Effect of Birth Weight and Litter Size on Productive Performance of Rabbits

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ABSTRACT : This study chiefly aims to ascertain the effect of birth weight and litter size on productive performance in rabbits. After delivery kits were removed from their mothers for individual weighing and randomly assigned to one of the following three experimental treatments: Group (KT 6) with six tiny kits (about 45 g) per litter (21 litters); Group (KT 8) with eight tiny kits (about 45 g) per litter (17 litters); Group (KN8) with eight normal kits (about 70 g) per litter (20 litters). The litters, separated from their mothers by putting them in a closed cage, suckled one time a day for 15 minutes. Daily milk production was measured by weighing the does immediately before and after suckling; body weight of kits was measured on a weekly basis. At weaning 60 rabbits per group were raised for six weeks to ascertain post-weaning performance and health. Compared with the two other groups, the kits of group KT8 ingested smaller quantities of milk both during the first 3 weeks (497.7 vs. 520.0 vs. 544.3 g, respectively for groups KT8, KN8, KT6) and the following period (261.3 vs. 285.0 vs. 302.7 g, respectively for KT8, KN8, KT6). The differences between groups KT8 and KT6 were statistically significant ($p<0.01$) in the first period while in the second period also KN8 group showed milk intake different in respect of KT8 ($p<0.01$) and KT6 ($p<0.05$) groups. Solid feed intake was significantly ($p<0.05$) lower in group KT6 (23.1 vs. 26.2 vs. 26.8 g/d, respectively for groups KT6, KN8, KT8). At weaning the kits of group KN8 always weighed more (966 vs. 894 vs. 888 g; $p<0.01$, respectively for groups KN8, KT6, KT8). After weaning, no parameter considered (daily weight gain, feed intake, feed conversion ratio, mortality and risk sanitary index) was affected by birth weight and litter size. ***(Asian-Aust. J. Anim. Sci. 2004. Vol 17, No. 8 : 1158-1161)***

Key Words : Rabbits, Birth Weight, Litter Size, Performance

INTRODUCTION

In rabbits, individual birth weight is about 60-70 grams, but can range from 35-40 to 80-90 grams. Generally, individually birth weight decreases with increase in litter size. Kits of larger litters generally also show a lower weight at weaning than the corresponding weight for kits of smaller litters (Poigner et al., 2000). This is because their weight gain depends on milk intake. Doe's milk production is positively related to litter size (De Blas and Galvez, 1973; Torres et al., 1979; McNitt and Lukefahr, 1989; Sabater et al., 1993; Ayyat et al., 1995). Nevertheless, kits of larger litters consume less milk than those of smaller litters.

This is why after delivery rabbit breeders equalize litters. During the litters equalization, breeders also form litters standardised by birth weight to eliminate the effect of imbalanced suckling by rabbits with different weights: in fact the heavier kits ingest more milk than lighter ones. In this regard, it is necessary specify that the kit intake capacity is much higher than the milk available as reported by Gyarmati et al. (2000). The authors showed that kits suckling milk twice a day from two does increased milk intake by 89%; consequently, weight gain improved and body weight was 70% higher at 21 days of age than kits nursing once a day from their mother.

The aim of this work was to establish whether by reducing the size of litters formed by lighter kits we could obtain similar productive performance at weaning and post weaning to that of rabbits with normal birth weight.

MATERIAL AND METHODS

The test was conducted during the Spring of 2003 on litters obtained from multiparous Hyla hybrid females. After delivery, kits were removed from their mothers for individual weighing and randomly assigned to one of the following three experimental treatments:

Group KT 6 with six tiny kits (about 45 g) per litter (21 litters)

Group KT 8 with eight tiny kits (about 45 g) per litter (17 litters)

Group KN8 with eight normal kits (about 70 g) per litter (20 litters)

Does and kits were housed in a commercial building (in province of Avellino, Italy) with artificial ventilation and a 16 h light-8 h dark schedule. The does were fed *ad libitum* with commercially available pellets (diet D, Table 1), and water was available to the animals from self-drinkers.

To maintain the standard litter size, any kits that died were replaced with suckling rabbits of similar age and weight previously not included in the experiment. The

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Table 1. Chemical composition of diets (g/kg)

Diets	Doe (D)	Weaner (W)	Finisher (F)
Dry matter	905	908	907
Crude protein	178	163	157
Ether extract	36	28	31
Ash	87	92	91
Neutral detergent fibre	310	373	350
Acid detergent fibre	172	206	184
Acid detergent lignin	42	51	45
Gross energy (MJ)	16.5	16.0	16.2

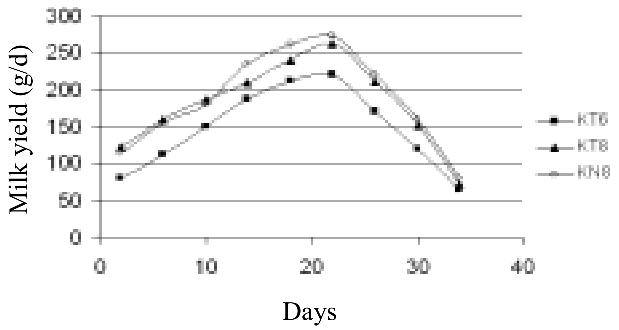

Figure 1. Milk yield (g/d).

litters, separated from their mothers by putting them in a closed cage, suckled one time a day for 15 minutes. Daily milk production was measured by weighing the does immediately before and after suckling; body weight of kits was measured on a weekly basis. From day 18 until weaning (day 35) a weaning commercial diet (Diet W, Table 1) was distributed *ad libitum* to kits. Solid feed intake was recorded from the 18^{th} day of life to weaning.

At weaning 60 rabbits per group were raised for six weeks to ascertain post-weaning performance and health. Hence the rabbits were housed in individual cages on two semi-superposed levels, kept in an experimental room with artificial ventilation and a 12 h light-12 h dark schedule. The rabbits were given *ad libitum* the same feed used before weaning for 3 weeks; then a finisher feed was administered (Diet F, Table 1). Body weight and feed intake were determined once a week. Mortality and the sanitary risk index were recorded daily; the risk index is defined as the sum of mortality and morbility. The criteria used to identify a morbid animal were detection of digestive troubles (signs of diarrhoea) and/or severe disturbance of feed intake, associated with a negative or very low daily weight gain (mean-2 X standard deviation) during one week. Chemical analysis of diets (Table 1) followed the AOAC method (1990) for dry matter (DM), ash, ether extract (EE), crude protein (CP) and crude fibre (CF), and van Soest et al. (1991) procedures for acid detergent fibre (ADF) with a thermostable amylase pre-treatment. Gross energy was determined by adiabatic bomb calorimeters (Parr).

Data were analysed by ANOVA using the general linear procedure (GLM, statistical analysis System Institute, SAS, 1989). The weights at weaning were covariated for live weight at birth (SAS, 1989). When treatments differed, comparisons of the means were tested using the Ryan-Einot-Gabriel-Welsch' procedure (SAS, 1989). Mortality and the sanitary risk index were analysed with the Chi-square method.

RESULTS AND DISCUSSION

Pre-weaning performance

Table 2 reports the variables observed in the pre-weaning period. The birth weight of kits was on average 45.2, 45.5 and 70.3 g, respectively for groups KT6, KT8 and KN8. During the first few weeks of life, a period in which kit intake is almost exclusively milk, the daily gain was 14.2, 13.0 and 14.2 g respectively for groups KT6, KT8 and KN8. These results are due both to doe milk yield (Figure 1) and to litter size.

Confirming the findings of other authors (De Blas and Galvez, 1973; Torres et al., 1979; McNitt and Lukefahr, 1989; Sabater et al., 1993; Ayyat et al., 1995) the females with 6 kits per litter (KT6) produced less milk than the others with 8 kits (5,082, 6,072 and 6,440 g respectively for groups KT6, KT8 and KN8). The 18-21% reduction in milk produced by KT6 does was higher than that (16%) reported by Ayyat et al. (1995) in the same comparison of litter size (6 vs. 8). However, the above authors obtained these results

Table 2. Pre-weaning performance (means) of the three rabbit groups

		Groups			SEM
		KT6	KT8	KN8	
Litters	n.	21	17	20	
Live weight at 1 day	g	45.2^{B}	45.5^{B}	70.3^{A}	2.23
Live weight at 35 days	"	894^{B}	888^{B}	966^{A}	41.39
Daily weight gain (1^{st}-3^{rd} wk)	g/d	14.2^{a}	13.0^{b}	14.2^{a}	0.86
Daily weight gain (4^{th}-5^{th} wk)	"	40.0^{b}	40.7^{b}	42.8^{a}	1.49
Milk intake (1^{st}-3^{rd} wk)	g	544.3^{A}	497.7^{B}	520.0	26.34
Milk intake (4^{th}-5^{th} wk)	"	302.7^{Aa}	261.3^{B}	285.0^{Ab}	14.81
Solid feed intake (4^{th}-5^{th} wk)	g/d	23.1^{b}	26.8^{a}	26.2^{a}	1.66
Mortality (1-35 d)	%	11.9	14.7	10.6	1.05*

$^{A, B}$ p<0.01; $^{a, b}$ p<0.05. * chi square value.

Table 3. Post-weaning performance of the three rabbit groups during the period 35-77 d

		Groups			SEM
		KT6	KT8	KN8	
Rabbits	n	60	60	60	
Initial weight	g	895	886	962	37.59
Daily weight gain	g/d	36.3	36.1	36.4	1.39
Feed intake	g/d	111.2	110.0	111.9	3.30
Feed conversion ratio		3.063	3.047	3.074	0.54
Final weight (77 d)	g	2,432	2,402	2,491	48.24
Mortality	%	5.0	6.7	3.3	0.70*
Health risk index	%	18.3	20.0	15.0	0.53*

* chi square value.

in New Zealand White does which yielded less milk than the does used in our research. Although the milk yield of KT6 does proved lower, their kits were able to ingest more milk as there were fewer of them (6) per litter: in fact individual milk intake of kits in the first three weeks of suckling amounted to 544.3, 497.7 and 520.0 g respectively for groups KT6, KT8 and KN8, significant different between KT6 and KT8 ($p<0.01$). The greater increase (about 9.2%) obtained by reducing litter size from 8 to 6 is borne out by the findings of Szendrò et al. (1996) and Rommers et al. (2000). However, these authors report higher differences (18 and 30% respectively). Moreover, neither of the above works reports milk yield. A similar increase (9.2%) was recorded by birth weight while maintaining the litter size constant. Also in this case, the differences observed by Szendrò et al. (1996) appear about 20% higher. In particular, for kits weighing 40-49, 50-59 and 60-69 g at birth daily weight gains of 12.7, 13.7 and 15.2 g are reported respectively. Also in the last two weeks of suckling, milk intake was significantly ($p<0.01$) higher in group KT6 (302.7 vs. 261.3 vs. 285.0, respectively for groups KT6, KT8 and KN8), although KT6 kits recorded a lower ($p<0.05$) solid feed intake (23.1 vs. 26.8 vs. 26.2 respectively for groups KT6, KT8 and KN8).

These results suggested that lower milk intake stimulates a higher intake of solid feed. Similar results are also reported in other research (Scapinello et al., 1999; Pascual et al., 2001; Nizza et al., 2002). In this period, the kits whose birth weight was about 70 g (KN8) supplied a higher ($p<0.05$) daily gain than the two other groups (42.8 vs. 40.0 vs. 40.7 respectively for groups KN8, KT6 and KT8). The daily weight gain recorded in the two periods affected weight at weaning which was higher in kits from group KN8 than those of the two other groups (966 vs. 894 vs. 888 g respectively for groups KN8, KT6 and KT8). The difference between the groups was statistically significant even after covariated weights at weaning for live weight at birth. The weaning weight of rabbits that had a birth weight of about 45 g (groups KT6 and KT8) appears fairly high and definitely falls within the averages reported by other authors for the same weaning age (Nizza et al., 1995; Fernandez Carmona et al., 1998; Heinzl et al., 2000; Nizza et al., 2001).

The high weight reached by individuals of groups KT6 and KT8 suggested that they are able to ingest all the milk yield from the mother and hence achieve sufficient daily gains. The intake capacity of kits is known to be much higher than the mother's milk availability. In this regard, McNitt and Moody (1988) and Gyarmati et al. (2000) showed that kits can suckle twice a day from two does and achieve almost double the intake of rabbits that are suckled only by their mothers. Mortality rates observed until weaning did not differ significantly among groups (11.9 vs. 14.7 vs. 10.6%, respectively, for groups KT6, KT8 and KN8). These results indicate that neither individual birth weight nor litter size affects the mortality rate. Similar results are reported by Szendrò et al. (1996) only for litter size. This authors report in the first three weeks of life mortality rates equal to 6.8 and 10.2% respectively for a litter of 6 to 8 kits and in the first six weeks 13.6 and 13.9% respectively per litters of 6 to 8 kits. Depending on birth weight, the same authors report significantly different mortality rates in the first three weeks (20.0 vs. 12.7 vs. 7.4% respectively for kits of 40-49, 50-59 and 60-69 g). It is concluded that birth weight proved to be significant only during the suckling period, particularly during the first week of life and in the case when low-weight rabbits at birth are reared in large litters, a common situation under natural circumstances.

Post weaning performance

The variables measured in the post-weaning period are reported in Table 3. The daily weight gain was on average 36.3 g, with no significant differences between the groups. Similar results are reported by Szendrò et al. (1996) in the 6-10 week period. Rommers et al. (2000) also report similar daily gains from weaning until first mating in does of different litter size before weaning (6 and 9 kits/litter). Also the feed intake (average 111 g) and hence the feed conversion ratio (average 3.06) showed no statistically significant differences and fall within the range of values reported in the literature (Fernandez-Carmona et al., 1998;

Muriu et al., 2002; Taranto et al., 2003). Final live weight, which was higher in kits of group KN8 as they were heavier at weaning, showed no significant differences when it was covariated for the post-weaning weight.

Mortality observed in this period was low (average 5%) and not affected by the experimental design. Moreover, Szendrò et al. (1996) report no significant effects of litter size and birth weight on mortality for the same period. Indeed, after weaning there are many factors that may affect mortality: of these a prime role is played by the building's environmental and sanitary conditions. The sanitary risk index also remained at acceptable levels (average 17.8%) and there were no significant differences between groups.

CONCLUSIONS

The results obtained in our study suggest that birth weight, despite affecting weaning weight, does not result in very great differences in this parameter. Differences are limited to 100 g, a range normally found between winter and summer, between kits of primiparous and multiparous does, etc.

Secondly, reduction in the size of lighter litters from 8 to 6 kits does not improve productive performance as rabbit does reduce their milk yield. Finally, after weaning, birth weight and litter size do not affect either livestock variables or mortality.

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