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Effect of Supplementing 21 Day Weaned Rabbits with Mixture of Mentha, Cumin Extracts with Cow Milk on Weaning Performance of Different Rabbits' Breeds

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ABSTRACT

The aim of the study was to investigate the effect of supplementing early weaning kits at 21 d with a mixture of Mentha and Cumin extracts with cow Milk (MCM) on the performance and blood plasma constituents of the rearing kits. A total of 288 weaned rabbits were used from four breeds (New Zealand White, California, Chinchilla and Rex). Rabbits were divided into three treated groups (96 rabbits each). The first group kits weaned at 27 d (G27), the second group was kits weaned at 21 d (G21) and the third group was kits weaned at 21 d (GS21) and supplemented for six days with a fresh mixture of MCM. The results showed that, at 27 d, the supplemented kits with the MCM mixture of different tested breeds (GS21) showed a significant higher ($p<0.05$) body weight and daily body weight gain compared with the other groups (G21 and G27). The MCM mixture supplementation improved generally the kits daily body weight gain by about 35.8%, compared with kits weaned at 27 d of age (G27). The 21 d weaned kits of California breed and supplemented with MCM mixture showed the highest percentage of improvement in the daily body weight gain, by about 48% higher than the California kits weaned at 27 d of age. In general, no significant differences for albumin, hemoglobin and red blood cells were detected among the tested breeds in the different tested rearing systems. However, significant higher ($p<0.05$) feed intake was detected for the group (G27). While, no significant differences were detected between groups (GS21 and G21). The average of total MCM mixture intake for the 6 days by the group (GS21) was about 225.52 ml/kit. There was no significant difference detected for the feed cost between groups GS21 and G27. While, the feed cost per total weight gain of group GS21 was significantly lower than both groups G21 and G27. In conclusion, supplementing early weaning kits at 21 d with the MCM mixture for six days could be considered as a milk formula specifically designed to meet the kit's requirements, and a more expeditions method for delivering the artificial milk to kits.

Keywords: early rabbit weaning, Mentha, Cumin, Cow Milk, kits growth performance

INTRODUCTION

Rabbits have fast reproductive and growth rates, and are excellent species in converting feed into body weight. They are known for utilizing high quality feed, they have small body size, a good feed conversion rate and they yield high quality meat. Rabbit meat contains low amounts of fat and cholesterol and a high amount of protein. The live weight at weaning in rabbits is strongly related to milk intake, kits from smaller litters, generally, show a higher weight at weaning than the kits from larger litters (Poigner et al., 2000) due to the higher milk availability (McNitt and Lukefahr, 1990; Sabater et al., 1993). In fact, Gyarmati et al. (2000) showed that the kits suckling milk twice a day from two does, increased milk intake by 89% and consequently, body weight at 21 d by 70% in comparison with the kits suckling once a day from their mother. Rabbits' solid feed intake (that generally starts around 20 d of age), is low and increases more slowly when milk availability is higher (Pascual et al., 2001). Early weaning of rabbits offers nutritional and animal health benefits, enabling the provision of a diet adapted to the young rabbits' requirements from a very early age and limiting the transmission of pathogenic agents between the mother and young (Kovacs et al., 2012). Moreover, using artificial milk formula could effectively reduce lactation stress on the doe, especially in early post-partum breeding regimens, thereby doe production and reproduction efficiency could be generally improved (Ferguson et al., 1997). In addition, artificial feeding of kits using measured quantities of milk formula could circumvent the otherwise natural competition for milk that occurs among siblings (especially in large litters), thereby reducing motility levels and possibly improved uniformity of market weight, the survival of kits and the longevity of does could also be expected to improve. However, feed industry started looking for alternative feed additives, which could replace antibiotics in guaranteeing satisfactory productive performances (Celia et al., 2015). Therefore, the aim of the study was to investigate the response of supplementing the early weaned kits at 21 days of age with a mixture of mentha and cumin extracts with cow milk (MCM) for 6 days on the growth performance and blood plasma constituents of different growing rabbits' breeds at 27 d of age.

MATERIALS AND METHODS

This study was conducted in a private farm in the province of Kafr El-Sheikh Governorate during November 2015 until March 2016. To study the possibility of applying early weaning in four different breeds of rabbits at the age of 21 d by feeding on a mixture of an alternative to mother's milk provides for rabbits weaned for six days only one meal a day. A total number of 36 female rabbit at 12-15 weeks of age were used from four breeds (New Zealand White (NWZ) - California - Chinchilla - Rex), mothers were randomly distributed to 3 groups having nearly similar average weights. The 12 rabbits of each group were subdivided into 3 replicates for each breed. A total of 288 weaned rabbits were used from the four breeds. Rabbits were divided into three treated groups (96 rabbits each). The first rabbits group weaned at 27 d (G27), the second group weaned at 21 d (G21) and the third group weaned at 21 d supplied with the MCM mixture (GS21). Rabbits were fed a commercial rabbits' pelleted diet once a day from the beginning until the end of the experiment, formulated to meet nutrient requirements (NRC,1977). The ingredients of the rabbits' diet were barley, calcium carbonate, sodium chloride, alfalfa hay, caraway, fennel, oats, herb natural soybean meal, L-lysine,

thyme, premix, disodium phosphate salt, limestone food. The chemical composition of the diet was 19% crude protein, 2.2:2.5% fat, 15:16% crude fiber and energy about 2300:2500 Kcal. The 2 liters of the mixture prepared by soaking dry *Mentha piperita* leaves (4 g) and *Cuminum cyminum* (10 g) for 5 min at one liter of distilled boiled water. Then the extract was filtered and mixed with 1 litter fresh cow milk (MCM mixture) and used at 40^{o}C for the rabbits weaned at 21 d of age once a day (9 am). The mixture MCM provided by the water system and after recording the MCM mixture consumption the system was cleaned twice by using hot water and then refill with fresh water. The chemical composition of the MCM mixture was 1.52 % protein, 2.49 % fat, 4.06% solid not fat and 2.13% lactose (measured by Milk Analyzer Lactoscan). Mothers rabbits were individually housed in galvanized wire cage, measuring (33x50x30 cm) with a nest box of (25x30x30 cm). Weaning rabbits were group housed in galvanized wire cage (4 rabbits/cage), measuring (33x50x25 cm) until slaughtering. Each cage was supplied with a feeder and a stainless-steel nipple for drinking. At 27 d of age, blood samples were taken from 36 weaned rabbits by slaughtering 12 rabbits from each group, of 3 replicates for each breed. The blood serum separated to determine the blood constituents, liver function enzyme alanine aminotransferase (ALT), red blood cells, white blood cells, total protein, albumin, globulin and hemoglobin by using commercial kits. Data obtained were analyzed using one-way analysis of variance. All statistical analysis was performed according to SAS (2008). Differences were subjected to (LSD) least significant difference.

RESULTS AND DISCUSSION

Data accentuate in Table (1) showed that no significant differences were found for does live body weight at the beginning of the study and for the number of kits given. Moreover, no significant differences ($p<0.05$) in total kits live body weight were detected among the tested groups (G27, G21 and GS21) during pre-weaning period at 0, 7, 14 and 21 d of age.

Table (2) cleared that there were no significant differences ($p<0.05$) observed for the total kits live body weight among the four tested breeds during the pre-weaning period (0-21 d of age).

The average live body weight and average daily body weight gain of growing kits from the tested breeds are presented in Table (3). Results obtained showed that for the all tested breeds, the early weaned kits (groups G21 and GS21) had the highest average daily gain, compared with group (G27). Additionally, the all tested rabbits' breeds weaned at 21 d and supplemented with the MCM mixture showed significantly higher ($p<0.05$) average daily body weight gain, compared with kits weaned at 27 d (G27) of the same breed. Moreover, the Rex rabbits breed showed the highest daily weight gain compared with other breeds within the same rearing system, followed by the NZW, Chinchilla and California, respectively, in descending order.

On the other hand, results presented in Figure (1) cleared that the daily body weights gain due to weaning kits at 21 d (G21) were higher than 27 d weaned kits (G27) by about 20%, 15%, 8% and 7% for Chinchilla, California, NWZ and Rex, respectively. While, the percentages of the improvement in kits daily body weight gain due to the MCM mixture supplementation were about 48%, 40%, 40% and 17% for California, NWZ, Chinchilla and Rex, respectively, when compared with the kits weaned at 27 d (G27) of the same breed.

Conflicting results have been recorded for most tested blood constituents among tested breeds as affected by the rearing systems (Table 4). Since, at 27 d of age, the supplementation with the MCM mixture decreased significantly ($p<0.05$) total protein and globulin concentrate in the NZW rabbits, while increased significantly ($p<0.05$) the ALT and the white blood cells values. However, the MCM mixture supplementation decreased significantly the California rabbits' ALT and increased significantly ($p<0.05$) the total protein and white blood cells values. Contrast results showed by the supplemented group of Chinchilla rabbits. The MCM mixture supplementation decreased the Rex rabbits' ALT and white blood cells. In general, no significant differences for albumin, hemoglobin and red blood cells were detected among the same breeds in the different rearing systems.

Table 1: The least square means (±SEM) of the kits number given and the total kits live body weights by the tested rearing systems of growing rabbits

	G27	G21	GS21	±SEM	G27	G21	GS21	±SEM
	No. of animals/doe				Total kits live body weights, g			
Does	12	12	12	-	2980.42	2931.25	3021.88	53.33
0 day	7.00	6.13	6.19	0.31	371.04	358.44	343.44	28.00
7 day	6.83	6.06	6.13	0.27	710.21	762.50	674.38	33.33
14 day	6.83	6.06	6.06	0.21	1270.83	1344.06	1346.25	67.88
21 day	6.83	6.06	6.06	0.21	1781.88	1982.19	1942.19	85.26

Table 2: The least square means (±SEM) of the pre-weaning total kits live body weights by the tested rearing systems of different rabbits' breeds

	NZW			California			Chinchilla			Rex			±SEM
	G27	G21	GS21	G27	G21	GS21	G27	G21	GS21	G27	G21	GS21	
0day, g	315.00	346.25	343.75	388.33	390.00	317.50	406.67	360.00	360.00	374.17	337.50	352.50	43.54
7day, g	654.17	772.50	651.25	680.83	835.00	632.50	749.17	792.50	701.25	756.67	650.00	712.50	66.1
14day, g	1216.67	1277.50	1343.75	1155.00	1370.00	1220.00	1344.17	1503.75	1311.25	1367.50	1225.00	1510.00	134.32
21day, g	1641.67	1880.00	1806.25	1656.67	2167.50	1807.50	1820.83	2101.25	2025.00	2008.33	1780.00	2130.00	168.69

Table 3: The least square means (±SEM) of the kits live body weights and the daily body weight gain by the tested rearing systems of different rabbits' breeds

	NZW			California			Chinchilla			Rex			±SEM
	G27	G21	GS21	G27	G21	GS21	G27	G21	GS21	G27	G21	GS21	
21 d, g	291.31^{c}	330.87^{a}	300.21^{c}	321.98^{ab}	331.36^{a}	302.14^{c}	332.2^{a}	307.05^{bc}	324.38^{ab}	334.55^{a}	325.71^{ab}	337.75^{a}	6.39
27 d, g	332.05^{e}	375.43^{bcd}	368.33^{bcd}	352.50^{de}	367.05^{cd}	360.71^{cd}	370.00^{bcd}	354.32^{de}	387.66^{abc}	393.70^{ab}	370.18^{bcd}	409.25^{a}	7.91
Daily weight gain, g	5.82^{c}	6.36^{bc}	9.73^{a}	4.36^{c}	5.10^{c}	8.37^{ab}	5.40^{c}	6.75^{bc}	9.04^{a}	8.45^{b}	9.04^{a}	10.21^{a}	0.67

a-f: Means in the same row with different superscripts are significantly different at p<0.05

Table 4: The least square means (±SEM) of blood plasma constituents by the rearing systems of different rabbits' breeds at 27 days of age

	NZW			California			Chinchilla			Rex			±SEM
	G27	G21	GS21	G27	G21	GS21	G27	G21	GS21	G27	G21	GS21	
ALT (U/L)	18.27^{def}	24.33^{abc}	28.37^{a}	19.83^{cde}	22.87^{bcd}	15.07^{ef}	15.93^{ef}	13.77^{f}	24.67^{ab}	15.40^{ef}	18.80^{de}	13.33^{f}	1.52
TP (g/dl)	5.59^{a}	3.67^{d}	3.82^{cd}	4.43^{bcd}	4.00^{bcd}	5.57^{a}	4.66^{b}	4.22^{bcd}	4.77^{b}	4.47^{bcd}	4.63^{bc}	4.47^{bcd}	0.25
AL (g/dl)	2.77^{ab}	2.21^{c}	2.29^{bc}	2.55^{abc}	2.08^{c}	3.03^{a}	2.58^{abc}	2.31^{bc}	2.53^{abc}	2.41^{bc}	2.23^{bc}	2.34^{bc}	0.16
GL (g/dl)	2.81^{a}	1.46^{d}	1.53^{cd}	1.91^{bcd}	1.92^{bcd}	2.47^{ab}	2.08^{bcd}	2.24^{abc}	2.23^{abc}	2.06^{bcd}	2.40^{ab}	2.10^{bcd}	0.22
He (g/dl)	10.93^{abc}	10.10^{c}	10.17^{c}	10.25^{bc}	11.53^{abc}	11.70^{abc}	11.00^{abc}	10.46^{bc}	10.90^{abc}	12.20^{a}	11.33^{abc}	11.90^{ab}	0.51
RBC (x10^{6}/mm^{3})	3.97	3.93	3.86	3.87	3.95	3.97	4.14	3.99	4.03	4.03	4.02	4.16	0.11
WBC (x10^{6}/mm^{3})	3666.7^{cd}	4000.0^{bc}	5083.3^{a}	3750.0^{c}	3983.3^{bc}	4650.0^{ab}	3500.0^{cd}	2966.7^{de}	2533.3^{e}	4650.0^{ab}	3800.0^{c}	3883.3^{bc}	243.2

ALT= Alanine Aminotransferase, TP= Total Protein, AL= Albumin, GL= Globulin, He= Hemoglobin, RBC= Red Blood Cells, WBC= White Blood Cells, a-f: Means in the same row with different superscripts are significantly different at p<0.05

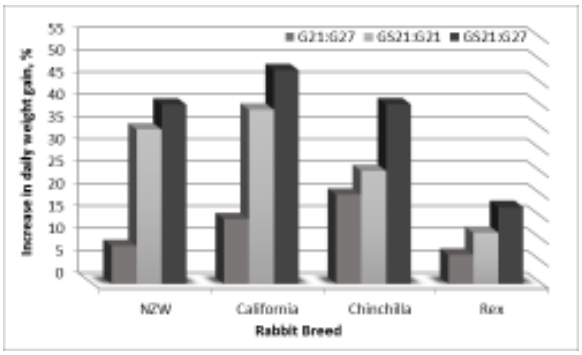

Figure (1): The percentages of the improvement in kits daily body weight gain by the rearing systems of different rabbits' breeds.

According to the statistical analysis of data in Table (5), regardless of breeds it could be noticed that, there were no significant differences (p<0.05) among the three tested groups for the average weights at the beginning of the experiment. At 27 d, the group of kits that supplemented with the MCM mixture (GS21) showed a significant higher (p<0.05) body weight, compared with the other tested rearing groups (G21 and G27). Similarly, a significant higher (p<0.05) daily body gain was detected for the group (GS21). The MCM mixture supplementation improved generally the kits daily body weight gain about 35.8%, compared with kits weaned at 27 d of age (G27). Moreover, significant higher (p<0.05) daily dry matter intake and feed intake were detected for the group (G27). While, no significant differences in this aspect were detected between groups (GS21 and G21). Generally, the average of total MCM mixture intake for the 6 d by the group (GS21) per kit was about 225.52 g. Additionally, the kits supplemented with MCM mixture (GS21) showed a significant higher (p<0.05) daily water intake, compared with group (G21). The rabbits weaned at 21d (G21) had a significant (p<0.05) lower feed cost, in comparison with groups G27 and GS21. While, no significant difference was detected for the feed cost values between the both groups (G27 and GS21). On the other hand, the feed cost per kits weight gain of group GS21 was significantly lower (p<0.05) than both groups G21 and G27.

Table (5): Effect of rearing systems on the economic efficiency of growing rabbits.

Treat	G27	G21	GS21	±SEM
Body weight at 21d, g	320.05	323.75	316.12	0.38
Body weight at 27d, g	362.06^{b}	366.97^{b}	381.50^{a}	3.58
Body weight gain, g	42.01^{c}	43.22^{b}	65.38^{a}	3.12
Daily body gain/kit, g	6.00^{b}	6.23^{b}	9.34^{a}	0.36
Daily DMI /(Doe+Kits), g	350^{a}	225^{b}	225^{b}	2.01
Feed intake/(Doe+Kits), g	2100^{a}	1350^{b}	1350^{b}	9.10
Total MCM intake/kit, mL	-	-	225.52	-
Daily water intake/kit, mL	-	30.82^{b}	50.58^{a}	0.43
Total feed cost/(Doe+kits), LE	7.56^{a}	5.40^{b}	7.56^{a}	0.51
Feed cost /kit, LE	1.26^{a}	0.90^{b}	1.26^{a}	0.05
Feed cost/kit weight gain, LE	0.030^{a}	0.021^{b}	0.019^{c}	0.001

a-c: Means in the same row with different superscripts are significantly different at p<0.05. The prevailing price per kg at the time of study was 3.60 LE for commercial rabbit diet, and 1.45 LE per liter for MCM mixture.

However, Nizza et al., (2001) concluded that the pre-weaning milk/feed ratio affects the microbiological and biochemical characteristics of the caecal content and also post weaning mortality and performance of rabbits. Piatoni and Maertens (1999) found that the kits weaned at 18 d do not eat any solid feed for 1 or 2 d, but they showed an earlier adaptation to the solid food intake than those weaned at 32 d, affecting their growth slightly, but not their mortality. Moreover, Pascual et al. (2001) cleared that early weaning was less problematic when young kits showed a slight solid feed intake (18-21 d). Herein in the present study, results confirmed that, generally, early weaning resulted in better growth rate of rabbits and showed the positive impact of early weaning upon the live body mass of animals at the 27 d of age. Similar result of a higher live weight of the early weaned rabbits was recorded at 35 d of age by Xiccato et al. (2003), Gidenne et al. (2004) and Zita et al. (2012). In contrast with such findings other studies (Gallois et al., 2004 and Vachkova et al., 2010). Although, Andras (2014) concluded that rabbits can be weaned on 21 d and reared without feed additives or medication under high management and hygienic conditions without the increase of mortality or morbidity. However, some data are available on the

effects of weaning age (21 to 25 d) on the rabbits' performance (Gidenne and Fortun-Lamothe, 2002; Cesari et al., 2007; Zita et al., 2007 and Gallois et al., 2008).

CONCLUSIONS

The supplementation of rabbits weaned at 21 d with MCM mixture for 6 days increased significantly the live body weight and the kits daily weight gain in all tested breeds at 27 d of age. The Rex rabbits breed showed the highest daily weight gain values, but also the lowest percentage of improvement in the daily body weight gain as a result of supplementation, compared with other breeds within the same rearing system. While, the California kits supplemented with MCM mixture showed the highest percentage of improvement in the daily body weight gain, by about 48% higher than the California kits weaned at 27 d of age. Moreover**,** the feed cost per kits' weight gain of the supplemented group was significantly lower than other tested groups (G21 and G27) at 27 d of age. Therefore, the MCM mixture and the rearing system used in the present study could be considered as a milk formula specifically designed to meet the kit's requirements, and a more expeditions method for delivering the artificial milk to kits.

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تأثير إضافة مخلوط من النعناع والكمون واللبن البقرى على أداء الفطام لأرانب مفطومة على عمر ٢١ يوم من سلالات مختلفة

ناظم عبد الرحمن شلبي و عمرو أحمد عبد الرازق جبر و هشام مصطفى السيد رحمه
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تهدف الدراسة لبحث تأثير إضافة مخلوط من مستخلص النعناع والكمون بالاضافة للبن البقرى على الأداء فى الارانب النامية والمفطومة على عمر ٢١ يوم من الولادة . قد استخدام في الدراسة عدد ٢٨٨ أرنب فطام من أربع سلالات مختلفة (النيوزيلاندي الأبيض ، الكالفورنيا ، الشنشلا ، الركس) وتم تقسيم الأرانب لثلاث مجموعات ، تضم كل مجموعه ٩٦ أرنب. مجموعة أولى : أرانب مفطومة عند عمر ٢٧ يوم ، المجموعة الثانية : أرانب مفطومة عند عمر ٢١ يوم ، المجموعة الثالثة : أرانب مفطومة عند ٢١ يوم ومدعمة بالمخلوط المستخدم فى التجربة لمدة ٦ أيام. أظهرت النتائج أنه لا يوجد فروق معنوية فى أوزان الأرانب المستخدمة فى بداية التجربة أو أوزان الأمهات. وعند عمر ٢٧ يوم من الفطام ، قد أدى المخلوط لزيادة معنوية فى معدل النمو اليومي والوزن الحي في جميع سلالات الأرانب المفطومة عند ٢١ يوم مقارنة بتلك المفطومة عند عمر ٢٧ يوم أو ٢١ بدون مخلوط. أظهرت الأرانب من سلالة كاليفورنيا المفطومة عند ٢١ يوم وحصلت على المخلوط أعلى نسبة تحسن في معدل النمو اليومي يصل لحوالي ٤٨% أعلى من مثيلاتها من نفس السلالة والمفطومة عند ٢٧ يوم. كما قد أوضحت النتائج عدم وجود فروق معنوية في الالبيومين والهيموجلوبين وخلايا دم الحمراء بين السلالات المختلفة داخل المجموعات التجريبية المختلفة. وبصرف النظر عن السلالات وجد أن هناك زيادة معنوية في المأكول من العلف للمجموعة الفطام على ٢٧ يوم ولم يكن هناك اختلاف معنوي بين المجموعتين المفطومتين على ٢١ يوم. وقد كان متوسط الكمية الكلية للمخلوط المستهلك خلال الستة أيام هي حوالي ٢٥٥.٥٢ملي/للأرنب. وبشكل عام قد اشارت النتائج لعدم وجود فروق معنوية فى تكلفة التغذية ما بين المجموعتين المفطومتين على عمر٢١ يوم مضاف لها مخلوط والـ ٢٧ يوم. ولكن عند حساب تكلفة التغذية بالنسبة لوزن الجسم المكتسب كانت المجموعة المضاف لها المخلوط هى الأقل معنوية عن باقى المجموعات. لذا فإنه توصى الدراسة بأن يمكن الفطام المبكر للأرانب عند عمر ٢١ يوم دون تأثير سلبي على الأرانب المفطومة، وأن تغذية الأرانب المفطومة عند ٢١ يوم لمدة ٦ أيام على مخلوط من مستخلص النعناع والكمون المضاف للبن البقرى قد أدى لتحسين الأداء الإنتاجى للأرانب المفطومة وذلك مقارنة بالأرانب المفطومة عند عمر ٢٧ يوم . لذلك فإن المخلوط المستخدم قد يعد هو بديل اللبن الأمثل لتلبية احتياجات الأرانب في هذا العمر والطريقة المتبعة في التغذية هي أفضل طريقة لتقديم هذا البديل وذلك مع السلالات المستخدمة في الدراسة.