, the MNB is a feed additive usually utilized. They supply fermentable energy (generally from molasses), sometimes vitamins and essential minerals. Earlier mini-blocks were prepared for rabbits (Perez, 1986 ; Cheeke and Raharjo, 1988). Numerous hundred formulas were developed and tested with molasses based on local accessibility quality and ingredient cost. This shows the technology's adaptability. The idea was utilized for small ruminants (Perez, 1990; Binh *et al.*, 1991; Osuna *et al.*, 1996; Salman, 1997; Houmani and Tisserand, 1999), buffaloes (Van Thu, 2000), although it intended in the main for dairy and beef cattle. All of them tested MNB's feeding value and its impacts on animal health (when block anthelmintics were added), physiology (reproduction), and production (growth, milk, and meat), additionally dietary status. Test production of block utilizing new local ingredients or binders as well. All experimental work has had beneficial impacts on parameters of reproduction, production and health.

Cheeke, *et al*. (1987) indicated that cement does not cause enteritis in the rabbit or influence the rate of growth. Trace elements indisputably act as an essential task in the physiology and pathology of the biological system. MNB is an exceptional tool for providing minerals. Animal feeding accounts for nearly seventy percent of the cost of production, so any alternative feedstuff that could decrease costs is helpful to the producer as a result of this will increase his revenue. Oxidative stress is one of the main reasons for weakened livestock growth (Meineri *et al.*, 2017). The outcome of oxidative stress contributes to disease and health status (Sies, 2018). Oxidative stress assessment can have great importance to identify negative situations within the farm and suggest the most suitable interventions to create optimal conditions for the animals.

The aim of the current study was to evaluate the impacts of additional MNB behind a diet for does rabbit on body weight, milk production and lipid peroxidation during summer conditions.

MATERIALS AND METHODS

This research was carried out at the Experimental Station of El-Nobaria, Institute for Animal Production Research, Ministry of Agriculture, Egypt; it was started in April and lasted 16 weeks. Rabbitry relative humidity, minimum and maximum temperatures, and temperature-humidity index (THI) during the experimental period were 62 - 75 %, 26.5 - 32.5°C, and 87.5 - 93.5, respectively, under Nobaria Experimental Station, El-Beheira, Egypt.

Multi-nutrient blocks Preparation:

It was discovered that the sequence of components blending was very crucial during the procedure to prepare of MNB. The MNB is made from materials such as palm kernel cake, olive cake, grape pomace molasses, salts elements, and cement, the process was like pursued in preparing 15 mini-blocks (each block weighing 200 g).

All the components were placed in different vessels and weighed separately in accordance with the formulation. Three additional vessels of diverse volumes (5 liters, 2 liters, and 250 ml) were used for mingling.

1) In the little vessel (two hundred and fifty ml), cement was mingled completely with half the part of popular salt. This would later assistance in averting the formation of masses.
2) In the second vessel (two liters), the remaining popular salt, the olive cake, grape pomace, and Palm kernel cake were mingled completely.
3) The third vessel was large adequate (five liters) to have all the components. Mixtures (1) and (2) above also, molasses were mingled together. Finally, all the

components were mingled completely to get homogeneous produce.

4) The molds were protected from insects and rodents, in addition, to remain in a dry and shaded location for setting.

5) The molds were moved into plastic buckets and enclosed.

Experimental design, management, housing and diets:

A 2 x 3 factorial arrangement was conducted. Rabbits were divided into two groups the first group was consumed a concentrated diet and the second group consumed a concentrated diet and supplied with MNB. Each of two groups was divided into three subgroups 1st mating at one day, 2nd mating after 15 day and 3rd mating after 30 days of feeding on the experimental diets, respectively. In this respect, forty-eight primiparous New Zealand White (NZW) rabbit does, aged 6-7 months with average initial body weight, 3068.33±29.56g were randomly divided into six comparable groups. All rabbits were fed on a basal pelleted ration (Tables 1). Mating was carried out at random between does and fertile bucks. Each doe was palpated 10 days thereafter to detect pregnancy. All kindling kits remained in the nests with their dams for suckling from birth up to weaning at 28 days of age.

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 (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 E, 40 mg; vitamin D3, 450 IU; vitamin A, 6000 IU; vitamin K3, 1 mg; vitamin B1, 1 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; iodine, 0.2 mg; pantothenic acid, 10 mg; choline chloride, 1200 mg; zinc, 35 mg; iron, 38 mg; selenium, 0.1 mg; manganese, 15 mg; copper, 5 mg.

The basal ration was formulated in one of the feed mills to meet the NRC (1977) nutrient requirements of rabbits. Pelleted feed *ad libitum* was fed to all rabbits. The composition and calculated analyses of the pelleted ration and MNB 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 nitrogen-free extract (NFE), crude protein (CP), ether extract (EE), crude fiber (CF), 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.

Experimental traits and milk yield determination:

Body weight of each rabbit does at 1st, 2nd, 3rd and 4th week of pregnancy and lactation period were recorded weekly. Determination of milk yield by litter sucking method; rabbit kits are known to be nursed only once every 24 hours for about 3 minutes (Chrenek *et al*., 2007). Glove-covered hands were used for 24 hours to separate the litters from their dams. Before and after suckling, both litters and dams were weighted. Milk yield was calculated using the following equation to take the average of the litter body weight variations and their dams before and after sucking:

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

$$\textbf{Daily milk yield} = \frac{(W1+W2)}{2}$$

W1 = Weight of litter after sucking-weight before sucking.
W2 = Weight of dam before sucking-weight after sucking.

Biomarkers of lipid peroxidation:

Blood samples from each doe's rabbit ear vein were gathered and immediately placed on ice in heparinized tubes. Blood plasma samples were withdrawn weekly during the pregnancy period. By centrifugation at 860 rpm for 20 min, plasma was separated from the blood and stored at -60°C. The blood plasma was used to measure thiobarbituric acid-reactive substances (TBARS ; µmol / ml) using Tappel and Zalkin (1959) technique.

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

Body weight of does:

Table (3) shows the means and the interaction of live body weight during pregnancy and lactation periods, in NEW rabbit does of addition MNB through different periods of mating days; 1st, 15th and 30th day from feeding diets.

Irrespective of mating days 1st, 15th and 30th;

results showed that there were no (P=0.4329 and 0.6387) difference in live body weight of rabbits fed on the basal diet or those fed diets with MNB to initial body weight and at 2nd week (wk.) of parturition, respectively. While, after parturition day live body weight of rabbits fed on concentrated diet plus MNB was (P=0.0002) higher than those fed only basal diet. Moreover, during lactation period live body weight of rabbits fed on concentrated diet plus MNB was (P=0.0001, 0.05 and 0.041) higher significant than those fed basal diet at 1st wk. of lactation, 2nd wk. and after weaning, respectively.

Table 3. Effect addition feed multi-nutrient block on the live body weight of does during pregnancy and lactation periods

Items	Live Body Weight (g)					
	Pregnancy periods			Lactation periods		
	Initial LBW	At 2nd wk. of Parturition	After Parturition	At 1st wk. of Lactation	At 2nd wk. of Lactation	At Weaning
Main effect of treatment						
Control	3083.7	3254.0	2734.3^{b}	2784.3^{b}	2906.3^{b}	2894.3^{b}
Block	3053.0	3268.7	2907.7^{a}	3002.0^{a}	3092.3^{a}	3112.0^{a}
SEM	44.61	41.12	36.66	35.94	18.28	17.13
P-value	0.4329	0.6387	0.0002	0..0001	0.05	0.041
Main effect of mating time						
1 day	3011.5^{b}	3182.5^{b}	2773.5^{b}	2832.5^{b}	2952.5^{b}	2941.5^{b}
15 day	3138.0^{a}	3323.5^{a}	2891.5^{a}	2969.0^{a}	3057.5^{a}	3067.0^{a}
30 day	3055.5^{ab}	3278.0^{a}	2798.0^{ab}	2878.0^{ab}	2988.0^{ab}	3001.0^{ab}
SEM	43.41	72.98	80.06	64.47	61.77	55.82
P-value	0.0391	0.0034	0.05	0.0181	0.0458	0.0113
Treatment by mating time interactions Treatment × Time						
Control × 1	3016.0	3179.0^{c}	2735.0^{c}	2772.0^{c}	2890.0^{c}	2867.0^{d}
Control × 15	3123.0	3278.0^{abc}	2765.0^{bc}	2826.0^{c}	2912.0^{c}	2910.0^{cd}
Control × 30	3112.0	3305.0^{ab}	2703.0^{c}	2755.0^{c}	2917.0^{c}	2906.0^{cd}
Block × 1	3007.0	3186.0^{bc}	2812.0^{bc}	2893.0^{bc}	3015.0^{bc}	3016.0^{bc}
Block × 15	3153.0	3369.0^{a}	3018.0^{a}	3112.0^{a}	3203.0^{a}	3224.0^{a}
Block × 30	2999.0	3251.0^{abc}	2893.0^{ab}	3001.0^{ab}	3059.0^{b}	3096.0^{b}
SEM	39.01	40.14	44.40	57.74	61.60	57.17
P-value	0.0993	0.0128	0.001	0.004	0.02	0.0005

$^{a-d}$, Means within a column at each item, bearing different superscripts are significant; LBW: Live body weight; SEM: standard error of the mean; wk.: week.

When the effect of addition MNB was overlooked, the results indicated that live body weight was affected by the time of mating as 1st, 15th and 30th days of rabbit does. During pregnancy and lactation body weight live body weight was (p=0.0391, 0.0034, 0.050, 0181, 0.0458 and 0.0113) increased in live body weight were dictated at mating 15th when compared with those of rabbit does mating at 1st and 30th days, respectively.

The interaction between addition blocks and mating day in the effect on live body weight was (P=0.128, 0.001, 0.004, 0.02 and 0.0005) differences during pregnancy and lactation periods. The best live body weight was detected with those rabbits fed on concentrated diets with MNB at 15th day of mating rabbits as compared with other interaction of the experimental treatments.

Improved live body weight especially at 15th of mating back to use MNB which contain molasses as an energy source, cement, minerals and (palm kernel meal, olive cake, and grape pomace) as a protein source for supplying rabbit does with important elements during pregnancy and lactation periods. As well as blocks containing phosphorus to overcome the phosphorus deficiency in basal feed and blocks containing copper or zinc to mitigate their deficiency and enhance the reproduction of rabbits does have also been developed. The findings presented are consistent with experiments in grower rabbits recorded by Zerrouki *et al.* (2008), where the final live weight with the mineral block on commercial diets was greater than that of the rabbit alone on commercial diets. In parallel to our results, Bagiarta *et al.* (2017) who studied the effect of supplemented different levels 0, 15, 30 and 45 g/head/day of multi-nutrient block which contain pollard flour, fermented tofu, molasses, coconut oil, tapioca flour NaCl and Calcium hydro phosphate on nutrient diets digestibility of local female rabbit, and found that compared to the control group, the digestible coefficient h as been considerably enhanced (P<0.05). Another way was conducted by Ruknuzzaman *et al.* (2018) who study the inclusion urea molasses multi-nutrient cake which contains (soybean meal 48, mustard oil cake added with the broken maize and wheat bran) in diets of rabbit does, live weight of pregnant does, was better (P<0.05) than those fed on basal diet.

MNB include molasses tend to improve the height of ilium villus, the depth of duodenum crypt, the absorption surfaces and ilium crypt depth (Oliveira *et al.*, 2013). Furthermore, molasses has low pH and regarded it favors the existence of saprophytic intestinal flora and avoids the formation of pathogenic bacteria that could cause colonization and toxin production to harm the intestinal mucosa. In animal feeding, acid substances such as MNB were also used as additives because they boost the digestibility of energy and crude protein, mineral absorption and retention (Diebold and Eidelsburger, 2006). Because of, lactating and pregnant rabbit does need greater dietary protein at the same time. These exceptionally elevated concentrations often lead to a negative protein equilibrium, and the doe must extract protein from its own body reserves (De Blas and Wiseman, 2010). The diet therefore requires a greater protein level of 17 to 18%. Where contrary to the expected results, the average live body weight of rabbit does fed with MNB was different with those of the control during pregnancy and lactation period. This improvement of the growth could be related to the proportion in dry matter of (palm kernel, grape pomace, and olive cake) sugars as molasses and ashes as minerals which is more important in the multi-nutrient block. However, the improvement body weight of rabbit does tend to that the blocks supplied approximately two-fold amount of calcium that was extracted from pellets. Nevertheless, it is not possible to exclude the impact of components other than calcium in the mineral blocks. Also, the current results are consistent with the results of Shrivastava *et al.* (2012), an increase in body weight in the rabbit does are supplied with mineral including in block suggests enhanced digestion of carbohydrate, protein and fat also, their absorption via the intestine, which may be due to more action of fermentation by microflora. This can also be ascribed to the added mineral level, especially Zn in the diet, as it plays an significant part in the body's protein synthesis. Deficiencies alteration in copper, iodine, cobalt, calcium, magnesium, phosphorus, and manganese may cause the positive impact of mineral addition on rabbit during pregnancy and lactation phases. The more rabbit growth supplied by the MNB also indicates increased metabolism and fat transport from the liver to various areas of the body.

Milk yields of rabbits:

Data presented in Table (4) showed that the rabbit does fed concentrated diet plus MNB was (P=0.0001 and 0.0012) increased in milk yield in 3rd weeks of lactation and the average of total milk yield than the control regardless for rabbits mating at 1st, 15th and 30th day effect, respectively. When the effect of adding MNB was overlooked, the best production of milk yield was obtained by 1st mating day in 3rd wk. of the lactation period.

Table 4. Effect addition feed multi-nutrient block on milk yield of doe's rabbits during lactation periods

Items	Milk yield (g) During lactation period				
	1st wk.	2nd wk.	3rd wk.	4th wk.	Total
			Main effect of treatment		
Control	83.45	107.25	120.23^{b}	106.23	412.4^{b}
Block	84.83	110.73	134.71^{a}	108.95	439.22^{a}
SEM	1.29	4.25	3.09	2.73	8.35
P-value	0.2291	0.1390	0.0001	0.2601	0.0012
			Main effect of mating time		
1 day	77.28	107.15	131.31^{a}	108.09	423.83
15 days	84.75	106.90	129.95^{b}	108.09	426.74
30 days	83.25	112.93	121.15^{b}	109.53	426.86
SEM	1.29	3.25	5.11	3.73	8.48
P-value	0.4443	0.0686	0.0089	0.3185	0.9296
			Treatment by mating time interactions Treatment × Time		
Control × 1	82.07^{b}	104.3^{bc}	121.2^{cd}	104.76	397.42^{c}
Control × 15	83.9^{ab}	101.2^{c}	124.1^{cd}	105.08	414.28^{bc}
Control × 30	85.0^{ab}	116.26^{a}	115.4^{d}	108.84	425.50^{ab}
Block × 1	87.4^{a}	110.0^{ab}	141.42^{a}	111.42	450.24^{a}
Block × 15	85.6^{ab}	112.6^{ab}	135.8^{ab}	105.2	439.20^{ab}
Block × 30	81.5^{b}	109.6^{abc}	126.9^{bc}	110.22	428.22^{ab}
SEM	1.41	2.79	1.81	2.58	5.78
p-value	0.0488	0.0103	0.0001	0.4199	0.0064

a - d, Means within a column at each item, not sharing similar superscripts are significantly different; wk. = week; SEM: standard error of the mean.

The interaction effect between addition MNB and mating day on milk yield, (P=0.0488, 0.0001 and 0.0064) increased in milk yield were dictated interaction of rabbit does at 1st and 3rd wk. of lactation and the average of total milk yield, respectively. While (P=0.0103) increased in milk yield at 2nd wk. of lactation were dictated for rabbit does mating at 30th day without addition MNB compared with other interaction of rabbit does. In our study, supplementation blocks that provide different nutrients such as some carbohydrates, nitrogen, vitamins and minerals are feeding. Mini urea-free blocks for rabbits were created (Ramchurn and Ragoo, 2000).

A gradual increase in milk production from 1st to 2nd wk. and achieving the peak at the 3rd wk. is reason and provide evidence that milk production is associated with the body weight Table 3, while the drop in milk production at the 4th wk. of lactation is also logic as the young begin to decrease its dependence on milk as the only source of food and begins to increase its consumption from the pelleted ration and green fodders as a source of food besides milk.

This was parallel with Mahmoud (2013) who mentioned that milk production increases at 3rd wk. of lactation with a peak of 300 g /day in New Zealand White rabbit. Nevertheless, does are terribly effectual in using dietary energy that is believed to flow from the mobilization of body fat for synthesis of milk, especially when milk production is at its top or when pregnancy is simultaneous with lactation during the mid-lactation period (De Blas and Wiseman, 2010). Rabbit milk is actual opulent in each mineral, so lactating does have upper supplies than non-lactating does or growing. On average, rabbit milk contains 3 to 5 times more phosphorus and calcium than cow's milk (El-Sayiad *et al*., 1994). Up to 2 g of calcium can be excreted by a doe at peak dairy production.

Biomarkers of lipid peroxidation:

Irrespective of mating days 1st, 15th and 30th; data showed the effects of addition MNB on blood lipid peroxidation TBARS during the experimental periods of rabbit does are presented in Table (5). Significant (p=0.001) decreased of plasma TBARS was detected in does fed diets supplemented with blocks. The results presented in Table (5) showed that, the interaction between addition blocks and mating day in the effect on biomarkers of lipid peroxidation of does. Significant (p=0.0001) increased of plasma TBARS was observed in does fed concentrated diets without MNB. Oxidative stress may be described as a physiological disorder with an unbalance between antioxidants (enzymatic or non-enzymatic) and free radicals, particularly the concentrations of reactive oxygen species (ROS) (Abudabos *et al*., 2016; Skowron *et al*., 2018), causing molecular deterioration and/or disruption of redox control and signaling (Sies and Jones, 2007; Sies, 2018). It would be actually beneficial to evaluate plasma oxidative levels in animals to consider animals' health status (Brambilla *et al*., 2002; Pasquini *et al*., 2008). The decrease of TBARS levels as a marker for lipid peroxidation in the does fed concentrated diets with MNB, indicating an oxidative stress reduction. Pregnancy is a lifetime in which oxidative stress can be expected due to high demand for energy and increased demand for oxygen (Ganong, 2005). A height of many oxidative stress indicators has been shown thru the pregnancy physiological pathway (Arikan *et al*., 2001 ; Djordjevic *et al*., 2004 ; Little and Gladen, 1999). During pregnancy, reproductive issues such as pre-eclampsia and abortion were connected with oxidative stress (Poston and Raijmakers 2004). In our study feed supplementation blocks as (Palm kernel cake, olive cake, grape pomace) supply different nutrients as some carbohydrates, nitrogen, vitamins, minerals and phenolic compound that work as the antioxidant activity and reducing responses to oxidation (redox) and chemical composition (Christaki, 2012).

Moreover, elevated ambient temperatures decrease growth efficiency, potentially due to excessive reactive oxygen species that oxidize and destroy cellular biological molecules, inhibit certain ATPase operations and ultimately cause a range of intestinal impairments (Liu *et al*., 2011). Additionally, Heat stress is a major constraint to rabbit production resulting from the negative effect of high temperature (Yassein *et al*., 2008) and the interaction between ambient temperature and relative humidity.

The results of lipid peroxidation (Table 5), body weight (Table 3) and milk production (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 body weight and milk production in these rabbit does. It can be linked to the quality of rabbit does health status and enhanced immunity, and decrease the oxidative stress which is positively reflected on does performance (weight and milk production) and may be explains one of the mechanisms of improving the performance of rabbit does.

Table 5. Effect addition feed multi-nutrient block on blood plasma lipid peroxidation of does during pregnancy periods.

Items	TBARS
Main effect of treatment	
Control	1.73[a]
Block	1.19[b]
SEM	0.04
P-value	0.0001
Main effect of mating time	
1 day	1.42
15 days	1.49
30 days	1.50
SEM	0.03
P-value	0.1978
Treatment by mating time interactions	
Treatment × Time	
Control × 1	1.78[a]
Control × 15	1.70[a]
Control × 30	1.72[a]
Block × 1	0.98[c]
Block × 15	1.27[b]
Block × 30	1.27[b]
SEM	0.09
P-value	0.0001

a - c, Means within a column at each item, bearing different superscripts are significant; SEM= standard error of the mean; TBARS= Thiobarbituric Acid Reactive Substances.

CONCLUSION

The findings of this study demonstrated that the present multi-nutrient block in rabbit cages with feed concentration improved body weight, milk production and lipid peroxidation during pregnancy and lactation period of rabbit does. In the current rabbit research, on the first day of the mating, the highest outcomes were achieved in addition to the multi-nutrient block.

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استجابة وزن الجسم و انتاج اللبن واكسدة الدهون في إناث الأرانب إلي الدعم بمجموعة مغذيات متعددة خلال ظروف الصيف

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ثمان وأربعون انثي أرنب من النيوزيلاندي الأبيض عمر حوالي 6-7 أشهر متوسط الوزن 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. تحسنت أوزان الجسم الحي فى الاناث بعد أيام الولادة وخلال فترات الرضاعة في الأرانب التي تتغذي على نظام غذائي مركز مُزوَّد بمجموعة مغذيات متعددة MNB بالمقارنة مع تلك التي تتغذى على نظام غذائي مركز فقط. خلال فترة الرضاعة كان انتاج اللبن الأسبوعي و إجمالي إنتاج الحليب أعلى معنويا في مجموعة الإناث التي تتغذى على علف مركز مُزوَّد بمجموعة مغذيات متعددة MNB. من ناحية أخرى، انخفضت معنويا المواد المتفاعلة مع حمض الثيوباربيتوريك (TBARS) كدليل اكسدة الدهون في مجموعة الإناث التي تتغذى على علف مركز مُزوَّد بمجموعة مغذيات متعددة MNB مقارنة بمجموعة الإناث التي تتغذى على علف مركز فقط. وفي الختام يمكن التوصية بوضع مجموعة مغذيات متعددة MNB في أقفاص الأرانب مع الأعلاف لتحسين الأداء الإنتاجي، و اكسدة الدهون خلال فترة الحمل والرضاعة لإناث الأرانب. أيضا، تم الحصول على أفضل النتائج عند دعم الإناث عند عمر اليوم الأول من التزاوج.

الكلمات الدالة: مجموعة مغذيات متعددة، اكسدة الدهون، إنتاج الحليب، إناث الأرانب, وزن الجسم.