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A STUDY ON SOME FACTORS AFFECTING MILK YIELD IN NEW ZEALAND WHITE RABBITS UNDER EGYPTIAN CONDITIONS

Mahmoud E.A.A
Departments of Animal Hygiene & Behavior and Management, Faculty of Veterinary Medicine, Benha University.

A B S T R A C T

This study was carried out on 50 adult does and 8 adult bucks of New Zealand white rabbit breed with their progeny and extended for about 2 years to study some factors affecting milk yield in doe rabbits under Egyptian conditions. The obtained results showed that food and water consumption were increased significantly $p \leq 0.05$ in lactating does when evaluated during the first two weeks of lactation. The body weight of does rearing litter size less than 7 pups were increased after parturition till the 2nd week then decreased at the 3rd week and re-increased again at the 4th week, while dams rearing litter size more than 7 young were increased in body weight during the 1st two weeks after parturition then decreased during the 3rd and 4th weeks post partum, all changes in the body weight of lactating does were non significant. The male body weight was higher than female at birth and continued higher than female till the time of weaning at 4 weeks of age. Increasing the number of suckling bouts from one to two times daily enhancing significantly the body weight of the suckling pups both male $p \leq 0.001$ and female $p \leq 0.05$ during nursing period. Milk yield was increased significantly $p \leq 0.05$ during winter than summer season and significantly increased $p \leq 0.05$ by increasing dam's body weight and also by increasing the number of suckling bouts form one to two times $p \leq 0.05$ per day. Milk yield differed according to the sex of the suckling pups, it was higher significantly $p \leq 0.0001$ in male kids versus female kids, also it was increased significantly $p \leq 0.05$ by increasing the litter size of the suckling kids.

Key Words: New Zealand white rabbit, milk yield, Egyptian conditions

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1. INTRODUCTION

One of the main interesting points in rabbit production is how to achieve optimum growth rate. Growth in rabbit is mainly affected by the growth gain during suckling period especially during the first three weeks of life, so for successful rabbit production a great interest must be focused on the newborn bunnies especially during their suckling period, which directly affect later on their growth rate. Lactation can be used as an evaluating factor for the reproductive efficiency of the doe. Rabbits milk yield varies according to a number of physiological, inherited and environmental factors (1 and 2). It increases gradually from the 1st week to reach its maximum at the 3rd week, then decreases thereafter ([3], [4], [5], [6] and [7]).

Studying of some factors affecting milk production in rabbit is as important as many deaths and growth disturbances in young bunnies may be occurred due to shortage in milk production.

The aim of this work was to evaluate the effect of the following factors on milk yield under Egyptian conditions to help us

to solve many problems related to milk yield inside the rabbit farms.

1- season of birth
2- number of suckling bouts
3-dam body weight
4- litter size
5- sex of the suckling kids

Dam body weight change, food consumption, growth and growth rate of the young were also recorded during this work to be used for discussing of the obtained results.

2. MATERIALS AND METHODS

This work was carried out at the rabbit research unit, faculty of veterinary medicine, Moshtohor, Benha University to study some factors affecting milk yield in New Zealand white doe rabbits under Egyptian conditions.

A total of fifty does and eight males of New Zealand white breed of rabbits with their progeny were used for this study which lasting for about two years; all experimental animals were apparently healthy and were kept under the same managerial, hygienic and environmental conditions throughout the experimental work

Does and bucks were individually housed in galvanized wire batteries provided with feeders and automatic stainless steel nipples for supplying each cage with a clean fresh water all the time. The does' batteries were also provided with nest box measuring 40X30X30cm for parturition and rearing of the bunnies. To drain off the urine away from the bunnies and nest materials the nest box floor was made of grid.

All batteries were located in an open rabbitry and exposed to natural environmental temperature and photoperiod and ventilated by windows and exhausted fans. Ceiling electric fans were also used when needed.

A commercial balanced pelleted ration was used ad libitum according to the reproductive state of animals.

Each doe showing the signs of receptivity was taken to the buck's cage for mating and then returned back to its cage after being bred.

Mating was assured after 2 successful trials and the day of mating was designated at first day of pregnancy[8]. All mated does were palpated 14 days post mating to determine pregnancy or to repeat mating in case of pregnancy failure.

On the 27th day of pregnancy the nest boxes were supplied with rice straw litter to provide a comfortable and warm place for kindling and rearing of bunnies. Once bunnies were observed for the first time inside the nest box they were examined, counted, sexed and weighed, body weight at this time is regarded as the birth weight.

To study the effect of nursing bouts number /day on the growth of suckling kids during nursing period, the young kids were divided into two groups , the first group was allowed to nurse once daily at 8.00 am while the second group was allowed to nurse twice daily at 8.00 am and 8 pm, the nest boxes were kept closed all the time except at the time of nursing. Body weights of both groups were taken at weekly intervals till the age of weaning at 4 week old.

The traits recorded for each doe were as follows:-

1-Body weight of dams was taken at kindling and at 7, 14, 21 and 28 days post kindling by using a sensitive balance.

2-Food and water consumption were recorded during the 1st and 2nd week of lactation.

3-Milk yield for each doe was recorded at 7, 14, and 21 and 28 days of lactation. For doing this bunnies were separated from their dams at 8.00 pm; thereafter the bunnies were allowed to suckle at 8.00am in the next day. Milk production was calculated as the average of the differences between weight of each doe and their bunnies before and after

suckling (weight-suckling-weight method) as described by [9]. Some factors were tested during this experiment to clarify its role in milk production such as:

a-Effect of dam body weight on milk production.

To study the body weight of the dam as a factor affecting milk production, dams were arranged into two groups according to their body weight, dams having body weight ranged from 2.500-3.000 kg constituted the first group, while dams having body weight more than 3.000 kg up to 3.500 kg constituted the second group .

b-Effect of litter size on the milk production.

To study the effect of litter size on milk yield , dams were arranged into three groups according to the litter size reared by each, the first group reared litter size of 4 young while the second group was allowed to rear litter size of 6 young and the third group reared a litter size of 8 kids.

c-Effect of double suckling on milk production during winter season.

To evaluate the effect of this factor on the milk yield, the nest boxes of tested dams were closed all the time to prevent the dam to enter except at the time of nursing at 8 am and at 8 pm.

d-Effect of season on milk production, milk yield was evaluated during summer and winter seasons and compared with each other.

e-Effect of the sex of the suckling pups.

Young were adjusted under tested dams to be in one sex and the milk yield was evaluated only during the first week after birth.

f-Effect of the age of the suckling kids on milk yield was obtained by measuring milk production weekly till the age of weaning at 4 weeks old. N.B milk yield was estimated by double method during winter season only because I want by this trial to clear out the efficacy of this method versus the other method reported in the literature [9] which determined milk yield after nursing the young only one time from their dam and choose winter season because it is regarded as the natural breeding season in rabbits. Milk yield was estimated only during the first week when testing the effect of the sex of suckling young, litter size and dam body weight on milk yield because the purpose of this trial was to clear out whether these factors are effective or non effective in milk yield so the first week was chosen as a representative to the nursing period

3. RESULTS

Table 1. Food and water consumption during first and second weeks of lactation as affected by litter size reared by the dam

	control	**During 1st week**		**During 2nd week**	
		Dams rearing litter size1-6	Dams rearing litter size7-12	Dams rearing litter size1-6	**Dams rearing litter size7-12**
Food consumption g/100 gm body weight	4.07±0.17a	5.98±0.31^{b}	8.73± 0.11^{c}	7.22± 0.39^{d}	**10.45± 0.26^{e}**
Water consumption Ml/100gm body weight	10.64± 0.54a	15.74± 0.76^{b}	16.04± 0.31^{c}	17.05± 0.91^{d}	**19.26± 0.97^{e}**

Means in the same raw not sharing similar superscripts are significantly different at $p \leq 0.05$

This table showing food and water consumption during the first and second weeks of lactation as affected by the number of suckling kids, obtained results denoted that food and water consumption were increased significantly during lactation period and increased also by increasing the number of suckling kids.

Table 2. Dam body weight change during lactation

	At parturition	At 1 week	At 2 weeks	At 3 weeks	At 4 weeks
Dams rearing litter size 1-6	3243.4[a] ±66.20	3259.6[ab] ±64.13	3306.8[ac] ±66..41	3302.20[ad] ±72.82	3332.5[ae] ±196.37
Dams rearing litter size 7-12	3265[a] ±52.68	3308.93[ab] ±51.69	3338.04[ac] ±59.90	3272.86[ad] ±55.51	3230.36[ae] ±50.94

Means in the same column not sharing similar superscripts are significantly different at p≤ 0.05

this table showing changes in dam body weight due to lactation as affected by the number of reared kids, it is evident from the obtained results that dam body weight was increased during the first two weeks after birth then decreased during the third week then increased again during the fourth week in dams rearing pups less than 6 but continued in decrease during the fourth week in dams rearing litter size more than6, all changed in dam body weight were non-significant.

Table 3. Milk yield as affected by season of birth and number of nursing bouts/day

	1st week	**2nd week**	**3rd week**	**4th week**
Winter Single lactation	78.66± 6.98[a]	121.65± 6.63[a]	213.08± 6.49[a]	117.31±5.26[a]
Winter Double lactation	108.5± 3.03[b]	206.1± 3.67[b]	302.0± 6.46[b]	200.0± 2.58[b]
Summer (Single)	54.89± 2.15[c]	102.86± 2.24[c]	202.6± 6.58[ac]	102.14± 4.15[c]

Means within the same column not sharing similar superscripts are significantly different at p≤ 0.05

it is evident from obtained results that milk yield was increased gradually by increasing the age of the suckling kids reaching the peak at the third week then decreased thereafter during the fourth week. Winter milk yield was significantly higher than summer milk yield. Milk yield in double nursing was higher significantly than single nursing.

Table 4.Effect of dam body weight on the milk yield during the first week of lactation.

Body weight/g	2500-3000	>3000-3500
Milk yield/g	74.00± 4.00[a]	89.00± 6.07[b]

Means in the same raw not sharing similar superscripts are significantly different at p ≤0.05.

It is cleared from obtained results that milk yield was significantly affected by the body weight of the dam, and this provepresence of a positive relationship between dam body weight and its milk production.

Table 5. Effect of litter size on the milk yield during the first week of lactation

Litter size	4	6	8
Milk yield/g	70.58 ±2.15[a]	78.00± 1.59[b]	96.4 ±3.77[c]

Means in the same raw not sharing similar superscripts are significantly different p≤0.01

Obtained results cleared that milk yield was affected by the number of suckling kid, where it was increased by increasing the number of suckling kids as shown in this table.

Table 6. Effect of the sex of the suckling pups on the milk yield during the first week of lactation

Sex	Male	Female
Milk yield/g	82.60 ± 2.11[a]	65.90 ± 1.16[b]

Means in the same raw not sharing similar superscripts are significantly different at p ≤ 0.0001

This table showing that the sex of the suckling kid is an effective factor in milk yield where milk production was increased significantly in male kids versus female kids.

Table 7.Body weight/g and growth rate of young nursing rabbit as affected by the number of nursing bouts

sex	age	At birth	7th day	14th day	21st day	28th day
Male Single lactation	Body weight	72.14± 1.99[a]	167.22± 4.34[a]	277.78± 4.54[a]	375± 4.45[a]	588.33± 12.50[a]
	Growth arte		131.79%	66.12%	34,99%	56.89%
Male Double lactation	Body weight	75.94± 2.02[ab]	205.26± 4.12[b]	326± 5.28[b]	403.33± 4.10[b]	657.33± 14.36[b]
	Growth rate		170.29%	58.82%	23.72%	62.98%
Female Single lactation	Body weight	61.27 1.26[a]	147.17± 5.06[a]	227.67± 6.08[a]	334± 9.37[a]	537.5± 11.27[a]
	Growth rate		140.19%	54.69%	46.70%	60.93%
Female Double lactation	Body weight	60.14± 1.18[ab]	176.67± 1.87[b]	242.67± 5.89[ab]	351± 8.79[ab]	594± 14.44[b]
	Growth rate		193.76%	37.36%	44.64%	69.23%

In male groups, means not sharing similar superscripts are significantly different at $p \leq 0.001$
In female groups, means not sharing similar superscripts are significantly different at $p \leq 0.05$

It is evident from data presented in this table that body weight was higher in males than females and in double nursing than single nursing, growth rate not showed a fixed pattern and not affected by the sex of the suckling kids or the number of suckling bouts.

4. DISCUSSION

Data concerning the amount of food and water consumed by lactating dams during the first and second weeks of lactation as affected by the number of reared kids are presented in table (1). Obtained results revealed that both food and water consumption were increased significantly ($p \leq 0.05$) during lactation, also food and water consumption were significantly affected by the number of reared pups where it was increased by increasing the litter size reared by the dam. The significant Increase in food consumption in lactating dams rearing large litter size versus females rearing small litter may be due to the differences in milk yield as females with large litter produce more milk so need more food to supply energy and nutrient needed for maintaining their

body weight and for manufacturing of milk needed for feeding of their young pups, While increased water consumption during lactation period may be to compensate water loss in milk production. Increasing food and water consumption from the first to the second week of lactation may be due to the increase of both doe body weight and milk production during the second week of lactation than that of the first week as shown in tables (2&4). Obtained results were in agreement with the results of (1) that showed feed intake was correlated to the size of the suckled litter.

It is evident from data present in table (2) that dams body weight were increased during the 1st and 2nd week post partum then decreased during the 3rd week in dams reared different litter sizes, this decrease continued during the 4th week in dams reared litter size more than 6, but in dams rear litter size less than 6 the body weight begins to increase again during the 4th week. Increased body weight during the 1st and 2nd weeks of lactation can be explained from

the 1st table which revealed that food and water consumptions were increased during the 1st and 2nd weeks of lactation, while the decrease in the dam body weight during the third week of lactation may be due to the achieving of the peak of milk yield during this week which need more energy from the dam, hence the lowering in dam body weight. In the 4th week the decrease in the body weight of dams reared large litter size and increase in the body weight of dams reared small litter size may be due to the differences in milk yield between the two groups as milk yield was increased by increasing the number of reared young as shown in table5. All changes in the body weight by increase or decrease were non significant. Our results agreed with those reported by (10) who reported that body weight of does was non significantly different at mating, kindling and at weaning

Many researches used single lactation to estimate milk yield in rabbits but also different reviews (11&12) mentioned that average of suckling /day was estimated as 1.53-1.64 (ranged between 1-6) with duration averaging 210 seconds (11&12) depending upon the previous reviews which mentioned that nursing in rabbits ranged from 1-6 times /day, a trial for using double nursing to estimate total milk yield in rabbits was performed in this experiment beside estimation of milk yield by using of single nursing and compare both results with each other to clear out the efficacy of both methods and this was occurred during winter season which is regarded as the real season for rabbit breeding in Egypt .

The obtained results (table 3), showed that milk yield was significantly increased ($p \leq 0.0001$) in double nursing compared to single one during the whole period of estimation. These results are logic, since giving two chances for suckling pups to nurse is beneficial for activating the mammary glands for more milk manufacturing so increasing the total amount of ingested milk than giving one chance for them. Obtained results agreed with those reported by (13) who mentioned that, kits could consume more milk when does enter the nest more than once per day, and were nearly similar to those obtained by (14& 15) who mentioned that increased suckling intensity in large litters may allow more complete evacuation of remainder milk through greater oxytocin release due to increase afferent nerve stimulation for the teats.

Regarding changes in milk yield as affected by week of lactation, results in Table (3) showed that the peak of milk production was reached during the 3rd week of lactation in both season's summer and winter, while the lowest values were recorded during the 1st week of lactation. Gradual increase in milk production from 1st to 2nd week and achieving the peak at the 3rd week is logic and prove that milk production is associated with the body weight and age of the young, while the drop in milk production at the 4th week of lactation is also logic as the young begins 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 beside milk. These results are agreeable with findings of (3, 4, 5, 6, 7and 13) who mentioned that milk production increases until end of the third week with a peak of 300 g /day, while disagreed with (16) and (17) who found that the peak of milk yield in New Zealand White rabbit was attained at the 2nd week of lactation.

The effect of kindling season on milk production are presented in table (3) obtained data declared that milk production was higher significantly ($p \leq 0.05$) in winter months in both single and double lactation than summer months except during the 3rd week of single lactation where there was an increase in the milk yield during winter months than that of the summer months but this increase was non significant. The significant increase in the milk yield during winter months compared to summer months may be attributed to suitability of the environmental conditions to rabbit production, increase in food consumption (personal observation) and abundance of green fodders during winter months. These results agree with (18) who mentioned that the decrease in milk production during hot climate may be due to

reduce in appetite and food intake and (19) and (20) who found that milk production was decreased in summer than winter under Egyptian conditions. Similar results were also obtained by (7) who found that milk production was higher in winter and spring than other seasons.

The dam body weight was found as an important factor affecting milk production in rabbits, data presented in table (4) proved that increasing body weight of dams had a positive significant effect ($p \leq 0.05$) on the milk production. The obtained positive correlation between milk yield and dam body weight may be attributed to the increase of the mammary gland size by increasing the dam body weight hence the increase in milk production. Our results were agreed with that obtained by (21) and (22) who reported a significant correlation between milk yield and doe weight at kindling. Other studies (9 and 23) found no significant relationship between milk yield and doe weight at kindling.

Litter size at birth was also found to be an important factor determining milk production in rabbit, as increasing the litter size from 4 to 6 then to 8 was associated with a significant increase ($p \leq 0.05$) in the milk production (Table 5), the higher milk production in the does with larger litters might be due to the increase in the amount of milk consumed by increasing the number of young which stimulate the mammary gland to increase its production from milk. The significant effect of litter size on milk yield was also observed by (24, 25, 26 & 27) who reported that milk production increases by increasing the number of suckling rabbits, but the individual milk intake decreases, and by (28) who suggested that the increase in milk production by increasing litter size might be due to a greater tactile stimulation of the does teats by their bunnies which enhancing the milk secretion and the higher suckling intensity by the larger litters might also led to higher release of oxytocin resulting in complete evacuation of residual milk from the mammary glands.

Regarding the effect of sex of the suckling pups on the milk production, it was found from the obtained data (Table6) that milk yield were increased significantly ($p \leq 0.0001$) in does suckling male pups only than does suckling female pups and this was positively reflected on the high body weight recorded in male pups throughout the suckling period (Table 7) where they score a higher body weight than females. However the literatures dealing with effect of sex of the suckling pups on the milk production are unavailable the increase of milk yield by dams rearing only male kits than dams rearing only female kits may be attributed to the increase in male activity versus female and the larger male body weight from the time of birth and throughout the whole period of lactation compared to that of female kits which make male pups to consume more milk as milk production depending upon the body weight of the suckling young (Table3) and thus stimulate more milk secretion by the dams.

Means of the live body weight and growth rate of young pups during lactation period as affected by the sex of suckling pup and the number of nursing bout are presented in table (7) obtained results showed that males body weight were significantly ($p<0.001$) higher in double lactation compared to single lactation. Regarding growth rate, it was higher in double lactation during 1st and 4th week while higher in case of single lactation during the 2nd and 3rd weeks of lactation, regarding females the body weight was higher significantly ($p<0.005$) in case of double lactation during the 1st and 4th week only while higher but non significant during the 2nd and 3rd weeks of lactation, the picture of growth rate in females was similar to that observed in male. It was higher during the 1st and 4th weeks in double nursing , while higher in single lactation during the 2nd and 3rd week of lactation. However the literatures dealing with the live body weight and growth rate of young pups during lactation period as affected by the sex of suckling pup and the number of nursing period unavailable, the increase in the body weight of both sexes in double lactation versus single

one and in males versus females may be attributed to the difference in the amount of milk consumed in both cases (Tables 3and 6).

CONCLUSION : Obtained results can be concluded in the following practical points which may be beneficial for rabbit breeders:

1-doe rabbits with a high body weight are preferred for fostering process due to its high milk production.

2-doe rabbits can be given a litter size up to 8 to rear them during fostering as milk production increased by increasing the number of reared young and this is a suitable number to the number of nibbles.

3-rabbit breeding is preferred during winter months due to high milk production during this time of the year.

4-doe rabbits with a high number of male kids are preferred for fostering process due to high milk production in these females.

5-doe rabbit with large litter need more food compared to female with low litter due to high milk production in large litter size.

6-It is preferred to adjust kids under dams rearing large litter to be unisex because males in large litter with a mixed sex may consume more milk on the expense of female which may led to growth disturbance in females during nursing period.

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كلية معتمدة 2013

دراسة على بعض العوامل المؤثرة على إنتاجيه اللبن في الأرانب النيوزيلاندي البيضاء تحت الظروف المصرية

عصام على احمد محمود
قسم الصحة وسلوكيات ورعاية الحيوان والدواجن، كلية الطب البيطري، جامعة بنها.

الملخص العربي

أجريت هذه الدراسة في مزرعة الأرانب التابعة لكلية الطب البيطري جامعه بنها بغرض التعرف على بعض العوامل المؤثرة على إنتاجيه اللبن في الأرانب ولأجراء هذه الدراسة تم استخدام عدد 50 أنثى وثمانية ذكور من الأرانب النيوزيلاندي الأبيض.

وقد تبين من خلال هذه الدراسة وجود العديد من العوامل التي لها تأثير مباشر على إنتاجيه اللبن في الأرانب ومن هذه العوامل:

1. عدد المواليد التي ترعاها الأم حيث كان هناك تناسب طردي بين عدد المواليد التي ترعاها الأم وكميه اللبن حيث أدى زيادة عدد المواليد إلى زيادة كميه اللبن المنتجة
2. كما كان هناك تأثير لجنس المواليد التى ترعاها الأم حيث كانت كميه اللبن المنتجة في حاله إرضاع الذكور أكبر منها في حاله إرضاع الإناث
3. وزن الأم أيضا وجد له تأثير ايجابي على كميه اللبن حيث زادت كميه اللبن مع زيادة وزن الأم
4. اختلفت كميه اللبن باختلاف أسابيع الرضاعة حيث زادت من الأسبوع الأول إلى الثانى ثم سجلت أعلى معدل لها في الأسبوع الثالث ثم انخفضت فى الأسبوع الرابع
5. كما أدى زيادة عدد الرضعات من مره إلى مرتين إلى زيادة في كميه اللبن
6. كما تبين من الدراسة أيضا إن لفصول السنة تأثير كبير على كميه اللبن حيث زادت كميه اللبن المنتجة في فصل الشتاء عن مثيلتها في فصل الصيف
7. كما تبين من الدراسة أيضا زيادة كميه العلف المستهلكة في الامها ت المرضعة وكانت الكمية المستهلكة فى الأسبوع الثاني اعلى من مثيلتها فى الاسبوع الأول.
8. كما زادت كميه العلف المستهلكة مع زيادة عدد المواليد التى ترعاها الأم
9. تبين أيضا من هذه الدراسة زيادة وزن الإناث والذكور في حاله زيادة عدد الرضعات إلى اثنين عنه في حاله الرضاعة مرة واحده وفى كلا الحالتين كانت الذكور اعلى وزنا من الإناث.

(مجلة بنها للعلوم الطبية البيطرية: عدد 52(2):13-22 ديسمبر 2013)