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SHORT REPORT

Growth rate of sucking chinchilla pups and lactating performance of their dams

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In a study on the ability to produce milk by chinchilla dams and growth rate of their offspring from litters of different sizes, the mean birth weight of a neonate was 60.4 g (SD=15.2). Pups born as singles had the highest mean birth weight – 72.2 g (SD=16.9) – compared to 59.5 g (SD=12.6) of individual twins and 49.3 g (SD=5.9) of individual triplets. Pups born as singles were also characterized by the highest body weight gain. The milk yield of dams over the first three weeks of lactation varied depending on litter size and amounted to 281.1, 468.3 and 518.19 g per female with one, two and three pups, respectively. Pearson's correlation coefficients showed the strong relationship between the milk yield and litter weight on day 14 of lactation (r=0.8; P<0.001).

KEY WORDS: body weight gain / chinchilla / litter size / litter weight / lactating performance / milk yield

Chinchillas are highly original fur animals not often bred in cages. Many of their living requirements remain unknown, leading to numerous mistakes in rearing. Among the least recognized aspects of chinchilla breeding and production are the period of lactation and early rearing of pups.

Chinchillas are born after a gestation period of about 111 days, and the neonate's weight ranges from 30 to 110 g depending on litter size. Two or three pups are

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usually born in a litter. According to Lanszki [1996] and Seremak [2007] the first two weeks postpartum are considered critical for young chinchillas because of possible developmental abnormalities, irregularities in body condition, bitings and injuries. This period is also characterized by the highest mortality which may result from poor vitality, colds leading to pneumonia, or lack of milk in sucking dams [Brach and Bieniek 2003]. During the first days of their life, it is essential that pups consume as much colostrum and mother's milk as possible, as it affects their health and survival rate. Colostrum provides passive immunity to young chinchillas, also known as maternal immunity, persisting over a short time. It is only after 3-4 weeks of age that chinchilla pups gain their own immunity [Brach i Bieniek 2003, Barabasz and Dzierżanowska-Góryń 2005]. Lactation usually lasts 6-8 weeks. Pups show a relatively early interest in solid feed given to their dams and begin to nibble it as early as 20-21 days after birth while growing very fast [Barabasz 2001].

In light of the important role of dam's colostrum and milk in the first weeks of neonatal life and its effect on survival and growth rate, the present study was performed to determine the volume of milk secreted by chinchilla dams and its effect on the growth of their pups.

Material and methods

The study was carried out in 2006-2007 on Standard chinchillas originating from a large breeding farm in southern Poland. A total of 36 foundation stock females and their 60 offspring were investigated. Females were divided into three groups, depending on litter size (delivering single, twin and triplet litters). All animals were kept in standard wiremesh cages commonly used in Poland and were fed complete pelleted feed containing 18.4% protein, 2.8% fat and 12% fibre.

The whole litter delivered was weighed on the day of birth and then at the age of 7, 14, 21, 28, 35, 42, 49 and 56 days. Indirectly, based on weight gain from birth to day 21 of age (*i.e*. during the period when the offspring took exclusively their dams' milk) and assuming that per 1g body weight gain 3 g of milk are used, the dam's milk yield was estimated based on the following formula given by Kawińska *et al*. [1979], Grudniewska [1982] and Kowalska [2003]:

$$M = (C_2 - C_1) \times 3$$

where:

M – coefficient of milk yield in a female;

C_1 – litter weight (g) at birth;

C_2 – litter weight (g) on day 21 postpartum.

In addition, the activity of mammary glands was visually assessed in dams.

Tukey's test was used to identify the significance of differences between the weight gain of young chinchillas from litters of different size (single, twin and triplet

litters) aiming at comparing females for their milk yield. The Pearson correlation coefficients between the body weight in offspring on day 14 of life and the coefficient of milk yield (M) in females were estimated using the StatSoft STATISTICA 6.0 package [2001].

Results and discussion

Out of a total of 36 females, 17 (47%) gave birth to litters with a single pup, 14 (39%) to litters with twins, and 5 (14%) to litters with three pups (mean was 1.67 pups per litter). According to Neira *et al*. [1989], most chinchillas deliver one pup (47.2%), followed by two (29.7%), three (7.6%) and four pups (0.6%) in a litter. The same authors reported that 14.9% of the females in the analysed group delivered no pups at all.

The present observations showed that mean litter weight increased with increasing litter size. The birth weight of a litter with one pup was 72.2 g (SD=16.9), that with two pups – 119.1 g (SD=24.8), and with three pups – 148.0 g (SD=19.1). The situation was inverse when the mean body weights of individual animals were compared: animals from single litters were the heaviest, and those from triple litters – the lightest (Tab. 1).

Significant differences in the body weight of pups between single and triple litters were found throughout the lactation period. Between pups from single and twin litters, significant differences occurred in the first period of lactation. However, when pups began supplementing their diets with solid feed, the differences decreased at day 28, 35 and 49 of life. The mean body weight of pups from twin litters differed significantly from those of triple litters on day 14, 21 and 28 of life, which can be related to the competition for nipple access. The lack of significant differences in the later period can be attributed to the fact the pups went on the solid feed and there was body weight compensation in pups from triple litters.

Wide variation occurred in neonatal pups' body weight (from 34 to 110 g) with the mean of 60.4 g (SD=15.2) – Table 1. Considerable inter-individual differences in chinchilla birth weight were reported by many authors. Barabasz [2001] showed that pups' neonatal body weight can range from 30 to 70 g depending on litter size. Barabasz and Dzierżanowska [2005] reported the mean birth weight in chinchilla to reach 48 g, while other authors suggested that it should approximate 50 g with no reference to litter size.

Comparison of weekly body weight gains (Fig. 1) showed no significant differences in the majority of cases. The differences only occurred between the mean body weight gain of triple litter at week 5 (the highest litter weight gain of 94.2 g) and the mean weight gain of a litter with a single pup after 2, 4, 5, 6 and 7 weeks of life. Significant differences were also found between the body weight gain of a litter with a single pup after 5 weeks of rearing (the lowest litter weight gain of 25.3 g) and the weight gain of triple litter at week 7 of life (Fig. 1).

Table 1. Means and their standard deviations (SD) for body weight of growing chinchilla pups depending on litter size, by day of their dam's lactation

Litter size (no. of pups)		Day 1	Day 7	Day 14	Day 21	Day 28	Day 35	Day 42	Day 49	Day 56
1	mean weight (g)	72.2^{ab}	104.7ab	131.9^{ab}	165.9^{ab}	195.9^{b}	220.4^{b}	252.3^{ab}	272.5^{b}	310.0^{ab}
	SD	16.9	18.7	27.7	28.8	31.2	31.7	28.9	36.3	34.8
2	mean weight (g)	59.5^{a}	77.5a	107.8^{ac}	137.6^{ac}	169.8^{c}	191.0	207.5^{a}	248.8	239.3^{a}
	SD	12.6	16.5	25.8	33.1	39.9	43.4	53.0	39.4	69.4
3	mean weight (g)	49.3^{b}	65.5b	85.0^{bc}	106.9^{bc}	129.1^{bc}	160.5^{b}	189.2^{b}	218.8b	230.8^{b}
	SD	5.9	9.4	7.8	11.9	13.9	25.1	34.9	34.2	42.9
Total	mean weight (g)	60.4	81.9	108.5	137.6	166.4	190.2	214.0	243.0	265.9
	SD	15.2	21.6	28.7	35.1	40.6	41.9	48.5	41.7	48.5

^{abc}Within days of lactation means for litter size bearing the same superscript differ significantly at P≤0.05.

Table 2. Means and their standard deviations (SD) for body weight gains of growing chinchilla pups depending on litter size, by weeks of their dam's lactation

Litter size (no. of pups)		Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8
1	mean gain (g)	32.5	27.2	33.9	30.0	25.5	30.8	26.7	41.4
	SD	12.1	13.7	13.1	11.0	10.5	10.5	14.6	20.5
2	mean gain (g)	17.9	30.3	33.5	28.6	21.2	20.4	32.1	23.7
	SD	15.3	13.6	23.5	13.3	16.1	9.6	12.1	8.8
3	mean gain (g)	16.1	19.5	21.9	22.2	31.4	28.7	29.6	17.7
	SD	5.1	4.3	10.8	9.4	18.8	11.3	4.5	15.5
Total	mean gain (g)	21.6	26.8	30.6	27.4	25.2	25.7	29.8	28.1
	SD	14.2	12.6	18.6	11.9	15.9	11.2	10.6	19.1

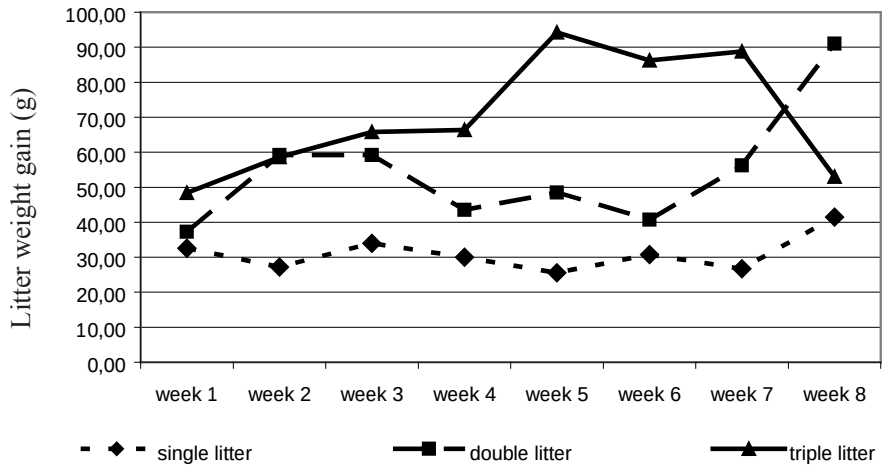

Fig. 1. Weekly weight gains in litters of different size.

In terms of a pup, mean weekly body weight gain for the entire period of the study was 26.6 g (SD=14.5). Comparison of mean weekly body weight gain in terms of one pup showed significant differences between pups from litters with a single pup at week 8 of rearing (41.4 g) and those from triple litters at week 1 (16.1 g) and 8 (17.7 g) and pups from twin litters at week 1 (17.9 g) – Table 2.

The highest body weight gain per animal was observed in litters with single pups born, showing always the highest weight gain from birth to weaning. The lowest body weight in terms of one animal at birth and weaning was always characteristic of animals from litters with three pups. Likewise, these pups were characterized by the lowest weight gain from birth to weaning.

The higher body weight of pups born and reared as singles may result from the fact that they did not have to compete for nipple access. The situation was completely different when the litter had three pups. In that case, the lower body weight of an individual was usually the consequence of competition among the pups. Another possibility is that the dam that has to suckle three pups secretes relatively less milk per pup than the dam with just a single pup. Growth compensation in pups with lower birth weight was only observed after the third week of lactation. This was particularly noticeable in pups from twin and triple litters. The mean weaning body weight of a pup was 310 g for litters with singles, 239.3 g for twin litters and 230.81 g for triple litters. Similar observations were made by Barabasz and Dzierżanowska [2005]. In their study chinchilla pups were weighed at weekly intervals until day 84 of life and the successive weekly weight gains were 16.5, 19.5, 21.0, 26.0, 104 and 90 g. The mean birth weight of a pup reported by the same authors was 48 g, with weaning weight 325 g. Those figures are similar to results reported here for a single chinchilla per litter. For double and triple litters, the weaning weight was lower. According to

Neira *et al*. [1989] and Gromadzka-Ostrowska [1998] chinchilla pups can have higher weaning weight of as much as 450-500 g depending on sex, because older females reach higher body weight than do older males.

Another parametre studied was the absolute milk yield (M) of a dam, calculated on the basis of pups' weight gain from birth to day 21 of life, when dam's milk is their only feed. In the present study the highest M was found in dams suckling a litter of three pups. It was by 84% higher than in females suckling litters of one pup and 11% higher than in females with litters of two pups (Tab. 3). This can be explained by the fact that the dam with a greater number of pups has to yield more milk to feed them. Conversion of these volumes into one suckled pup shows that most milk is taken by pups born as singles.

Table 3. Means and their standard deviations (SD) for estimated milk yield of chinchilla dams depending on litter size

Litter size (no. of pups)		Litter weight (g)		Gain in litter weight during 21 days (g)	Estimated milk yield during 21 days (g)
		on day of birth	on day 21		
1	mean (g)	72.2	165.9	93.7	281.1
	SD	17.5	29.7		
2	mean (g)	119.1	275.2	156.1	468.3
	SD	24.8	64.9		
3	mean (g)	148.0	320.7	172.7	518.1
	SD	19.1	38.5		

Volcani *et al*. [1973] administered oxitocin 2 h postpartum and collected milk from females a minute later. From dams with two active nipples 1-2 ml of milk was obtained. The cited authors concluded that this is a volume that may reach the pups at one time (*i.e*. at one sucking). The highest milk yield was observed on day 2 and 3 postpartum, when animals used 3 g of milk per g of body weight gain. The milk yield of females is determined genetically, but can also change under the influence of nutrition, age of female, and season of the year. According to Volcani *et al*. [1973] chinchilla female during 27-28 days of lactation yields 0.3-0.6 kg of milk.

The correlation calculated between the litter weight at the age of 14 days and the estimated milk production of females showed that these two parametres are strongly related (r=0.80; P<0.001) – Figure 2.

The correlation between litter weight on day 14 of life and milk yield in chinchilla females was also reported by Rozempolska-Rucińska *et al*. [2006]. Such correlation enables early selection of chinchillas for increased body weight of the offspring, simultaneously increasing the milk yield in dams.

The observation of activity of mammary gland showed that the number of active nipples in females depended largely on litter size. When there was only one pup in a litter, two front nipples were most often active. One of the nipples was usually larger

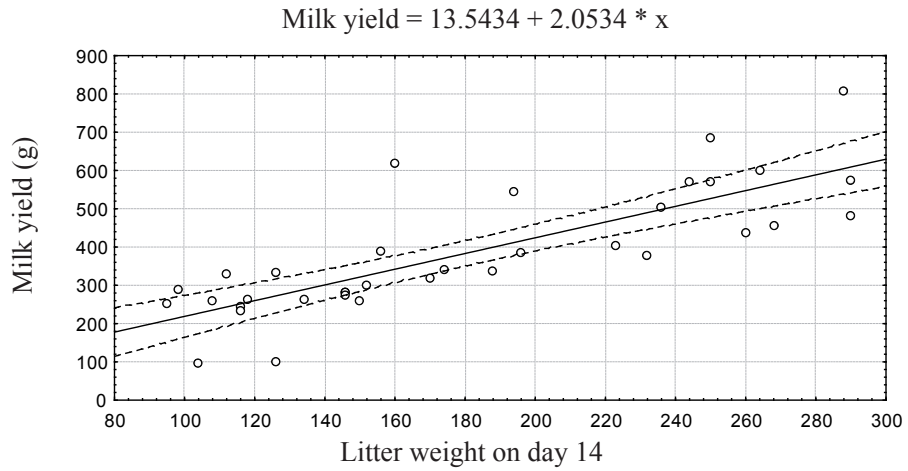

Fig. 2. Correlation between litter weight on day 14 and milk yield of females (r = 0.80; P<0.001).

than the other, possibly indicating that it was used by the pup. When there were two pups in a litter, the first two nipples were most often used. When the number of active nipples equalled the number of pups in a litter, there was no fighting for nipple access. Pups from those litters were most often of the same size. Sometimes, a female with two pups had three or just one active nipple. In the former situation, pups most often used the first two nipples. However, when only one nipple was active, pups began to compete for nipple access. The same situation was observed when a female with three pups had only two active nipples. In that case, one of the pups had already been smaller and usually bitten. For a litter with three pups, a female activated four of its 3 nipples. Upper nipples were active the longest and bottom nipples the shortest.

Summarizing, the results presented here show that highest birth weight of pups occurred in litters containing one pup (mean body weight 72 g). Growing chinchillas from larger litters showed growth compensation from the time they went on a solid feed. The highest body weight gain in pups and the highest milk yield per pup were found in females that suckled a litter of only one pup. Litter weight on the day of rearing was strongly correlated with milking yield of females and can be used in the future for selection of females. The number of active nipples reflected the number of pups in a litter.

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Ocena mleczności samic i przyrostów masy ciała ssących szynszyli

S t r e s z c z e n i e

W badaniach nad mlecznością samic i masą ciała młodych szynszyli z miotów o różnej liczbie osesków (1, 2 lub 3) średnia masa ciała noworodka w pierwszym dniu po urodzeniu wynosiła 60,4 g (SD=15,2). Młode z miotów liczących jednego noworodka charakteryzowały się w pierwszym dniu po urodzeniu największą średnią masą ciała 72,2 g (SD=16,9), podczas gdy średnia masa noworodka w miocie bliźniaczym wynosiła 59,5 (SD=12,6), a w trojaczym 49,3 (SD=5,9). Młode z miotów liczących jednego noworodka cechowały się także największymi przyrostami. Oszacowana mleczność wskazała, że w pierwszych trzech tygodniach laktacji samice z jednym, dwoma lub trzema oseskami w miocie produkowały odpowiednio 281,1 g, 468,3 g i 518,2 g mleka. Współczynnik korelacji Pearsona obliczony dla 14 dnia laktacji między mlecznością samicy a masą miotu wykazał, że są to cechy silnie ze sobą skorelowane (r=0,80; P<0,001).