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EFFECT OF THE AVERAGE KITS BIRTH WEIGHT AND OF THE NUMBER OF BORN ALIVE PER LITTER ON THE MILK PRODUCTION OF ALGERIAN WHITE POPULATION RABBIT DOES

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ABSTRACT

In order to determine the influence of litter size at birth and of the average birth weight of kits on the milk production of does, 153 litters from rabbit does of Algerian White population, were studied during the lactation period (3 weeks following parturition). Milk production of does was estimated by weighing each doe before and after the single daily suckling (3-5mn between the 2 weighing operations). The factors studied were the effect of the number of born alive (5 levels: from 4 to 8 kits) and the effects of the average weight of kits at birth (4 levels: from 30-50g to more than 70g). The rabbit does of White population produced on average 2264 ± 733g in 21 days, that is 108. ± 5.8g of milk/day or 18.7 g/kit and per day. When the number of born alive increased from 4 to 8 kits per litter, the doe's milk production was significantly increased : 475, 664, 668g and 1787g *vs* 663, 908, 983g and 2527g, respectively during weeks 1, 2, 3 and during the whole period for litters of 4 *vs* 8 kits at kindling (P<0.001). Simultaneously the individual kits milk intake in 21 days was reduced by 22%. The average weight of kits at birth affected also significantly the average milk production during the two first weeks or during the whole period. During the first and the second week, milk yield was 28% and 18% larger for females giving birth to heavy kits than for those giving birth to light kits. For the 21 days period the increase was of 18.2% (P= 0.011). For the heaviest kits at birth (70 g & more) the milk intake during the first week was 37% larger than that for the lightest ones (30 to 50 g) but the difference became not significant during the third week of lactation.

Key words: milk production, birth weight, litter size, Algerian White population rabbits

INTRODUCTION

During the three weeks following birth, the young rabbits feed exclusively with milk. The viability of the young rabbit between birth and weaning depends on the milk capacity of the mother on the one hand but also of its live weight at the birth and on the size of the litter from which it results (Toms *et al.,* 1979; Lukefahr *et al*., 1983; McNitt and Lukefahr, 1990).

A previous works (Gacem *et al.*, 2009) had described heavier does and better litter size at weaning for Algerian White population (3434g and 6.09) than for the local population (3278 g and 5.40). This could probably be related to a better milk production capacity of these females. The first study concerning the estimation of the milk production of the Algerian local population does (Zerrouki *et al*., 2005) revealed that the quantity of milk produced during lactation and the quantity of milk consumed by young rabbits varied with the number of kits as it was previously described for other genotypes (Lebas, 1969; Lukefahr *et al*., 1983).

Thus it seemed interesting to estimate the milk capacity of this White population and to estimate the effect of the number of kits born per litter as well as their average individual weight on the milk produced by their mothers during the first 21 days of lactation.

MATERIALS AND METHODS

Animals and experimental design

This study was conducted in the rabbitry of Djebla (Tizi-Ouzou, Algeria), during one year from April 2007 until March 2008. The 142 rabbit does used in this study belonged to the White population described by Zerrouki *et al*. (2007).
The females were housed in individual all wire mesh cages placed on one single level. All females received *ad libitum* the same commercial pelleted diet (16.0% protein and 10.8% crude fiber). Water was always available from automatic nipple drinkers. Lighting was natural. The females were presented to a male at 10 to 12 days after parturition. A nest box was placed in the cage 3-4 days before the expected day of parturition and maintained during all the 21 days of control following parturition. Litters were weighted and litter size determined immediately after birth and then 2 to 4 times per week, during the studied period of lactation (21 days).

After parturition and birth controls, up to 21 days of lactation, does had access to nest box only once a day in the morning, during 3 minutes. Milk production was estimated as the female weight loss during the daily suckling (Lebas and Zerrouki, 2011). Milk intake of kits was calculated as the milk production during a period divided by the average number of kits effectively present at suckling during this period.

Statistical analysis

From a total of 268 litters controlled, only 153 litters were used for calculations in order to have a minimum of 5 litters in each basic case of the factorial design corresponding to each studied litter size and range of birth weight. Recorded data were analyzed according to the factorial experimental design with the two main effects: number of kits born alive (5 levels: 4, 5, 6, 7 or 8), average weight of kits at birth (4 levels: 30-49.9g , 50-59.9g, 60-69.9g and 70g &+). Litters with less than 4 kits or more than 9 kits born alive were excluded, as were those with an average kits birth weight below 30 g . All interactions were included in the statistical model of analysis (GLM procedure proposed by SAS, 1998). In one of series the analyses the female's weight was introduced as covariate. In the different analyses, a possible beginning of gestation after the 10-12 d post-partum mating, was not considered as a potential factor of variation because it's well known that the pregnancy has no influence on milk production during its first half at least (see Maertens *et al.,* (2006) for a review).

RESULTS AND DISCUSSION

Parameters taken in account.

When the weight of the female was introduced as covariate, its effect was not significant for any of the criteria ($P > 0.10$). It clearly means that the studied effects were not related with doe's weight. Thus only results of the factorial experimental design without covariate are presented. Similarly the interactions between litter size and kits weight were not significant, except for milk production during the 2nd week ($P=0.014$), and corresponding to an amplification of the effect of kits weight with 7 kits per litter. Despite this last case, effects of litter size and of kits birth weight are presented separately.

Average milk production.

The milk production obtained in 21 days was 2264g / doe on average, corresponding to an average daily production of 108g/day or a intake of 18.7 g/kit and /day. Total milk production increased with weeks of lactation: 580g the 1st week, 807 during the 2nd week and 877 g during the 3rd lactation week, and the kits milk intake followed the same trend (Table 1).

Table 1. Average milk production observed during the suckling period for 153 litters.

Periods	Milk production (g/doe)		Kits per litter (n)		Kit's milk intake (g/kit))	
	Mean	*standard deviation*	Mean	*standard deviation*	Mean	*standard deviation*
- Week 1	580	*250*	6.15	*1.46*	97	*41*
- Week 2	807	*301*	5.89	*1.48*	140	*50*
- Week 3	877	*375*	5.84	*1.58*	154	*65*
Production in 21 days	2264	*733*	5.96	*1.42*	392	*120*

This total milk production obtained in 21 days with does of the White population was a bit litter higher than that described by Zerrouki *et al* (2005) for the local Kabylian population (2180 g) or by Khalil (1998) in Egypt for the Baladi red (2150 g) and the Baladi black (2180 g). It was just lower than the 2640g described by the same author for the Giza white, but clearly lower than the 3567g observed by Mohamed and Szendrö (1992) for litters of 6 kits of a Californian line selected in Hungary. The relatively low milk production can be related to the relatively small adult weight (3.3 kg) of this population (Zerrouki *et al.*, 2007; Gacem *et al.*, 2009) and partly to the low quality of food distributed (Lebas *et al* ., 2011) and partly of the hot climate which reduces feed intake and milk production as a consequence (Maertens *et al*., 2006).

Effect of the number of kits born alive per litter

Milk quantity produced in 21 days increased with the number of kits born alive per litter (Table 2) as it is generally observed in the rabbit (Lebas, 1969; Zerrouki *et al.,* 2005). Nevertheless, it must be emphasised that if arithmetic maximum milk production of does was obtained in response to litters of 8 born alive, the value was quite identical to that observed with 7 kits and not significantly larger than that observed with only 6 kits /litter, as illustrated on figure 1. During each of the three weeks of lactation, the milk quantity produced per week increased significantly when the number of kits/litter increased. The maximum of production was observed on the second and third weeks with 8 kits at birth (table 2).

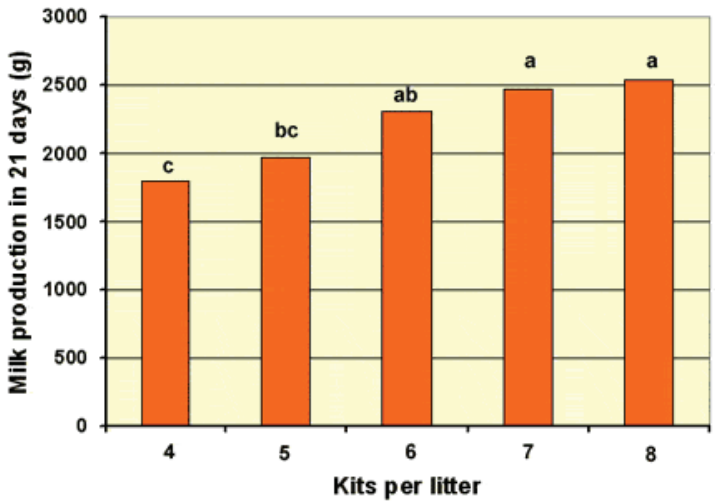

Figure 1 : Average milk production in 21 days according to litter size at birth

Table 2. Effect of the number of kits born alive on milk production.

Kits born alive (n litters)	Milk production (g/doe)				Kit's milk intake (g/kit)			
	week 1	**week 2**	**week 3**	**21 days**	**week 1**	**week 2**	**week 3**	**21 days**
4 (n=24)	475 c	664 b	668 c	1787 c	119 a	165 a	165	450 a
5 (n=24)	513 bc	685 b	765 bc	1963 bc	107 ab	151 ab	164	422 ab
6 (n=26)	568 abc	838 a	889 ab	2294 ab	95 b	141 ab	157	392 abc
7 (n=43)	614 ab	862 a	957 ab	2459 a	88 b	131 b	156	376 bc
8 (n=36)	663 a	908 a	983 a	2527 a	88 b	127 b	138	352 c
Res. Coef.Var.	*41.6%*	*32.9%*	*40.8%*	*28.7%*	*42.5%*	*32.3%*	*43.1%*	*29.1%*
Probability	**0.0087**	**0.0019**	**0.0035**	**< 0.0001**	**0.0419**	**0.0062**	**0.3642**	**0.0186**

a, b c : in a column, with the same letter means are not different P>0.05

For kits, the quantity of milk available per head decrease with the litter size increase. When litter size increased from 4 to 8, the average milk quantity for each young was reduced by 22%. This effect was more important during week 1 (-27%) than during the 2 others (-24% and -17% for weeks 2 and 3).

Zerrouki *et al* (2005) observed a similar increase of total milk yield with litter size of local Kabylian population, until 7 kits. The other works, developed with different lines of selected rabbits such Californian does had observed a similar increase with litter size, but until 10 kits (Mohammed and Szendro, 1992) or 11 kits (Lebas, 1987). Thus, this limited ability to increase total milk production when litter size is higher than 7-8 observed in Algerian population (the White and the local populations) was probably at least related to the Algerian conditions of breeding (climate and quality of feed available).
The decrease of milk intake per kit was still described for example by Lebas (1969) and many following authors. The magnitude of the effect depends mainly on the genotypes studied and of the range of litter size studied by each author (Maertens *et al*, 2006).

Effect of average kits weight at birth

Milk produced until 21 days increased with the average weight of kits at birth (Table 3) independently of litter size. It must be emphasised that maximum milk production capacity of does was obtained for kits weighting more than 70g at birth. Between the litters with the lighter and the heavier kits, during the first week milk production was increased by 28% (P=0.016); during the second week the increase was of 18% (P=0.012); but during the third week the 12% increase was not significant.

This increase of milk production with kit's weight was probably related to a better physiological state of the females giving birth to heavier kits than those producing weak young rabbits at kindling. This better status of the does may be related to their parity number, but this parameter was not included in the present study. The viability of the young rabbit between the birth and weaning depends on the milk capacity of its mother on the one hand but also of its live weight at the birth (Lukefahr *et al*., 1983; McNitt and Lukefahr, 1990) on the other hand. According to the present results, it seems that the young heavy at birth have a better capacity to make the most of the milk capacity of their mother and therefore to improve their own viability.

Table 3. Milk production in relation with the average weight of kits at birth.

Kits birth weight (n litters)	**Milk production (g/doe)**				**Kit's milk intake (g/kit)**			
	week 1	**week 2**	**week 3**	**21 days**	**week 1**	**week 2**	**week 3**	**21 days**
30-50 g (n=40)	520 b	763 b	822	2105 b	87	138 bc	152	376 b
50-60 g (n=51)	573 ab	752 b	853	2178 ab	92	125 c	145	362 b
60-70 g (n=39)	601 ab	865 a	940	2407 ab	101	150 ab	165	416 ab
70 g & + (n=23)	665 a	903 a	921	2489 a	119	164 a	162	444 a
Res. Coef.Var.	*41.6%*	*32.9%*	*40.8%*	*28.7%*	*42.5%*	*32.3%*	*43.1%*	*29.%*
Significance	**0.0159**	**0.0118**	**0.2623**	**0.0108**	**0.0829**	**0.0104**	**0.5799**	**0.0907**

This new way to search factors of variation of the milk production indicated that the kits birth weight influences positively the milk quantity available per kit mainly during the first week: + 37% for heavier kits compared to lighter kits. During the second week of suckling the advantage was only +19% and it was numerically only +9% during the third week, a difference that was not significant.

CONCLUSIONS

As a conclusion it could be considered that the characteristics of the milk capacity of Algerian White population does are:

- an average milk production of 2264g in 21 days, *i.e* 108 g per day.

- an increase of milk production with the number of kits born alive per litter (+41% between litter of 4 and 8 kits). Despite this increase, the quantity of milk available per kit is reduced by 22% on average when litter size is increased from 4 to 8 kits at birth.
- an increase of milk production with the average weight of kit at birth (+18% between extreme weight groups). This effect is observable mainly during the first week after parturition.

The limited ability to increase total milk production when litter size is higher than 7-8 observed in the two Algerian populations: White and local populations, may be related to a possible genetically limited milk production potential. But it could also be related to the Algerian conditions of breeding, especially the discrepancy between does nutritional requirements and the quality of commercial feed provided to lactating does.

REFERENCES

Gacem M., Zerrouki N., Lebas F., Bolet, G., 2009. Comparaison des performances de production d'une souche synthétique de lapins avec deux populations locales disponibles en Algérie. *13èmes Journées Recherche Cunicole, Le Mans, France, 17-18 Nov, 149-152.*

Khalil M.H., 1998. Model for description of rabbit genetic resources in Mediterranean countries. Application to the Egyptian breeds Giza White and Baladi. *Mediterranean rabbit working group, 41 p.*

Lebas F. 1987. Influence de la taille de portée et de la production laitière sur la quantité ingérée par la lapine allaitante. *Reproduction Nutrition Développement, 27, 207-208.*

Lebas F., 1969. Alimentation lactée et croissance pondérale du Lapin avant sevrage. *Ann. Zootech., 18, 197-208.*

Lebas F., Zerrouki N., 2011. Méthodes de mesure de la production laitière chez la lapine. *14èmes Journées de la Recherche Cunicole, 22-23 novembre 2011, Le Mans*, 53-55.

Lebas F., Zerrouki N., Gacem M., Bolet G. 2011. Présentation de la souche synthétique algérienne: Interaction nutrition-génétique et diffusion auprès des éleveurs en Algérie. Conférence INRAA, Alger 7 décembre 2011.

Lukefahr S., Hohenboken W.D., Cheeke P. R., Patton N. M., 1983. Characterization of straightbred and crossbred rabbits for milk production and associative traits. *J. Anim. Sci*. 57: 1100.

Maertens L., Lebas F., Szendrö Sz., 2006. Rabbit milk : a review of quantity and non dietary affecting factors. *World Rabbit Science, 14, 204-230.*

McNitt J.I., Lukefahr S.D.1990. Effects of breed, parity,day of lactation and number of kits on milk production of rabbits. *J. Anim. Sci., 68, 1505-1512.*

Mohamed M.M.A., Szendrö Zs., 1992. Studies on nursing and milk production of does and milk intake and suckling behavior of their kits. *5th World Rabbit Congress, Corvallis, USA, 708-716.*

SAS, 1998 SAS User's guide, statistics, *Version 6.0, Ins, Inc., Cary, NC.*

Toms. A.. Fraga M.J.,. de Blas C.. 1979. Produccion de leche y mortalidad de los gazapos en la raza Neozelandesa. *An. Inst. Nac. Invest. Agrar. Ser. Prod. Anim. 1025.*

Zerrouki N., Kadi S.A., Lebas F., Bolet G., 2007.Characterisation of a Kabylian population of rabbits in Algeria: Birth to weaning growth performance. *World Rabbit Sci., 15, 111-114.*

Zerrouki N., Lebas F., Berchiche M., Bolet G., 2005. Evaluation of milk production of an Algerian local rabbit population raised in the Tizi-Ouzou area (Kabylia). *World Rabbit Sci. 13, 39 –47.*