# Effect of weaning age and solid feed distribution before weaning on performances and caecal traits of young rabbits

**Piattoni F., Maertens L.**

*in*

**Testik A. (ed.), Baselga M. (ed.).**
**2. International Conference on Rabbit Production in Hot Climates**

**Zaragoza : CIHEAM**
**Cahiers Options Méditerranéennes; n. 41**

**1999**
pages 85-91

# EFFECT OF WEANING AGE AND SOLID FEED DISTRIBUTION BEFORE WEANING ON PERFORMANCES AND CAECAL TRAITS OF YOUNG RABBITS

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**SUMMARY -** The effect of early weaning and dietary shift from milk to milk and pellets, at different ages, on growth performances and ontogenic factors of young rabbits, was studied. Fifteen conventional litters, of 8 young each, were allotted to five experimental groups (A; B; C; D; E). Weaning was performed at the age of 18 days for treatment A or at the age of 32 days for the others. The latter received pellets at the age of 18 (B), 22 (C), 25 (D) and 28 days (E), respectively. Milk intake and pellet intake, separately from their mother, was measured daily. Out of each litter one young rabbit was sacrificed at the age of 22; 25; 28; 31, 35, 42 and 56 days, to determine caecum weight and biochemistry. Both weaning age and solid feed distribution affected significantly growth performances and caecum development. Early weaned young (A) showed a significantly lower DWG between 18 and 22 days of age ($P<0.01$). However, afterwards they recovered and showed a comparable DWG with treatments receiving milk and pellets. Late distribution of solid feed (C, D and E young) resulted in a significant lower LW at weaning, compared to early feed distribution (B-litters)($P<0.01$). At 32 days, LW was, for treatment A to E, 671; 783; 597; 697 and 579 g/young, respectively. The development of the caecum (as % LW) and the drop of caecal pH was clearly related to the intake of solid feed. Treatment A showed always the highest caecum weight, paralleled by the lowest pH, especially before 28 days of age.

**Key words:** Rabbit; weaning, feeding, growth, caecum development, pH.

**RESUME -** *"Effet de l'âge au sevrage et de l'administration de l'aliment solide avant sevrage sur les performances de croissance et du développement du caecum du lapereau". L'effet du passage du lait maternel à une alimentation mixte (granulés + lait) sur les performances de croissance et du développement du caecum du lapereau a été étudié. Quinze nichées de 8 lapereaux conventionnels chacune, partagées en cinq lots (A; B; C; D; E) ont été utilisées. Le lot A a été sevré à 18 jours d'âge tandis que les autres lots ont été sevrés à 32 jours et ont reçu du granulé à 18j (B), 22j (C), 25j (D) et 28j (E). A 22; 25; 28; 31; 35; 42 et 56 jours, on a sacrifié un lapereau de chaque nichée pour peser le caecum et étudier sa biochimie. L'âge au sevrage ainsi que l'administration du granulé ont influencé significativement les performances de croissance et le développement du caecum. Le sevrage précoce (lot A) s'est traduit par un GMQ significativement inférieur entre 18 et 22 jours d'âge (P<0.01). Immédiatement après, les lapereaux du lot A ont récupéré et dès le 22ème jour leur croissance était comparable à celle des lots soumis à l'alimentation mixte. Les lots qui ont reçu les granulés plus tard (C; D; E), ont montré un PV significativement inférieur au lot B (P<0.01). À 32 jours, les PV des lots A, B, C, D et E étaient de 671; 783; 597; 697 et 579 g/lapereau, respectivement. Le développement du caecum (en pourcentage du PV) ainsi que la chute du pH caecal étaient clairement liés à l'ingestion des granulés. Ainsi, avant le 28ème jour d'âge, le lot A a toujours montré le poids caecal le plus élevé, accompagné du pH le plus bas.*

***Mots-clés:*** *Lapereau; sevrage; nutrition, croissance, caecum, pH.*

## INTRODUCTION

During the last 2 decades, performances of intensive rabbit production improved a lot, due to the development of specialised strains (hybrids), increasing use of artificial insemination, adapted diets and management rationalisation. However, mortality of young before and after weaning is still very high and amounts in total to nearly 25% (Koehl,1997). The major part of these losses is due to diarrhoea, whose etiology is multifactorial (Peeters, 1988).

As in other species, weaning is a critical phase especially when performed at an early stage (28 -32 days in commercial rabbit production). Apart from specific pathogenic agents, dietary composition is considered as a predisposing factor to digestive disorders because of the sudden shift from doe milk to solid feed. Hence, before 18 days of age the young rabbit consumes exclusively milk. In the fourth week of age, the young change very quickly to mainly solid feed intake (Lebas, 1970; Szendrö et al., 1985; Maertens and De Groote, 1990).

Early weaning is already possible at 14 days, using milk powder and pellets (Prud'hon and Bel, 1968; Mc Nitt and Moody, 1992) or on artificial milk feeding and solid feed (Ferguson, et al., 1997). Physically, rabbit young proved, in these experiments, to be able to start with solid feed intake at 18 days of age. Rabbit milk is mainly composed of lipids and proteins while the carbohydrate content is very low (Lebas, 1971). Rabbit pellets, on the other hand, have a high carbohydrate content (fibrous nature) and a reduced lipid content. In contrast with piglets, young rabbits are fed in practise the same diet as their mother. The change from milk to solid feed and early weaning provokes, therefore, important changes in the digestive physiology of the young rabbit (Padilha et al., 1995; Piattoni et al., 1995). From the observations of Padilha et al. (1995), the passage from milk to solid feeding corresponds to the main changes rather than the weaning itself.

Therefore the aim of the present work was to study the effects of (i) very early weaning and (ii) different ages of solid feed distribution on zootechnical performances and caecal traits of young rabbits.

## MATERIALS AND METHODS

Animals and rearing method

One hundred and twenty young, conventional rabbits from the experimental strain of the Research Station for Small Stock Husbandry were used. Initially, 24 litters of multiparous does (Maertens, 1992), born on the same day and with at least 8 young, were chosen. Out of them, 15 litters with 8 surviving young and with the most homogeneous animal weights were selected for the experiment. Eighteen days post parturition, all these does were housed in a separate cage of their litter, in order to measure milk and feed intake of the young.

Before and during the whole experimental period, a standard lactating diet (Table 1) was fed *ad libitum* and water was freely available using a nipple drinking system. The same diet was distributed to all young. In order to facilitate the intake, early weaned litters (A) received the pellets between 18 and 22 days of age in a flat dish while water was provided in an open drinker. Both were placed near the nestbox. From then off, feed and water was distributed using normal feeders and nipple drinkers. All animals were kept under common environmental conditions : 12h of light/day, temperature between 16 and 22°C.

**Table 1 - Ingredients and calculated chemical composition of the diet**

| Ingredients | % | Composition * | % DM |
|---|---|---|---|
| Alfalfa meal | 24 | Crude protein | 17.5 |
| Wheat middlings | 28 | Lysine | 0.76 |
| Wheat | 13 | Methionine + cystine | 0.61 |
| Full fat soybeans | 8 | Threonine | 0.63 |
| Sunflower meal (29%) | 12 | Ether extract | 5.0 |
| Flax chaff | 5 | Crude fibre | 13.7 |
| Cane molasses | 4 | Ca | 1.14 |
| Min. + vit. Mix | 2.5 | P | 0.65 |
| Renderes fat | 1 | DE (MJ/kg) | 10.1 |
| Salt | 0.05 | | |
| DL-methionine | 0.04 | | |

* calculated

Experimental design

At the age of 18 days, the 15 litters were allotted to 5 experimental groups (A; B; C; D; E). Male effect was taken into account to distribute them homogeneously. Weaning was performed at the age of 18 days for treatment A or at the age of 32 days for the others. The latter received pellets at the age of 18 (B), 22 (C), 25 (D) and 28 days (E), respectively. Out of each litter one young rabbit was sacrificed at the following ages: 22; 25; 28; 31, 35, 42 and 56 days, to determine caecum weight and pH. In order to have enough caecal sample, 2 young/litter were euthanised in litters receiving exclusively milk. All the sacrificed young were immediately replaced by others of the same age (recognisable from an ear-tag) to avoid that the experimental ones could drink more milk.

Slaughtering and sampling

Sequential slaughterings were performed by cervical dislocation between 0900 and 1300 hours. After bleeding and dissection, the caecum was isolated by tying off the three extremities with a nylon string, to prevent movement of digesta. After weighing, the content was squeezed out into a beaker, carefully mixed with a spatula and pH was immediately measured by a glass electrode (pHM62, Radiometer, Copenhagen). Further analysis were performed and results will be published elsewhere.

Zootechnical performances

The experimental period lasted 38 days (from 18 to 56 days of age). Milk intake was measured daily, by difference between the weight of the doe before and after nursing. Pellet intake per cage was calculated separately from the doe, by difference between the amount distributed and refused. Live weight (LW) of the young rabbits was determined individually. If mortality occurred, a correction was performed considering that no intake occurred the day before the death. During the pre-experimental period (0-18 days of age) LW was determined every 4 days.

Statistical analysis

Data were analysed using a linear analysis of variance, to evaluate the effect of weaning age and age of solid feed distribution (Program Statistica 4.5, 1993). Data are presented as means ± SEM and means were compared using orthogonal contrasts. Initial LW was used to covariate LW data. Significance is declared at $P<0.05$.

## RESULTS

Mean initial LW (day 18) was 322, 303, 274, 303 and 304g for young A to E, respectively. Because young from litter C differed significantly from the others ($P<0.01$), initial LW was taken into account as covariate in LW data. Daily weight gain (DWG) was affected by age of solid feed distribution mainly during the first part of the experimental period (Table 2). Early weaned young (A) did not gain weight between 18 and 22 days. However, between 22 and 25 days they had a comparable DWG with treatment B and C but a significantly higher DWG ($P<0.01$) than the young who received only milk feeding (treatments D and E).

Young of treatment C showed a quite low solid feed intake between 22 and 25 days (4.6g/young, Table 4) which resulted in low gains during the corresponding period (Table 2). When the feed was distributed late (treatments D and E), already in the next 3 days young nearly tripled their DWG due to a very quick intake of important amounts of feed (Table 4). This last observation and the fact that after day 35 differences, according to treatments, disappeared, confirms the rapid adaptation of the young rabbits to solid feed intake. However, because young were sacrificed for caecal determinations, the remaining number of young is too low to judge the post-weaning effect.

The effect of age of solid feed distribution on LW was very pronounced (Table 3). During the whole experimental period, young who received already pellets at the age of 18 days (B) had always a significantly higher LW than the others ($P<0.01$). Both early weaning (A) and late distribution had a negative effect on LW, already pronounced on day 22. At weaning (day 32), differences with treatment B were between 12% (D young) and 25% (E young). At the age of 42 or 56 days, still about the same difference in LW was observed (-15% and -22% for D and E, respectively).

Mortality was very low and limited to one rabbit of treatment A (because of enterotoxemia) at 22 days of age.

Mean caecum weights (CW), expressed as percentage of LW, are shown in Figure 1 and corresponding caecal pH values in Figure 2. Linear regression coefficients between age and CW are 0.98, 0.96, 0.96, 0.86 and 0.95 for treatments A to E, respectively. Already on day 22, early weaned young showed a much more developed caecum (nearly double weight) compared to treatments not yet receiving solid feed (P<0.01) whereas treatments that just started solid feed intake show intermediate values.

Parallelely, in treatment A caecal pH is significantly lower than in the others (P<0.01). At 28 days of age, the effect of age of solid feed distribution is still very pronounced: young not yet receiving pellets (E), had still a very small caecum and a high pH while early weaned young (A) differed from all other treatments for their CW and pH. Treatments B, C, and D had already a comparable CW and pH. Once the age of 32 days is reached, differences in CW became smaller and were not more significant. Similarly, caecal pH decreased once the young had significant intake of solid feed. However, at 56 d of age, late distribution led to a higher (P<0.01) caecal pH.

**Table 2 - Effect of weaning age and solid feed distribution on DWG of young rabbits**

| **Weaning age** | | 18 | 32 | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Age of solid feed distribution** | | 18 | 18 | 22 | 25 | 28 | SEM | P | Significant |
| **Treatments** | | A | B | C | D | E | | value | contrasts[bc] |
| **Period (n)[a]:** | **18-22d** (120) | 0.0 | 15.9 | | **13.4** | | 0.67 | <0.01 | $1^{**}; 2^{**}$ |
| | **22-25d** (101) | 28.0 | 27.3 | 22.9 | **12.5** | | 1.04 | <0.01 | $1^{**}$; |
| | **25-28d** (86) | 35.0 | 46.1 | 25.4 | 36.1 | **12.5** | 1.61 | <0.01 | $2^{**}; 3^{**}$ |
| | **28-32d** (53) | 39.8 | 46.9 | 38.8 | 49.8 | 34.8 | 1.72 | <0.05 | $3^{*}$ |
| | **32-35d** (53) | 43.5 | 43.7 | 36.8 | 44.5 | 32.8 | 2.15 | NS | NS |
| | **35-42d** (37) | 46.2 | 49.4 | 44.8 | 45.8 | 50.3 | 1.20 | NS | NS |
| | **42-56d** (23) | 37.8 | 50.0 | 48.7 | 44.4 | 44.1 | 1.61 | NS | NS |

[a] = number of rabbits at the end of the experimental period.
[b] = contrast 1: treatment A *vs* all the others; contrast 2: treatment A *vs* B; contrast 3: treatment B *vs* C,D,E;
[c] = levels of significance: $^{*}$P<0.05; $^{**}$P<0.01

**Table 3 - Effect of weaning age and solid feed distribution on live weight of young rabbits**

| **Weaning age** | | 18 | 32 | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Age of solid feed distribution** | | 18 | 18 | 22 | 25 | 28 | SEM | P | Significant |
| **Treatments** | | A | B | C | D | E | | value | Contrasts[bc] |
| **LW at (n)[a]:** | | | | | | | | | |
| | **22d** (120) | 322 | 366 | | **347** | | 4.30 | <0.01 | $1^{**}; 2^{**}$ |
| | **25d** (101) | 404 | 451 | 379 | **399** | | 5.32 | <0.01 | $1^{**}; 2^{**}; 3^{**}$ |
| | **28d** (86) | 510 | 588 | 449 | 505 | **438** | 8.64 | <0.01 | $2^{**}; 3^{**}$ |
| | **32d** (53) | 671 | 783 | 597 | 697 | 579 | 16.11 | <0.01 | $2^{**}; 3^{**}$ |
| | **35d** (53) | 801 | 914 | 707 | 831 | 676 | 19.32 | <0.01 | NS |
| | **42d** (37) | 1103 | 1269 | 968 | 1142 | 1024 | 25.69 | <0.01 | NS |
| | **56d** (23) | 1744 | 2089 | 1640 | 1781 | 1654 | 45.83 | <0.01 | NS |

[a,b,c] = see Table 2.

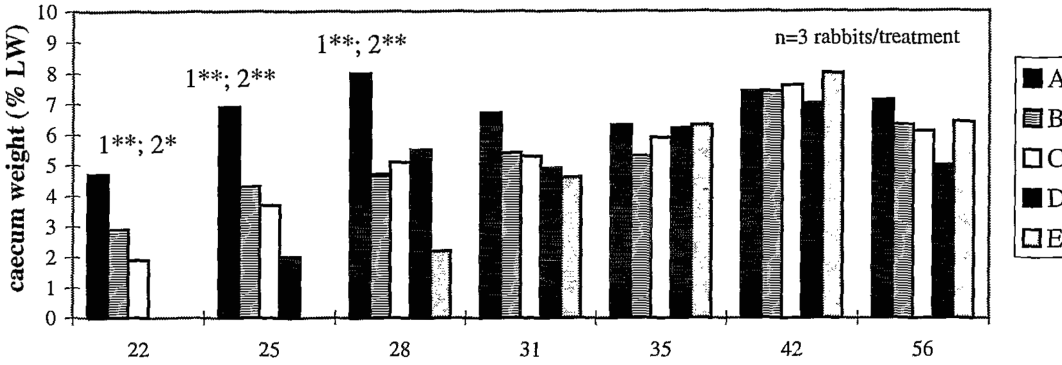
**Table 4 - Feed and milk intake of the young rabbits according to the different treatments (g/young/day)**

| | | **Treatments** | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | A | | B | | C | | D | | E | |
| | | Pellet | Milk | Pellet | Milk | Pellet | Milk | Pellet | Milk | Pellet | Milk |
| **Intake between:** | **18-22d** | 6.1 | - | 1.2 | 31.2 | - | 26.4 | - | 32.3 | - | 31.6 |
| | **22-25d** | 28.4 | - | 10.4 | 30.9 | 4.6 | 27.4 | - | 29.2 | - | 31.3 |
| | **25-28d** | 53.5 | - | 32.9 | 26.4 | 17.9 | 24.6 | 16.5 | 24.3 | - | 29.4 |
| | **28-32d** | 71.1 | - | 54.1 | 21.2 | 40.8 | 22.1 | 40.7 | 21.9 | 19.7 | 28.1 |
| | **32-35d** | 87.3 | - | 71.0 | - | 57.9 | - | 65.4 | - | 39.1 | - |
| | **35-42d** | 103.2 | - | 111.0 | - | 82.6 | - | 97.9 | - | 84.4 | - |
| | **42-56d** | 127.9 | - | 156.5 | - | 123.4 | - | 129.6 | - | 120.5 | - |

## DISCUSSION

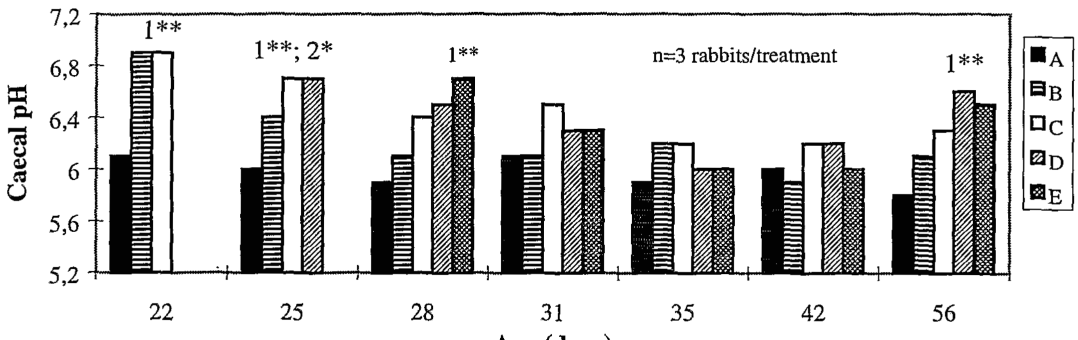
Our results show that even on a conventional rabbit pellet, young can survive when weaned at 18 days of age. However, rabbit young did not gain weight during several days after early weaning. If a more adapted diet is fed, the transition period is less drastic than in our experiment (Mc Nitt and Moody, 1992; Ferguson et al., 1997).

**Figure 1 - Effect of weaning age and solid feed distribution on rabbit caecum weight (as % of LW)**




Sign. contrasts: 1: treatment A *vs* all the others; contrast 2: Treatment A *vs* B; contrast 3: treatment B *vs* C/D/E;
Levels of significance: *P<0.05; **P<0.01

**Figure 2 - Effect of weaning age and solid feed distribution on rabbit caecal pH.**




1, * = see Figure 1.

Once young of group A got used to solid feed and their intake increased (28.4g/d between 22 and 25 days), they showed a DWG comparable to treatments B and C (P=0.1), which intake was composed of about 1/3 pellets and 2/3 milk. However, their growth was significantly higher than that of treatments D and E (P<0.01), which were exclusively milk fed (30.2g/d). This clearly indicates that the exclusive milk intake is already largely insufficient at 22d of age to obtain a normal growth of the young.

The highest DWG and corresponding LW was obtained when the young received pellets (+ milk) from 18 days off (treatment B), which corresponds to the normal practise. In order to obtain high growth rates before weaning, an early intake of solid feed is necessary. Maertens and De Groote (1990) showed that the removal of the nestbox on day 18, instead of day 21 or 24, stimulates early intake and results in a significant increased litter weight at weaning. Other possibilities to start early solid feed intake have to be searched as a more adapted diet or presentation and taking into account the diets' palatability for the young.

The experimental design was planned to stress the effect of the sudden shift from an exclusively milk intake to an exclusively solid feed intake. This was clearly reflected in the caecum development. Hence, its rapidity of development and pH stabilisation is striking after changing to an exclusive solid feed ingestion (treatment A), opposite to the slower evolution observed for those groups to which solid feed distribution was delayed (C, D, E). Once all young were weaned, no significant differences were found both in zootechnical performances and caecal traits. These results confirm the observations of Padilha et al. (1995) showing clearly that the change from milk to solid feed is much more important than the weaning itself. In fact, in our experiment the day before weaning (day 31) the intake of milk is limited and amounted on average to only 23.9g compared to a solid feed intake of 36.0g. This explains why the largest caecal differences occurred at an earlier stage and pH and caecal weight were yet comparable in the different treatments at 31 days of age.

As kidlets start the ingestion of solid feed, a gradual increase in CW paralleled by a gradual decrease of pH, was observed. Moreover, caecum development is linear in each group and thus in line with Yu Bi & Chiou (1997) who recently observed a linear development for all segments of digestive tract between 2 and 8 weeks of age.

From the present results we may conclude that :

1. Weaning at 18 days without adapted diet is possible but results in a serious stress because during the first days the young did not gain weight. Afterwards they showed a normal development.
2. Late distribution of solid feed resulted in growth retardation before weaning. However, a very quick adaptation to solid feed was observed.
3. Caecum development and pH is dominated by the intake of solid feed. Early weaning or late solid feed distribution is clearly reflected in caecal traits.

## ACKNOWLEDGEMENTS

The authors are grateful to the University of Bologna for a grant to Ir. Federica Piattoni. The authors also wish to thank R. Lemmens for taking care of the rabbits, A. Vermeulen for the skilful data recording and C. Vermander for the help to collect caecal contents.

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