

## **IMPACT OF MACA (*Lepidium meyenii*) TREATMENT ON PRODUCTIVE PERFORMANCE, LITTER SIZE AND MILK YIELD OF RABBIT DOES OF DIFFERENT BREEDS.**

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### **SUMMARY**

Most rabbit breeders suffer some problems during summer season such as fertility and litter size as well as increase feed costs. Litter size at birth and weaning are important economic traits, which determine the number of kits for future breeding programs and life-time productive. This experiment aimed to study the impact of Maca (*Lepidium meyenii*) capsules administration on body weight, feed consumption and milk yield of rabbit does as well as number of litter size, pre-weaning mortality and litter weight. Thirty-six rabbit does, from the breeds of V-line, New Zealand white and Bouscat, with 12 of each. They were divided equally into two equal groups of each breed. In the 1<sup>st</sup> group, rabbits were fed a commercial breeder ration without any supplementation, while the 2<sup>nd</sup> group were fed the commercial breeder ration and received daily oral does 500 mg Maca capsule/doe before mating by one week. All does were re-administered with the same dose after three days from parturition for one week (day per day), then re-mated directly for the second and third parties. The traits measured were body weight and feed consumption of rabbit does. Also, number of litter size, litter weight, the pre-weaning mortality and the milk yield were recorded as well. The obtained results revealed that the body weights of V-line and NZW rabbit does after treating and birth were significantly ( $P \leq 0.01$ ) reduced than that of the Bouscat, while the means of daily and total feed consumption were not affected by rabbit breed. The litter size at birth (LSB) of NZW and Boscuat rabbit does were significantly ( $P < 0.01$ ) higher than those of V-line, while the highest value of litter weight at weaning (LWW) were recorded in V-line, followed by NZW, while the lowest one was recorded in Bouscat. The body weights and daily feed consumption of treated rabbit does were not effected by Maca capsules, while during lactation period were significantly increased than those of the control. The litter size at 7, 14 and 21 days of rabbit does treat with Maca capsules were significantly increased, while those at LSB and LSW were insignificantly increased compared with control group. No significant effect on milk production and litter weight at birth, 7, 14, 21 and 28 days in the treated group compared with control. There were no significant effects due to the interaction between rabbit breed and Maca treatment on the body weights, daily feed consumption, litter size, litter weight and milk production. From these findings could be concluded that the administration M aca capsules to rabbit doe increased the litter size at 7,14 and 21 days, while LSB, LSW, milk production and litter weight at birth, 7, 14, 21 and 28 days were not influenced.

**Keywords:** *Rabbit does, Maca, productive performance and milk yield.*

### **INTRODUCTION**

The Maca (*Lepidium meyenii*) plant was mentioned as a “lost crop of the Incas” (NRC, 1989) has been cultivated and used for food and medical properties and to enhance fertility in humans and animals (Canales *et al.*, 2000 ;Dini *et al.*, 1994 ;Quiroz *et al.*, 1997 and Cobo, 1956).

The findings of Ruiz-Luna *et al.* (2005) showed that that offspring number for mice females administered with Maca were significantly ( $P < 0.05$ ) increased compared with control group. Similarly, Chacon (1997) reported Maca increased the number of follicles for female mice than that of the control.

The results of Yoshida *et al.* (2017) indicated that the Maca play an important role to promotes optimal functioning for both hypothalamus and pituitary, throughout the balance effects on FSH, estradiol and progesterone of women.

Ruiz- Luna *et al.* (2005) reported that, female mice that received Maca delivered more pups than the control group. This suggests that Maca may have a protective effect on the number of resorptions, having a less occurrence of them between day 7 of pregnancy and the subsequent days of pregnancy in the Maca treated group. Supplementation of Maca in diets improved growth rates and survival of rainbow trout *Oncorhynchus mykiss* (Walbaum) alevins and juveniles (Lee *et al.*, 2004).

Clark *et al.* (1994) reported that, some possible mechanisms through which Maca may act include increased uterine receptivity, altered immune functions and effects on vascular system. It is known that functional lymphocytic progesterone binding sites are needed for the maintenance of normal pregnancy, and that progesterone-mediated immune suppression is needed for the maintenance of gestation. (Szekeres *et al.*, 1994).

Amstislavsky *et al.* (2004) said that litter size was higher at birth and at postnatal day 4 in the groups treated with Maca than in the controls. This effect seems to be due to a reduction in embryo resorptions, since number of implantation sites were similar in mice treated with Maca than in control. This effect seems not to be due to any estrogenic activity of Maca, since exposure to estradiol-17 beta or the proestrogen methoxychlor reduced litter size.

Finally, using the Maca plant was restricted to humans and mice based on the research obtained. There were rare of literatures on Maca effect on the rabbit, therefore, the current study was conducted to evaluate the impact of treating rabbit does with Maca in capsulated form during the experimental period (56 days) on the productive traits of rabbits.

## **MATERIALS AND METHODS**

This study was carried out at the research rabbit farm, Poultry Production Department, Faculty of Agriculture Sohag University from August 2017 to January 2018. It was to investigate the effect of Maca on the productive and reproductive performance of rabbit does.

### ***Experimental design:***

A total of 36 rabbit does V-line, New Zealand white and Bouscat, with 12 of each. Rabbits were divided equally into two equal groups; each of them included 6 V-line, 6 Newzeland and 6 Bouscat and with 12 of each. Rabbits were divided equally into two equal groups; each of them included 6 V-line , 6 Newzeland and 6 Bouscat. In the 1<sup>st</sup> group, rabbits were fed a commercial breeder ration without any supplementation, while the 2<sup>nd</sup> group were fed the commercial breeder ration and orally administered with 500 mg Maca capsules/doe/day for one week before mating. All does were re-administered with the same dose after three days from parturition for one week (day per day), then re-mated directly for the second and third parties.

### ***Housing the experimental rabbits:***

All does were individually housed in wire galvanized battery cages (50 cm L × 50 cm W × 40 cm H) in open side house under the same managerial and hygienic conditions. They were daily exposed to 12 continuous lighting hours as well as they were offered *ad-libitum* the feed and fresh tap water during the experimental period.

### ***Experimental diets:***

All experimental rabbit does were fed on a basal commercial. Basal diet was formulated to meet all nutrients requirements according to NRC (1989) and was nearly iso-nitrogenous and iso-caloric based on digestible energy and crude protein and was fortified with adequate vitamins and minerals mixtures. The basal diet included 16.89% crude protein, 12.67% crude fiber, 2.99% fat, 0.63% Ca and 2799Kcal/kg digestible energy. Analytical composition of dry Maca composition included 10.2% crude protein, 59.0% carbohydrates, 2.20% fat, and 8.5% fibers (Documenta Geigy., 1963).

### ***Climatic conditions:***

The interior ambient temperature (°C) and relative humidity (%) were daily recorded in the rabbit farm at 9 am and 13 pm by using a thermo-hygrometer. The temperature humidity index was calculated and recorded by the following equation according to Marai *et al.*, (2002):

$$THI = db^{\circ}C - [(0.31 - 0.31RH/100) \times (db^{\circ}C - 14.4)]$$

THI= Temperature humidity index, db°C= the ambient temperature, RH = the relative humidity (%).

**Table (1): Average of ambient temperature, relative humidity and temperature humidity index during the experimental period.**

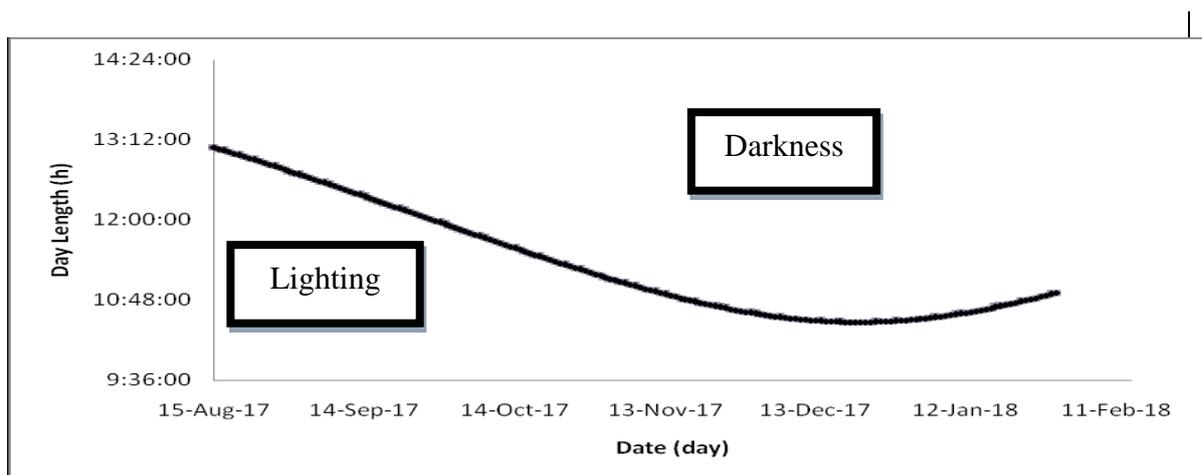
Period	Date	AT (°C)	RH (%)	THI (units)
1	15 Aug.-12 Sep.	30.86	63.25	22.53
2	12 Sep.-10 Oct.	29.18	61.75	21.77
3	10 Oct.-7 Nov.	28.92	61.75	21.64
4	7 Nov.-5 Dec.	25.63	57.50	20.15
5	5 Dec. -2 Jan.	22.00	58.25	18.27
6	2 Jan.- 30 Jan.	18.63	58.25	16.55

AT= Ambient temperature (AT/°C), RH (%)=Relative humidity (AT/°C), THI (index) = Temperature humidity index, Period= 28 days.

**Lighting program:**

All rabbits exposed to the same lighting program according the natural day length. According the data in Table (2) which shows the length of every day during the experimental period, so the design light programme curve was as follow:

The lighting program is continuous light and dark cycles and is decreasing lighting programme. The light intensity was 5 Lux during the day light.



**Studied traits:**

Body weights (g): rabbit does were weighed at the beginning, after dosage, one week from mating and at parturition, while the changing body weight for each rabbit doe was calculated during the experimental period i.e. from administration up to the weaning. The daily feed intake (g) for rabbit does were weighed and weekly recorded during the period of administration, pregnancy and lactation periods.

Litter size (kids), the number of kids were counted and recorded at birth, 7, 14, 21 and 28 days (weaning), while the kids were weighed (LW/g) at birth, 7, 14, 21 and 28 days (weaning).

Pre-weaning mortality rate (PWMR/%): Pre weaning mortality rate of progenies was recorded from birth up to weaning (28 day). Daily milk production (g) was estimated and recoded two times weekly during the 1<sup>st</sup>, 2<sup>nd</sup>, 3<sup>rd</sup>, and 4<sup>th</sup> weeks, respectively of the lactation period by using the weight-suckle-weight technique (removing the born kids from their dams at 12 hours before suckling), according to McNitt and Lukefahr (1990), while the total milk yield (TMY/g) was estimated as the sum of milk production during the 1<sup>st</sup>, 2<sup>nd</sup>, 3<sup>rd</sup> and 4<sup>th</sup> weeks of lactation period, respectively.

**Statistical analysis:**

The obtained data were statistically analyzed using GLM, procedure (SAS, 2004). Duncan's new multiple ranges tests (Duncan, 1955) were used to determine significant differences between treatment means. The following linear model was applied:  $E_{ij} = \mu + B_i + T_j + B_iT_j + e_{ij}$

Where,  $Y_{ij}$ = Observation measured,  $\mu$ = Overall mean,  $B_i$ = Effect of rabbit breed (1, 2 and 3),

$T_j$ = Effect of Maca treatment ( $j = 1$  and  $2$ ),  $BT_{ij}$ = Interaction between rabbit breed and Maca treatment,  $e_{ij}$ = Random error component was normally distributed assumed.

## RESULTS AND DISCUSSION

### Effect of treatments on the body weight of rabbit does:

The results in Table 2 showed that the body weights of V-line and NZW rabbit does after treating and birth were significantly ( $P \leq 0.01$ ) lower than the Bouscat does. The increased body weight of Bouscat could be attributed to the genetical effect, which positively reflects the variations in body weight and their behavior of different rabbit lines. These findings disagreed with Steven *et al.*, (1983), who found that the NZW rabbit does were significantly heavier than that of the California rabbit does at 154 days during the first breeding season. Similarly, the findings of Iraqi *et al.*, (2010), found that the body weight for V-Line rabbit does were superior to Gabali rabbit does.

The results showed that body weights of rabbit does in the control group were insignificantly improved as compared to treatment group. These results are in agreement with those of Ruiz-Luna *et al.*, (2005), who found that the body weights of female mice orally treated with 1g Yellow Maca /kg BW were insignificantly influenced than those of females in the control group. Similarly, Manuel Gasco *et al.*, (2008) found the body weights of rats treated with Maca during the experiment (28 days) were remarkably increased than those of the control group. In contrast, these results disagreed with those of EL-Tohamy *et al.* (2012), who found that the final body weight of male NZW rabbits supplemented with 9% for radish, rocket, black cumin and mixed meals diet (3% radish + 3% rocket +3% black cumin) were significantly decreased than those of the control group.

The results showed that there were no significant differences in the body weight for rabbit does at different periods due to the interaction between rabbit breed and Maca treatment allover experimental period.

**Table (2): Body weight of rabbit does affect by breed, Maca treatment and their interaction (LSM±SE).**

Breed / Treatment	DWBT(g)/ Initial)	DWAT (g)	DWAB (g)(Final)
Effect of rabbit breed (B)			
V-line	2409.50±65.7	2432.50 <sup>b</sup> ±50.5	2633.64 <sup>b</sup> ±45.7
NZW	2488.24±63.7	2552.85 <sup>b</sup> ±49.8	2702.42 <sup>b</sup> ±49.6
Bouscat	2565.46±63.8	2721.75 <sup>a</sup> ±50.0	2871.61 <sup>a</sup> ±50.7
Effect of Maca treatment (T)			
Control	2438.81±52.1	2585.57±41.7	2701.11±38.7
Treatment	2536.68±53.1	2552.50±40.1	2770.68±40.8
Effect of interaction (B×T)			
V-line	Control	2412.81±92.9	2437.50±71.5
	Treatment	2406.25±92.9	2427.50±71.5
NZW	Control	2472.06±90.1	2503.82±69.3
	Treatment	2504.41±90.1	2601.88±71.5
Bouscat	Control	2431.55±87.6	2716.17±67.4
	Treatment	2699.375±92.9	2727.33±73.8
Probability			
Breed (B)	0.2398	0.0005	0.0032
Treatment (T)	0.1914	0.5690	0.2205
Interaction (B×T)	0.2683	0.7215	0.3197

<sup>A, b</sup> Means with different letters within each column are significantly different ( $P \leq 0.05$ ).

Sig = Significant, Ns= Non-significant, C= Control group, T= Treatment group

**Effect of treatments on the feed consumption of rabbit does:**

The results in Table 3 showed that the daily feed consumption for NZW rabbits does during the preparation period were significantly ( $P \leq 0.01$ ) increased as compared with Bouscat and V-line rabbit does. While the means of feed consumption for V-line and NZW rabbit does during lactation period were significantly increased than those of the Bouscat rabbit does. The means of feed consumption of rabbit does during supplementation and pregnancy periods were not affected. Generally, the means of daily and total feed consumption were not affected by rabbit breed. The increased feed consumption for V-line and NZW rabbit does could be attributed to increased number of kids especially during 21 to 28 days of the lactation period. These results agreed with Steven *et al.*, (1983), who found that the daily feed consumption for NZW rabbit were significantly ( $P < 0.01$ ) increased than those of the Californian does.

The results in table 3 indicated that the daily feed consumption of rabbit does treated with Maca capsule during preparation, supplementation and pregnancy periods were not effected, while during lactation period was significantly increased than those of the control. Generally, from these findings could be noted that the means of daily and total feed intake for treated rabbit does were insignificantly increased than those of the control group. The increased feed consumption for treated rabbit does during lactation period could be attributed to an increased number of rabbit kids especially from birth up to 21 days of age than those of the control. These results agreed with EL-Tohamy *et al.* (2012), who found that the best feed conversion values were recorded for NZW rabbits supplemented with 9% radish, 9% rocket, mixed meals diet (3% radish + 3% rocket + 3% black cumin) as compared with control group. Also, the results of Leung and Foster (1996) reported that the improved feed conversion values could be attributed to the properties of these materials that act as antibacterial, antiprotozoal, antifungal and antioxidant. Also, the results of Nguyen and Nguyen (2008) showed that the better feed consumption and feed conversion ratio of crude protein for rabbits supplemented with diets contained 60 and 80% cabbage than those of the control.

The results in table 3 showed no significance in the feed consumption for different rabbit lines during supplementation period, while during preparation, pregnancy and lactation as well as daily and total feed consumption were not affected. The increased feed consumption of rabbit does during supplementation period could be attributed to the differences in feed consumption between different lines and treatment.

**Table (3): Daily feed consumption of rabbit does affect by breed, Maca treatment and their interaction (LSM±SE).**

Line / Treatment	Preparation (g)	Supplementation (g)	Pregnancy (g)	Lactation (g)	Daily feed intake (g)	Total feed intake (kg)	
Effect of rabbi breed (B)							
V-line	122.91 <sup>b</sup> ±2.9	129.16±3.8	144.38±6.3	171.78 <sup>a</sup> ±4.2	134.16±4.1	29.09±1.7	
NZW	144.94 <sup>a</sup> ±2.9	136.30±3.8	134.53±6.3	164.97 <sup>a</sup> ±4.0	134.14±4.1	30.99±1.7	
Bouscat	124.29 <sup>b</sup> ±2.9	136.22±3.8	137.61±6.3	138.37 <sup>b</sup> ±4.2	123.41±4.1	28.51±1.7	
Effect of Maca treatment (T)							
Control	131.27±2.4	135.40±3.1	143.43±5.3	152.26 <sup>b</sup> ±3.4	129.78±3.4	28.71±1.4	
Treatment	130.16±2.4	132.39±3.1	134.25±5.1	164.84 <sup>a</sup> ±3.4	131.36±3.4	30.34±1.4	
Effect of interaction (B×T)							
V-line	C	120.37±4.1	132.60±5.4	152.49±9.7	173.94±6.2	133.90±5.8	27.12±2.5
	T	125.46±4.1	125.72±5.4	136.28±8.9	169.93±5.7	134.42±5.8	31.05±2.5
NZW	C	147.37±4.1	147.62±5.4	136.45±8.9	156.22±5.7	136.59±5.8	31.16±2.5
	T	142.52±4.1	124.99±5.4	132.60±8.9	173.72±5.7	131.68±5.8	30.42±2.5
Bouscat	C	126.07±4.1	125.99±5.4	141.34±8.9	126.63±5.7	118.86±5.8	27.46±2.5
	T	122.51±4.1	146.44±5.4	133.87±8.9	150.10±6.2	127.97±5.8	29.56±2.5
Probability							
Breed (B)	0.0001	0.3302	0.5509	0.001	0.1213	0.5821	
Treatment (T)	0.7457	0.4999	0.2229	0.0167	0.7426	0.4240	

Interaction (B×T)	0.4349	0.0015	0.7871	0.0651	0.4876	0.5886
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<sup>A, b</sup> Means with different letters within each column are significantly different ( $P \leq 0.05$ ).

Sig = Significant, Ns= Non-significant, C= Control group, T= Treatment group

**Effect of treatments on litter size and pre-weaning mortality of rabbit Does:**

The results in Table 4 showed that the litter size at birth of NZW and Bouscat rabbit does were significantly ( $P < 0.01$ ) increased than those of V-line. The significant increased in litter size at birth of Bouscat rabbit does could reflect the increased ovulation rate for these breeds compare with NZW and V-line. The highest values of litter size at weaning were recorded in NZW, followed by V-line, while the lowest one was recorded in Bouscat. Generally, the litter size at 7, 14 and 21 days were insignificantly affected. The increased litter size for both breeds may be attributed to decrease mortality rate, which coincided with increase milk production. Also, this may be attributed to animal genotype (Harris *et al.*, 1982). These results are in agreement with those of Das *et al.*, (2006), who found a significant ( $P < 0.05$ ) higher in litter size at weaning for NZW rabbit does than those of Soviet Chinchilla rabbit does. Similarly, the results of Azoz and El-kholy (2005), indicated that litter size at birth and at weaning of V-line rabbit does were significantly increased than those of Bouscat rabbit does. The obtained data indicated that the highest pre-weaning mortality rate was recorded in Bouscat does, followed by V-line, while the lowest one was recorded in NZW rabbit does without any significant effect. These findings agreed with Steven *et al.*, (1983), indicated that the preweaning mortality in NZW rabbit does were significantly greater than those of Californion rabbit does. In contrast, the results of Azoz and El-Kholy (2005) reported that the number of kids at birth for V-line and Bouscat were insignificantly affected. Also, the results of El-Hammady and Abdel-Kareem (2015) showed no significant differences in LSB and LSW as well as PWM among V-Line, NZW and Bouscat rabbit does.

**Table (4): Litter size and pre-weaning mortality of rabbit does affected by breed, treatment and their interaction (LSM±SE).**

Breed/Treatment	LSB (kids)	LS7days	LS14days	LS21days	LS28days	PWM (%)	
Effect of rabbit breed (B)							
V-line	4.18 <sup>b</sup> ±0.4	3.83±0.4	4.21 <sup>a</sup> ±0.4	3.83±0.4	3.49 <sup>a</sup> ±0.5	44.02 <sup>a</sup> ±7.7	
NZW	5.47 <sup>a</sup> ±0.5	4.48±0.4	4.37 <sup>a</sup> ±0.4	4.31±0.4	3.56 <sup>a</sup> ±0.5	35.78 <sup>b</sup> ±8.9	
Bouscat	5.75 <sup>a</sup> ±0.5	5.19±0.5	4.38 <sup>a</sup> ±0.5	4.65±0.6	1.93 <sup>b</sup> ±0.5	67.40 <sup>a</sup> ±8.5	
Effect of Maca treatment (T)							
Control	4.66±0.4	3.93 <sup>b</sup> ±0.3	3.79 <sup>b</sup> ±0.3	3.75 <sup>b</sup> ±0.3	2.87±0.4	42.21±6.6	
Treatment	5.60±0.4	5.07 <sup>a</sup> ±0.4	4.85 <sup>a</sup> ±0.4	4.81 <sup>a</sup> ±0.4	3.11±0.4	55.93±7.1	
Effect of interaction (B×T)							
V-line	C	4.00±0.6	3.45±0.6	3.27±0.5	3.27±0.5	3.09±0.7	32.01±11.4
	T	4.36±0.6	4.20±0.6	5.14±0.6	4.37±0.6	3.89±0.7	56.04±10.6
NZW	C	5.27±0.7	4.56±0.6	4.33±0.6	4.22±0.6	3.46±0.7	38.52±12.6
	T	5.67±0.6	4.40±0.6	4.40±0.5	4.40±0.5	3.67±0.6	33.04±12.6
Bouscat	C	4.71±0.6	3.78±0.6	3.75±0.6	3.62±0.6	2.07±0.6	56.09±10.6
	T	6.78±0.7	6.60±0.8	5.00±0.8	5.67±1.0	1.78±0.7	78.70±13.3
Probability							
Breed (B)	0.0282	0.1132	0.9499	0.4375	0.0277	0.0313	
Treatment (T)	0.0711	0.0305	0.0402	0.0377	0.6664	0.1606	
(B×T)	0.3180	0.0826	0.2671	0.3708	0.7298	0.3972	

<sup>A, b</sup> Means with different letters within each column are significantly different ( $P \leq 0.05$ ).

Sig = Significant, Ns= Non-significant, C= Control group, T= Treatment group

The effect of Maca treatment, the obtained findings indicated that the highest value of the number of litter size at 7, 14 and 21 days were recorded in Maca treated group with a significant effect. While the increasing number of litter size at birth and weaning were not significantly. They attributed to the increase of available milk production for kids, which pronouncedly decreased the mortality rate of young kids (Szendro *et al.*, 2002). These results agree with Ruiz-Luna *et al.*, (2005), who reported that the number of pups for female mice treated with 1g Maca /kg BW were remarkably increased than those of the control group. They suggested that Maca

may have a protective effect on the number of resorptions, having a less occurrence of them between day 7 of pregnancy and the subsequent days of pregnancy in the Maca treated group. Similarly, Amstislavsky *et al.*, (2004) reported litter size at birth and at postnatal day 4 in the groups treated with Maca was higher compared with the control group. They attributed this effect to a reduction in embryo resorption since numbers of implantation sites were similar in mice treated with Maca than in controls as well as may be due to any estrogenic activity of Maca, since exposure to estradiol-17 beta or the pro-estrogen methoxychlor reduced litter size. Similarly, Manuel Gasco *et al.*, (2008), said that the number of mice offspring was remarkably increased when Maca was administered. Referring to preweaning mortality rate, the obtained findings showed no significant effect of Maca administration on litter size of rabbits. These results agreed with those of Ruiz-Luna *et al.*, (2005), who found that the pups mortality rate for mice treated with 1g Maca /kg BW were remarkably decreased by about 32.16% than those of the control group.

Effect of interaction, the results in table 4 showed that there were no significant effect due to the interaction between rabbit line and Maca treatment on litter size at birth, 7, 14, 21 and 28days as well as pre-weaning mortality rate.

**Effect of treatments on litter weight of rabbit:**

The results in Table (5) showed that the litter weight at birth for Boscuat rabbit were significantly ( $P<0.01$ ) increased, while the litter weight at 7, 14, 21 and 28 days were insignificantly effecte as compared to those of NZW and V-line. The obtained results indicated that the highest value of litter weight at weaning were recorded in V-line, followed by NZW, while the lowest one was recorded in Bouscat, could reflect the decreased the percent of mortality rat. Also, the increased litter weight of kids at birth for Boscuat rabbit could be attributed to increased ovulation rate and consequently litter size at birth than those of of NZW and V-line. These results agreed with those of Khalil *et al.*, (1987), who found that the increased litter weight of kids could be due to doe effect, which affecting on body weight at birth and up to weaning. Similarly, the results of Azoz and Kholy (2005), indicated that litter weight at weaning for V-line rabbits were insignificantly increased than those of Bouscat rabbits. In contrast, the same authors found that litter weight at birth for V-line rabbits were insignificantly increased than those of Bouscat rabbits. Similar results were also found by Das *et al.*, (2006), who found a significant ( $P<0.05$ ) higher litter size and litter weight at weaning in NZW rabbits than those of the Soviet Chinchilla rabbits.

The results indicated that no significant effect on the litter weight at birth, 7, 21 and 28 days , while at 14 days was insignificantly lower than the control group. These results agreed with Ruiz-Luna *et al.*, (2005), who found that the litter size and weight of mice treated with Maca were remarkably increased than that of the control.

It had no significant effect due to the interaction between rabbit line and Maca treatment on litter weight at birth, 7, 14, 21 and 28 days (weaning).

**Table (5): Litter weight of rabbit progenies affected by line, Maca treatment and their interaction (LSM±SE).**

Breed /treatment	At birth	7 days	14 days	21 days	28 days (weaning)	
<b>Effect of rabbit breed (B)</b>						
V-line	231.67 <sup>b</sup> ±20.0	394.75±36.5	684.01±51.3	995.60±69.6	1267.78±90.5	
NZW	297.03 <sup>a</sup> ±21.7	460.22±38.4	747.82±48.7	1030.42±66.1	1265.94±86.0	
Bouscat	316.71 <sup>a</sup> ±22.2	482.56±46.6	778.00±64.9	972.31±97.4	1199.44±124.8	
<b>Effect of Maca treatment (T)</b>						
Control	265.11±16.9	438.52±31.2	771.85±40.4	952.96±54.9	1168.31±69.8	
Treatment	298.30±17.9	453.17±35.2	701.36±49.6	1045.93±72.8	1320.46±94.7	
<b>Effect of interaction (B×T)</b>						
V-line	C	223.85±28.8	370.00±50.3	582.73±63.9	885.91±86.8	1102.27±112.8
	T	238.93±27.8	419.50±52.8	785.29±80.1	1105.29±108.8	1433.29±141.4
NZW	C	288.64±31.3	484.44±55.7	801.33±70.7	1073.33±95.9	1263.78±124.7
	T	305.42±30.0	436.00±52.8	694.30±67.0	987.50±91.0	1268.10±118.3
Bouscat	C	282.86±27.8	461.11±55.7	931.50±74.9	899.63±101.8	1138.89±124.7
	T	350.56±34.6	504.00±74.7	624.50±106.0	1045.00±166.2	1260.00±216.1
<b>Probability</b>						
Breed (B)	0.0123	0.2751	0.4821	0.8706	0.8900	
Treatment (T)	0.1812	0.7567	0.2767	0.3138	0.2028	

(B×T)	0.6245	0.6112	0.0099	0.2722	0.4279
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<sup>A, b</sup> Means with different letters within each column are significantly different ( $P \leq 0.05$ ). Ns= Non-significant, C= Control group, T= Treatment group

**Effect of treatment on the milk production of rabbit does:**

The results in table 6 showed that there was no significant effect observed between three rabbit lines in milk yield at 1<sup>st</sup>, 2<sup>nd</sup>, 3<sup>rd</sup>, 4<sup>th</sup> weeks as well as daily and total milk production. The obtained results indicated that milk yield for rabbit does during the 1<sup>st</sup>, 2<sup>nd</sup>, 3<sup>rd</sup>, 4<sup>th</sup> wk as well as daily and total milk production, were insignificantly affected by rabbit line. The insignificant variation in milk yield of rabbit doe may be due to breed effects (Cowie 1969). In contrast, the results of Mehaia *et al.*, (2002), found that V-line had significantly increased in milk yield compared to Gabali Saudi rabbits. Also, Lebas *et al.*, (1997) and Rommers *et al.*, (1999) attributed the improve milk production to in V-line does to the ability to produce higher progenies at birth and weaning.

The results indicated that there was no significant effect on milk production of treated rabbit does. Generally, the milk yield of rabbit does were remarkably decreased during the experimental period, which may be due to increased litter size at weaning. The increase of milk production in Maca treatment group reflect the increased of the number litter size in Maca treated group, seemed to stimulate the mammary glands to produce the highest quantity of milk (El-Sayaid, 1994). Moreover increased suckling intensity in large litters may allow the more complete evacuation of remainder milk, through greater oxytocin release due to increased afferent nerve stimulation of the teats (Linzell *et al.*, 1972). Rasambainarivo *et al.*, (2002) found that the cow supplemented with radish at 10-15 kg of cultivated fresh fodder radish/cow per day insignificantly affected compared with the concentrates. They calculated that the rate of decline in milk production was higher for cows fed the concentrates than for those on fodder radish. Assuming that the curves have the same origin the milk production from the radish group was 6% higher than for the cows receiving only concentrates.

It had no significant effect due to the interaction between breed and treatment on the milk production at 1<sup>st</sup>, 2<sup>nd</sup>, 3<sup>rd</sup>, 4<sup>th</sup> wk, daily and total milk production.

**Table (6): Milk production of rabbit does affect by breed, treatment and their interaction (LSM±SE).**

Breed/Treatment	Milk production per week				DMP	TMP	
	1 <sup>st</sup>	2 <sup>nd</sup>	3 <sup>rd</sup>	4 <sup>th</sup>			
Effect of rabbit breed (B)							
V-line	40.36±6.5	67.99±7.3	71.85±10.4	68.35±7.9	51.97±6.0	1455.02±170.1	
NZW	60.33±7.1	60.45±6.9	74.25±9.9	58.27±7.5	63.94±6.6	1679.80±186.5	
Bouscat	41.49±9.5	72.50±10.2	70.16±14.6	65.89±11.1	57.19±8.8	1601.35±249.5	
Effect of Maca treatment (T)							
Control	53.73±5.7	65.94±5.8	71.85±10.4	62.82±6.2	61.96±5.3	1735.56±151.4	
Treatment	41.05±6.9	68.02±7.7	74.25±9.9	65.52±8.3	53.41±6.4	1421.88±181.9	
Effect of interaction (B×T)							
V-line	C	44.81±8.7	66.41±9.1	79.77±13.0	65.63±9.9	56.44±8.1	1580.33±230.3
	T	35.91±9.5	69.57±11.4	63.93±16.3	71.07±12.4	47.49±8.8	1329.70±250.3
NZW	C	73.61±10.5	61.40±10.1	90.00±14.4	64.39±10.9	71.31±9.8	1996.60±276.7
	T	47.05±9.5	59.500±9.6	58.50±13.7	52.15±10.3	56.57±8.8	1363.00±250.3
Bouscat	C	42.78±10.5	70.00±10.7	68.49±15.3	58.44±11.6	58.21±9.8	1629.76±276.7
	T	40.21±15.7	75.00±17.4	71.83±24.9	73.33±18.9	56.18±14.7	1572.94±415.1
Probability							
Breed (B)		0.0959	0.5774	0.9702	0.6384	0.4118	0.6665
Treatment (T)		0.1638	0.8283	0.2897	0.7956	0.3095	0.1908
(B×T)		0.5238	0.9504	0.6088	0.5442	0.8441	0.6070

<sup>A, b</sup> Means with different letters within each column are significantly different ( $P \leq 0.05$ ).

DMP= Daily milk production, TMP= Total milk production, Ns= Non-significant, C= Control group, T= Treatment group

## CONCLUSION

In conclusion, the results of this study supported the body weights of V-line and NZW rabbit does after treating and birth were significantly ( $P \leq 0.01$ ) lower than that of the Bouscat, while the means of daily and total feed consumption were not affected by rabbit breed. The litter size at birth (LSB) of NZW and Bouscat rabbit does were significantly ( $P > 0.01$ ) higher than those of V-line, while the highest value of litter weight at weaning (LWW) were recorded in V-line, followed by NZW, while the lowest one was recorded in Bouscat.

Maca capsule had no effect on the body weights and daily feed consumption of treated rabbit does, while during lactation period were significantly increased than those of the control. The litter size at 7, 14 and 21 days of rabbit does were significantly increased while LSB and LSW were insignificantly increased compared with control group. No significant effect of Maca on milk production and litter weight at birth, 7, 14, 21 and 28 days were not significant influenced than that of the control.

The interaction between rabbit breed and Maca treatment had no significant effect on the body weights, daily feed consumption, the litter size, the litter weight at 7, 14, 21 and 28 days and milk production

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## تأثير تجريع كبسولات الماكا على الاداء الانتاجي لامهات الارانب وعدد الخلفات ونتاج اللبن

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يواجه العديد من مربى الارانب العديد من المشكلات خاصة اثناء موسم الصيف ومن اهم هذه المشكلات انخفاض معدلات الخصوبة وبالتالي الانتاج مما يترتب عليه غياب اعداد الخلفات عند بداية الموسم الانتاجي الجديد وزيادة تكلفة الغذاء المستهلك دون اى عائد انتاجي. كما تعتبر اعداد الخلفات عند الميلاد والقطام اهم المحددات الاقتصادية التي تترتب عليها عملية انتاج الارانب. لذا تهدف هذه التجربة لدراسة تأثير تجريع كبسولات الماكا على معدلات الامساك وعدد مرات التلقيح وانتاج الهرمونات الجنسية لامهات الارانب. فى هذه الدراسة تم استخدام عدد 36 ام من ثلاث سلالات مختلفة وهى الفى-لاين و النيوزيلاندى والبوسكات بمعدل 12 ام من كل سلالة وقد قسمت الى مجموعتين بواقع 6 امهات فى كل مجموعة وقد سميت المجموعة الاولى بمجموعة المقارنة والثانية بمجموعة المعاملة بكبسولات الماكا بتركيز 500 ملجم / ام وقد تم عملية التجريع لمدة اسبوع (يوم بعد يوم) قبل التلقيح باسبوع للبطن الاولى ثم اعادة التجريع بعد ثلاثة ايام من الولادة لمدة اسبوع ايضا للبطن الثانية وهكذا فى البطن الثالثة ز وقد اخذت القياسات التالية : اوزان الجسم وكميات الغذاء المستهلكة لامهات الارانب - اعداد واوزان الخلفات عند الميلاد وعند عمر اسبوع و14 يوم و21 يوم وعند القطام وكذلك كميات اللبن المنتجة لامهات الارانب.

وقد اشارت النتائج الى انخفاض اوزان امهات الارانب لسلاى الفى -لاين و النيوزيلاندى بعد المعاملة والولادة انخفاضاً معنوياً مقارنة بامهات سلالة البوسكات بينما لم تتأثر كميات الغذاء المستهلكة باختلاف نوع السلالة. وقد حققت امهات سلاى الفى-لاين و النيوزيلاندى والبوسكات زيادة معنوية فى اعداد الخلفات عن مثيلاتها لامهات سلالة الفى-لاين. سجلت امهات الفى-لاين يليها النيوزيلاندى اعلى اعداد للخلفات عند القطام بينما سجلت امهات البوسكات اقل الاعداد.

كما اشارت النتائج الى عدم وجود اى تأثير معنوى للماكا على اوزان الجسم ومعدلات استهلاك الغذاء اليومية للمهات المعاملة مقارنة بمجموعة المقارنة بينما لوحظ وجود زيادة معنوية فى كميات الغذاء المستهلكة اثناء مرحلة الرضاعة مقارنة بمجموعة المقارنة. اشارت ايضا لزيادة اعداد الخلفات عند عمر اسبوع و14 و21 يوم لدى الامهات المجرعة بكبسولات الماكا زيادة معنوية بينما لم تتأثر اعداد الخلفات عند الميلاد والقطام معنوياً. لم يتأثر انتاج اللبن بالمعاملة بكبسولات الماكا بينما انخفضت اوزان الخلفات عند الميلاد وعند الاعمر الاثنية و7 و14 و21 و28 يوم انخفاض غير معنوى مقارنة بمجموعة الكنترول.

اما بالنسبة لتأثير التداخل بين نوع السلالة والمعاملة بكبسولات الماكا لم يلاحظ اى تأثير معنوى على اى من القياسات السابقة

يتضح من هذه الدراسة ان للماكا تأثير معنوى بالزيادة على اعداد الخلفات عند عمر 7 و14 و21 يوم بينما لم تتأثر الاعداد عند الميلاد والقطام وكميات اللبن المنتجة واوزان الخلفات عند الميلاد وعند 7 ، 14 ، 21 و28 يوم.