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# EFFECT OF NUMBER OF KIDS ASSIGNED ON MILK PERFORMANCE OF THE DOES DEPENDING ON THE LITTER WEIGHT AT BIRTH

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SUMMARY - A two factorial experiment using 88 hybrid does of different age was undertaken to quantify the effects of litter weight at birth (<450, 450-650 *vs.* >650 g) and number of kids assigned (7, 8 or 9 kids per doe) on milk performance of the does and milk intake and growth performance of the kids. Litters were balanced out completely. Milk performance of the does were measured by weighing the does before and after sucking twice per week during the first three weeks of lactation. Body weight development and milk intake of the kids were measured by weighing the kids frequently. Litter weight at birth and number of kids assigned influenced milk performance of the does significantly. Special attention is given to a significant interaction between both factors under investigation. Milk performance of does with high litter weight at birth (≥ 450 g) is strongly influenced by the number of kids assigned, whereas no effect was found in does with litter weight at birth below 450 g.

Key words: *milk intake, milk performance, litter size, litter weight, balanced litter, rabbit doe*

*RÉSUMÉ - Une expérience bifactorielle utilisant 88 lapines hybrides d'âges différents a été entreprise pour mesurer l'effet du poids de la portée à la naissance (<450, 450-650 vs. >650 g) et du nombre de lapereaux affectés (7, 8 ou 9 lapereaux par nourrice) sur la production de lait de la lapine et sur la consommation de lait et la croissance des lapereaux. Les portées était équilibres complètement. La production de lait des lapines était mesurée en pesant les lapines avant et après l'allaitement deux fois par semaine pendant les trois premières semaines de la lactation. Le développement du poids et la consommation de lait des lapereaux étaient mesurés en les pesant fréquemment. Le poids de la portée à la naissance et le nombre des lapereaux affectés exercent une influence significative sur la production de lait de la lapine. Une attention particulière est donner à l'interaction des deux facteurs à l'étude. Le nombre des lapereaux affectés exerce une forte influence sur la production de lait des lapines à haut poids de la portée à la naissance (≥ 450 g), tandis qu'on n'a pas trouvé d'influence de ce facteur sur les lapines ayant un poids de portée au dessous de 450 g.*

*Mots-clés: consommation de lait, production de lait, la taille de la portée, le poids de la portée, lapine*

## INTRODUCTION

The milk production of does is influenced by many factors. Several authors point out that both the litter weight at birth and the number of suckling kids influence the milk production strongly. With increasing litter weight at birth the milk production increases as consequence of the uterine induction. Likewise the milk production of does can be increased by the number of suckling kids (Bolet *et al.*, 1996; Petersen *et al.*, 1996). The fact that milk production might be limited by additive gene effects (Ayyat *et al.*, 1995; Lukefahr *et al.*, 1996) and being positively correlated to the litter weight at birth (Lukefahr *et al.*, 1983; Khalil, 1994; Petersen *et al.*, 1996; Singh, 1996), permits the assumption that the effect of the number of assigned kids to the nursing doe on milk production is not independent on the litter weight at birth. In the present study interaction effects between litter weight at birth and the number of assigned kids on milk production of the does are investigated and practice-oriented conclusions are summed up.

## ANIMALS AND METHODS

In a two factorial experiment about 50 hybrid does of different age were used for six consecutive trials in 1997/98 and provided data of 88 litters and 696 kids. In each trial about 10 % of the does were replaced and a total of 32 does were inseminated. Terminal cross does of different age of the origin ZIKA, which were inseminated with mixed sperm by ZIKA bucks were used. On day 32 after the insemination all kids were removed from all does. All kids were individually weighed and divided within each litter after the median of the litter into two weight classes called "small" and "large" kids. Then the nursing does were divided randomly into 9 groups by litter weight at birth (<450, 450-650 *vs.* > 650 g) and number of kids to be assigned (7, 8 or 9 kids per doe) and received approximately half of the litter "small" and "large" kids. Within the "small" and "large" class the kids were selected at random. Litters were balanced out completely. Thus litters with similar mean and variance in the individual birth weight of the kids were reared. Some additional does were kept to rear replacement kids to maintain the experimental design up to day 35.

Milk performance of the does and milk intake and growth performance of the kids were measured. The milk production was determined twice per week in the first three weeks of the lactation, after preceding 24-h separation from the kids by weight difference of the doe before and after the suckle. The lactation period lasted 35 days. The body weight of the kids was taken at birth and at weekly intervals. The husbandry conditions were in accordance with the recommendations of the German group of the WRSA for intensive rabbit production (Vásquez *et al.*, 1997).

## RESULTS

Weekly mortality of the kids from the 1st to the 5th week of life were very low (4.2, 1.3, 0.5, 0.3 and 1.0 % resp.). No clear differences showed up in the mortality rates of the kids within the two examined factors. In contrast both the litter weight at birth and the number of suckled kids affected the milk production of the does, the individual milk consumption as well as the daily gain of the kids in the first three weeks of life (figure 1). In the present experiment only very large litter weight at birth of the nursing doe, i.e. more than 650 g significantly increased milk production whereas no significant difference was found between small and medium litter weight at birth. Between both factors an interaction effect on milk production in the 2nd and in the 3rd lactation week, as well as for the entire milk production in the first three lactation weeks was determined ($p<0.05$; table 1). In the 1st lactation week the same tendencies were observed, however the interaction was significant at the $p<0.10$ level only.

For does with a litter weight at birth of less than 450 g no improvement of the milk production by increasing the number of assigned kids was found. In contrast the milk production of does, with litter weight between 450 and 650 g was significantly improved by assigning 8 or 9 kids. For does with more than 650 g litter weight at birth similar tendencies could be observed as in the medium litter weight group.

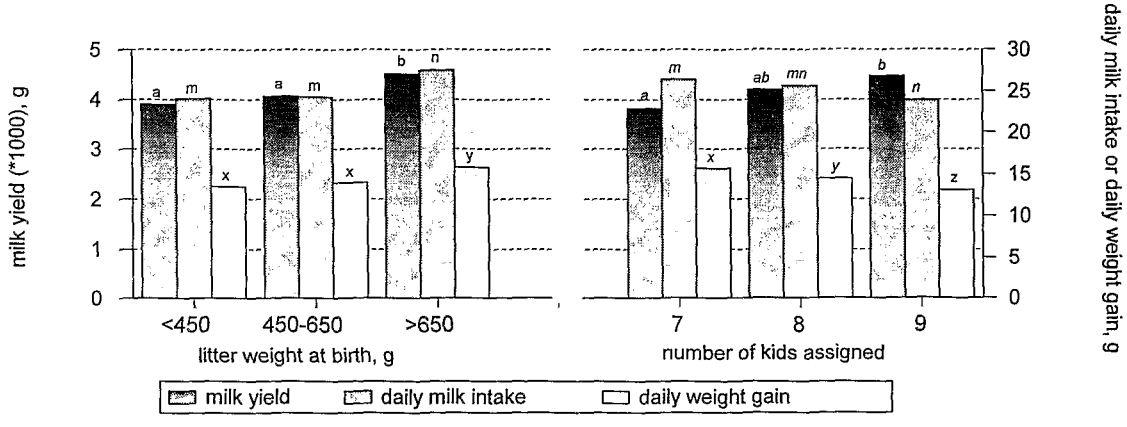


Fig. 1. Effect of the litter weight at birth and the number of assigned kids on the milk yield, individual daily milk intake and daily weight gain of young rabbits in the first three weeks of the lactation

The average individual daily milk consumption (TIMV) of the kids can be calculated on the basis of the milk production of the does and the number of suckled kids. For kids reared by does with less than 450 g litter weight at birth individual daily milk consumption (1st to 3rd wk) is significantly reduced by 24 % if the number of assigned kids per doe is increased from 7 to 9. No clear influence on this trait was observed for does with higher litter weight at birth (table 1).

Table 1: Effect of the number of assigned kids on the milk production of does dependent on the litter weight at birth, LSM in g

| Trait | Signifi-cance of the interaction | $\sqrt{MSE}$ | Interaction (litter weight at birth × number of kids assigned) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | <450 g | | | 450-650 g | | | >650 g | | |
| | | | 7 | 8 | 9 | 7 | 8 | 9 | 7 | 8 | 9 |
| *n* | | - | *11* | *7* | *8* | *13* | *15* | *10* | *10* | *6* | *8* |
| ML*1* | + | 223 | 928$^{a}$ | 936$^{a}$ | 858$^{a}$ | 819$^{m}$ | 1040$^{n}$ | 1179$^{n}$ | 998$^{x}$ | 1020$^{x}$ | 1306$^{y}$ |
| ML2 | ** | 215 | 1402$^{a}$ | 1358$^{a}$ | 1355$^{a}$ | 1170$^{m}$ | 1531$^{n}$ | 1557$^{n}$ | 1418$^{x}$ | 1520$^{xy}$ | 1782$^{y}$ |
| ML*3* | ** | 275 | 1667$^{a}$ | 1565$^{a}$ | 1631$^{a}$ | 1362$^{m}$ | 1792$^{n}$ | 1740$^{mn}$ | 1691$^{x}$ | 1815$^{x}$ | 1976$^{x}$ |
| ML*1-3* | ** | 625 | 3997$^{a}$ | 3859$^{a}$ | 3844$^{a}$ | 3351$^{m}$ | 4364$^{n}$ | 4476$^{n}$ | 4108$^{x}$ | 4346$^{x}$ | 5064$^{x}$ |
| TIMV*1-3* | ** | 3,8 | 27,6$^{a}$ | 23,7$^{ab}$ | 20,9$^{b}$ | 22,9$^{m}$ | 26,2$^{n}$ | 23,9$^{mn}$ | 28,6$^{x}$ | 26,9$^{x}$ | 27,0$^{x}$ |

Significance: + p≤0.10; ** p≤0.01; MLx: milk production in the x$^{th}$ lactation week, TIMV1-3: daily individual milk intake in the 1$^{st}$ - 3$^{rd}$ lactation week, LSM: Least Square Means $\sqrt{MSE}$: Root of " Mean Square error ". Means with different letters in a row within litter weight class are significantly different from each other (p≤0.05), *n*: number of litters.

The interaction effect between litter weight at birth and number of suckled kids on weight gain of the young rabbits up to the 3rd wk of life was highly significant (p<0.001). Weight gain of kids reared by does with less than 450 g litter weight at birth decreased significantly if the number of kids assigned increased (table 2). Compared to 8 kids in this litter weight class changes the number of kids assigned by one affected weight gain by 17 %. Although in the medium litter weight class higher milk production was associated with increased number of kids assigned no significant effect on body weight gain of the kids up to the 3rd week was found. In the litter weight class above 650 g the kids of the nursing does with 7 kids showed higher daily weight gain by 2 g in the first three weeks than from nursing does with 8 or 9 kids (p<0.05). In the 4th and 5th week no significant interaction effect on body weight gain was found.

Table 2: Effect of the number of assigned kids on the growth rate of young rabbits (1$^{st}$ - 3$^{rd}$ wk) dependent on the litter weight at birth, LSM in g

| Trait | Signifi-cance of the interaction | $\sqrt{MSE}$ | Interaction (litter weight at birth × number of kids assigned) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | <450 g | | | 450-650 g | | | >650 g | | |
| | | | 7 | 8 | 9 | 7 | 8 | 9 | 7 | 8 | 9 |
| TZ*1* | *** | 3,7 | 13,7$^{a}$ | 10,9$^{b}$ | 8,8$^{b}$ | 11,8$^{m}$ | 13,4$^{m}$ | 12,3$^{m}$ | 15,5$^{x}$ | 13,4$^{x}$ | 14,0$^{x}$ |
| TZ2 | *** | 3,7 | 16,9$^{a}$ | 14,1$^{b}$ | 11,4$^{c}$ | 14,1$^{m}$ | 15,1$^{m}$ | 14,0$^{m}$ | 18,1$^{x}$ | 15,3$^{y}$ | 15,0$^{y}$ |
| TZ*3* | *** | 4,2 | 17,0$^{a}$ | 15,5$^{ab}$ | 13,4$^{b}$ | 15,1$^{m}$ | 15,7$^{m}$ | 14,2$^{m}$ | 19,0$^{x}$ | 16,6$^{xy}$ | 14,6$^{y}$ |
| TZ*1-3* | *** | 2,8 | 15,8$^{a}$ | 13,5$^{b}$ | 11,3$^{c}$ | 13,8$^{m}$ | 14,8$^{m}$ | 13,5$^{m}$ | 17,6$^{x}$ | 15,3$^{x}$ | 14,5$^{x}$ |

Significance: *** p≤0.001; TZx: Daily weight gain in the x$^{th}$ week of life, other abbreviations: see tab. 1; means with different letters in a row within litter weight class are significantly different from each other (p≤0.05)

Table 3: Effect of the number of assigned kids per nursing doe and the litter weight at birth on the growth rate of young rabbits (4th and 5th wk), LSM in g

| Trait | $\sqrt{MSE}$ | litter weight at birth | | | number of kids assigned | | |
|---|---|---|---|---|---|---|---|
| | | <450 | 450-650 | >650 | 7 | 8 | 9 |
| TZ4 | 7,7 | 34,7 $^{a}$ | 36,4 $^{ab}$ | 37,8 $^{b}$ | 38,2 $^{m}$ | 36,5 $^{m}$ | 34,1 $^{n}$ |
| TZ5 | 7,6 | 46,5 $^{a}$ | 44,6 $^{a}$ | 45,5 $^{a}$ | 46,9 $^{m}$ | 45,4 $^{mn}$ | 44,2 $^{n}$ |

TZx: Daily weight gain in the x$^{th}$ week of life, other abbreviations: see tab. 1; means with different letters in a row within litter weight class are significantly different from each other ($p \leq 0.05$)

## DISCUSSION

Both the litter weight at birth of nursing does and the number of suckled kids influence the milk production. The higher the litter weight at birth of the nursing doe, the higher the milk production in the first three weeks of lactation usually is. Likewise milk production of does can be increased by increasing the number of kids assigned during the lactation period. Nevertheless their effect is not linear but interaction in the presence of both factors was found. In the first week of the lactation the interaction between litter weight at birth and number of kids assigned on the milk production of does is less clear. That can be explained by the fact that a reliable differentiation of the does regarding their milk production can only be measured after the 3rd day of the lactation (Vásquez, unpublished).

The work of Bolet *et al.* (1996) and Petersen *et al.* (1996) applying the method of complete litter balance showed statistically significant effects of litter weight at birth of the nursing doe on subsequent milk production. Mohamed and Szendrô (1992) quantified the influence of the number of suckled kids on their development by means of a complete kid exchange with different number of kids per nursing doe (6, 8 or 10). The results obtained in the present study confirm the results obtained there. Further authors (Abo *et al.*, 1981; Lukefahr *et al.*, 1983; McNitt and Moody, 1990; Khalil and Khalil, 1991; Khalil, 1994; Ayyat *et al.*, 1995; Singh, 1996) report on an increase of the milk production with increasing litter size. In these works however the effects of the litter weight at birth (uterine induction) and the number of suckled kids (litter size or litter weight of the nursing doe) are mixed up, because the kids were predominantly sucked by their mothers. So far no investigations are known, that separated the effects of litter weight at birth and number of suckled kids, although this would have been possible by the experimental design in the work of Mohamed and Szendrô (1992).

In the present investigation does with litter weight at birth less than 450 g did not increase milk production by allocation of 7, 8 or 9 kids and thus the individual milk intake was proportionally reduced and thus resulted in reduced weight gain by increasing kid number. In contrast the milk production of does with 450 to 650 g litter weight at birth increased by rising the number of suckled kids but did not result in significant differences in body weight gain. In does with more than 650 g litter weight at birth increasing the number of suckled kids induced higher milk production. Nevertheless the kids in this group with 7 kids assigned tended to grow faster than with 8 or 9 kids assigned although individual milk intake was similar. This indicates possibly lower energy or nutrient content of the milk of does with a higher milk production. One explanation of the phenomenon of the interaction between litter weight at birth and number of suckled kids on milk production can be a genetically caused limited milk production for does with low litter weights. A positive correlation between litter weight at birth and milk production of the does in the first three weeks of lactation supports this hypothesis.

In practice the litter balancing has to be adapted to the litter weight at birth of the does: Does with low litter weight at birth should not be assigned more than 7 kids per litter. Each additional kid would lead to a proportional decrease of the individual performance of the kids in the first three weeks of life. Does with litter weight at birth of more than 450 g more than 7 kids can be assigned, without having to accept important negative effects to the individual milk intake and to the growth rate of the young rabbits. It is advisable to ensure at least one teat per assigned kid is present.

The maximal exploitation of the performance potential of the does is not always advisable. Parigi-Bini *et al.* (1990-1996) supported by Xiccato *et al.* (1995) particularly report energy shortage during the lactation period of young does. They reported substantial energy deficit that can not be compensated

by feeding strategies (high energy ration). Each additional supply of protein and energy is used completely for milk production. The results from the literature and the result reported here suggest that a renunciation of maximal milk production can be useful for young does, in order to minimise the energy deficit and the negative effects on the future performance of the does. That can be achieved by applying litter balance with different numbers of kids per doe. Young does should be assigned less kids than older does. The litter weight at birth should be taken into consideration in addition to the age of the doe.

## CONCLUSIONS

The effects of the number of assigned kids on the milk production of the does are different depending upon the litter weight at birth:

- Does with low litter weight at birth (<450 g) show no increase in milk production with increasing number of assigned and suckled kids. Each additionally assigned kid causes a decrease in the individual growth rate of the kids.

- Does with medium (450-650 g) or high (>650 g) litter weight at birth show increased milk performance by assigning additional kids and thus limiting the negative effects on the individual growth rate of the young rabbits.

Litter balance does not only represent a technique to decrease mortality rates among the kids, but also to increase the milk production and to reduce the nutritional and physiological problems of the doe. The age and the litter weight of the nursing does at birth should be taken into consideration to optimise the litter balancing technique.

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