# The effect of weaning age on performance and nutrient digestibility of broiler rabbits

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**ABSTRACT**: The effect of weaning age on growth, feed consumption, digestibility of nutrients, carcass yield, mortality and parasite incidence was studied in a balance experiment. Forty Hyplus® rabbits proceeding from a commercial rabbitry were assigned to four groups of 10 rabbits according to weaning age at 25, 28, 31 and 35 days. The experimental diet had 17.03% crude protein, 4.66% fat and 18.30% crude fibre. Feed and water were available *ad libitum*. At the end of the experiment, at 84 days of age, six rabbits per group were slaughtered. In the experiment, most results of performance were not significantly ($P \leq 0.05$) affected by weaning age. Only the rabbits weaned at 25 days of age had higher live weight ($P \leq 0.05$) at the age of 35 days (996, 986, 971 and 910 g, respectively), but at the end of the experiment we did not find any differences between groups. Higher digestibility of nutrients was recorded in the second collection period. In the first collection period the digestibility of nutrients was higher in rabbits weaned at 25 days of age in comparison with the other groups. No differences between groups in the digestibility of nutrients were observed in the second period. The age of weaning did not influence carcass characteristics. Dressing percentage was insignificantly higher in rabbits weaned at 25 and 35 days of age (53.11 and 53.07%, respectively) in comparison with rabbits weaned at 28 and 31 days of age (50.89 and 52.67%, respectively). There was no significant effect of weaning age on mortality. The incidence of *Eimeria* ssp. was the highest after weaning in rabbits at the age of 35 days.

**Keywords**: rabbit; early weaning; growth; carcass characteristics; nutrient digestibility; parasite incidence; mortality

Early weaning is one of the solutions allowing the rabbits to be offered a diet adapted to their needs from a very early age. Kits begin to consume limited amounts of solid feed at 18 to 20 days of age (Maertens and de Groote, 1990; Scapinello et al., 1999), then the microflora begins caecal colonization and fermentation develops soon afterwards (Gidenne, 1997), and some of the enzymatic digestive activities show important changes (Marounek et al., 1995). Early weaning reduces the incidence of digestive disorders and reduces pathogen transmission by limiting contacts between litters and does (Schlolaut, 1988).

The growth of rabbits could be affected by weaning age. Trocino et al. (2001) observed that early weaned kits showed a lower live weight in comparison with rabbits weaned at 32 days of age. Similar results were reported by Gidenne and Fortun-Lamothe (2001). The negative effect of early weaning on live weight was also found by Ferguson et al. (1997), Gidenne and Fortun-Lamothe (2001, 2003, 2004) and Gallois et al. (2003, 2004). In contrast Petersen et al. (1992), Gidenne et al. (2004) and Tůmová et al. (2006a) did not prove any significant differences in live weight during the time of fattening.

Feed consumption influences the development of digestive tract. According to Gallois et al. (2003, 2004) slight solid feed consumption led to the earlier development of digestive tract. On the other

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hand, the digestive tract development does not affect feed consumption of early or traditionally weaned rabbits (Xiccato et al., 2000; Tůmová et al., 2006a).

There is a lack of information on the digestibility of nutrients in early weaned rabbits. Nicodemus et al. (2004) and Tůmová et al. (2006a) found that the dry matter and crude protein digestibility was higher in early weaned rabbits and decreased with age (Tůmová et al., 2002, 2006a,b).

Mortality can also be affected by the age of weaning. McNitt and Moody (1992), Ferguson et al. (1997), Gidenne and Fortun-Lamothe (2001, 2004) reported higher mortality in early weaned rabbits. According to Piattoni et al. (1999), Trocino et al. (2001) and Xiccato et al. (2003) mortality was not affected by the age of weaning.

Little is known about the carcass performance of early weaned rabbits. Trocino et al. (2001) indicated the lower empty body weight in early weaned rabbits at 21 days of age, but at 56 days of age the empty body weight was similar in weaning groups. In our previous experiments (Tůmová et al., 2006c) the age of weaning did not affect dressing percentage.

The aim of the present study was to evaluate the effect of weaning age on growth, feed consumption, digestibility of nutrients, carcass yield, mortality and parasite incidence in broiler rabbits.

Table 1. Ingredients of experimental diet (g/kg)

| Ingredients | g/kg |
|---|---|
| Soybean meal | 30 |
| Sunflower meal | 170 |
| Barley | 80 |
| Oats | 90 |
| Lucerne meal | 300 |
| Wheat bran | 225 |
| Sugar-beet pulp | 60 |
| Rapeseed oil | 15 |
| Vitamin-mineral supplement* | 10 |
| Ground limestone | 10 |
| Dicalcium phosphate | 5 |
| Feeding salt | 5 |

*Composition of vitamin and mineral supplement in 1 kg: vitamin A 1 200 000 IU; vitamin $D_3$ 200 000 IU; alpha tocopherol 5 000 mg; vitamin $K_3$ 200 mg; vitamin $B_1$ 300 mg; vitamin $B_2$ 700 mg; vitamin $B_6$ 400 mg; vitamin $B_{12}$ 2 mg; niacin amide 5 000 mg; calcium pantothenate 2 000 mg; biotin 20 mg; folic acid 170 mg; choline 60 000 mg; Dl-methionine 100 g; L-lysine HCL 20 g; sodium salinomycinate 2 250 mg; cobalt 100 mg; copper 2 000 mg; iron 5 000 mg; iodine 120 mg; manganese 4 700 mg; zinc 5 000 mg; selenium mg; antioxidant 10 000 mg

## MATERIAL AND METHODS

### Animals, diet and design

In a balance experiment forty Hyplus® rabbits (♂ PS59 × ♀ PS19) were used. The rabbits were from a commercial rabbitry and were taken from multiparous does at the weaning age of 25, 28, 31 and 35 days and were divided into 4 groups of 10. The rabbits were housed in all-wire individual metabolic cages with urine and faeces separation. The floor density was 0.2 $m^2$ per rabbit. The temperature of 16°C and relative humidity about 65% were maintained during the whole period of fattening. A twelve-hour photoperiod was used. Feed and water were available *ad libitum*. During the experiment rabbits received a commercial pelleted feed mixture until 84 days of age. The diet composition is given in Table 1 and the analysed content of nutrients per 1 kg of diet is in Table 2. Before weaning, kits received a feed mixture for does without anticoccidial drugs.

Animals were individually weighed every week, feed consumption was measured daily. Mortality and morbidity were also recorded in groups over the whole period of fattening.

At the end of the experiment, at 84 days of age, six rabbits per group of the average live weight were slaughtered. The slaughter and carcass dissection

Table 2. Analysed nutrient content of experimental diet (g/kg)

| Composition | g/kg |
|---|---|
| Dry matter | 905.0 |
| Crude protein | 170.3 |
| Fat | 46.6 |
| Crude fibre | 183.0 |
| Ash | 74.3 |
| Nitrogen-free extract | 430.8 |
| Starch | 152.2 |
| ADF | 223.6 |
| NDF | 354.8 |
| Nutritive values: | |
| Digestible protein | 120.0 |
| Digestible energy (MJ) | 9.9 |
| Digestible protein/digestible energy (g/MJ) | 12.1 |

Table 3. Performance traits and mortality of rabbits

| Measurement | Group (days of age) | | | | Significance | SEM |
|---|---|---|---|---|---|---|
| | 25 | 28 | 31 | 35 | | |
| Live weight (g) | | | | | | |
| at weaning (initial) | 564 | 631 | 746 | 910 | | |
| at 35 days of age | 996[a] | 986[ab] | 971[ab] | 910[b] | * | 14.177 |
| at 84 days of age | 3 210 | 3 246 | 3 226 | 3 238 | NS | 42.659 |
| Average daily weight gain (g) | | | | | | |
| 35–84 days of age | 45.59 | 46.14 | 46.02 | 47.55 | NS | 0.759 |
| Feed consumption (35–84 days of age) | | | | | | |
| per day/rabbit (g) | 150.8 | 177.5 | 174.8 | 140.9 | NS | 6.704 |
| per kg live weight (kg) | 3.83 | 3.87 | 3.81 | 3.69 | NS | 0.041 |
| Mortality (*n*) | 2 | 0 | 0 | 3 | | |

*$P \leq 0.05$; NS = not significant; SEM = standard error mean
[a,b]means with common superscripts do not differ significantly, determined by Scheffe's test

were carried out in an experimental slaughterhouse. Rabbits were fasted overnight, and slaughtered the following morning by electric stunning and bleeding by jugular cut. The method of carcass measurements was harmonised with Blasco and Ouhayoun (1996).

The digestibility of nutrients was determined by a quantitative method, according to the modified method of Perez et al. (1995). There were two collection periods: the first from 42 to 49 days of age and the second from 56 to 63 days of age. Each collection period lasted for 7 days. During the collection period, the total faeces excretion was collected daily into plastic bags and stored at –18°C until analysis. Faeces were analysed for dry matter, crude protein, fat, crude fibre, ash and nitrogen-free extract.

Parasite incidence was determined a day after weaning (e.g. at 26, 29, 32 and 36 days of age) and at the age of 42, 49, 56 and 63 days.

### Analytical methods

The feed and faeces were analysed using standard AOAC methods (1995). Protein and fat concentrations were determined employing the Kjeltec Auto A 1030 Analyser and Soxtec 1043 from Tecator AB (Sweden), respectively. Crude fibre was determined according to the procedure of Van Soest (1991), using Fibertec 2010.

Coefficients of digestibility of nutrients were determined according to the formula:

$$\frac{\{(\text{quantity of feed} \times \text{nutrients of feed}) - (\text{quantity of faces} \times \text{nutrients of faces})\}}{\text{quantity of feed} \times \text{nutrients of feed}} \times 100$$

Samples of excrements were examined for the presence of parasites according to the procedures of Bréza (1957) and Pavlásek (1991).

### Statistical analyses

The statistical analysis of data on fattening characteristics and carcass yield was performed by one-way analysis of variance by the GLM procedure of SAS (SAS, 2003). The significance of differences between groups was tested by Scheffe's test on the level of significance $P \leq 0.05$. Data on digestibility were evaluated by two-way analysis of variance, treatment and balance interactions using the GLM procedure of SAS (SAS, 2003). Means marked with a different superscript letter within each column are significantly different.

## RESULTS AND DISCUSSION

In the experiment, most results of performance (Table 3) were not significantly ($P \leq 0.05$) affected by weaning age. Only the rabbits weaned at 25 days of age had higher live weight ($P \leq 0.05$) at the age of 35 days, but at the end of the experiment we did not find any differences between groups. The results of our experiment are in accordance with findings of Xiccato et al. (2000, 2003), Gidenne and Fortun-Lamothe (2001), Pascual et al. (2001), Trocino et al. (2001), Gidenne et al. (2004) and Tůmová et al.

Table 4. Digestibility of nutrients (%)

| Nutrient | Weaning age (days) | Balance (days of age) | | Significance | | | SEM |
|---|---|---|---|---|---|---|---|
| | | 42–49 | 56–63 | balance | group | balance × group | |
| Dry matter | 25 | 58.94 | 59.79 | < 0.0001 | 0.0085 | 0.0034 | 0.818 |
| | 28 | 58.31 | 60.91 | | | | |
| | 31 | 49.21 | 60.81 | | | | |
| | 35 | 49.20 | 60.67 | | | | |
| Crude protein | 25 | 73.57 | 73.80 | 0.0171 | 0.1021 | 0.5419 | 0.509 |
| | 28 | 71.79 | 74.29 | | | | |
| | 31 | 68.52 | 72.73 | | | | |
| | 35 | 70.18 | 72.77 | | | | |
| Crude fibre | 25 | 23.00 | 17.90 | 0.6710 | 0.7123 | 0.0837 | 0.934 |
| | 28 | 21.31 | 19.97 | | | | |
| | 31 | 14.39 | 22.44 | | | | |
| | 35 | 20.64 | 22.24 | | | | |
| Fat | 25 | 88.89 | 90.15 | < 0.0001 | 0.1836 | 0.0070 | 1.393 |
| | 28 | 88.32 | 91.66 | | | | |
| | 31 | 75.61 | 94.14 | | | | |
| | 35 | 74.36 | 94.22 | | | | |
| Ash | 25 | 49.31 | 47.40 | 0.1435 | 0.8830 | 0.3488 | 0.894 |
| | 28 | 46.87 | 48.07 | | | | |
| | 31 | 41.22 | 45.33 | | | | |
| | 35 | 40.20 | 47.08 | | | | |
| Nitrogen-free extract | 25 | 66.85 | 70.90 | < 0.0001 | 0.0003 | 0.0006 | 0.894 |
| | 28 | 67.41 | 71.89 | | | | |
| | 31 | 56.42 | 71.46 | | | | |
| | 35 | 56.94 | 70.94 | | | | |

SEM = standard error mean

(2006a). On the other hand, lower live weight of early weaned rabbits was recorded at 35 days of age by Xiccato et al. (2000), Gidenne and Fortun-Lamothe (2001), Trocino et al. (2001).

Feed consumption was insignificantly higher in rabbit weaned at 28 days of age (Table 3). The results correspond with Gallois et al. (2003, 2004), who demonstrated that the early weaned rabbits had the higher feed consumption in comparison with rabbits weaned at 35 days of age.

The results of digestibility of nutrients are presented in Table 4. The digestibility of dry matter and nitrogen-free extract was significantly affected by weaning age. In the 1st collection period the digestibility of dry matter and nitrogen-free extract was higher in rabbits weaned at 25 and 28 days of age compared with those weaned at 31 and 35 days of age. The higher digestibility of dry matter in early weaned rabbits was also reported by Nicodemus et al. (2004) and Tůmová et al. (2006a). A significant difference was determined between collection periods in digestibility of dry matter, crude protein, fat and nitrogen-free extract whereas higher digestibility of nutrients was in the second collection period. This result was obtained also by Tůmová et al. (2002, 2006a,b), who reported that nutrient digestibility decreased with the age in all rabbits. There were significant interactions among groups and age in digestibility of dry matter, fat and nitrogen-free extract.

Carcass characteristics were not influenced by weaning age (Table 5). Dressing percentage was insignificantly higher in rabbits weaned at 25 and 35 days of age in comparison with rabbits weaned at 28 and 31 days of age. Tůmová et al. (2006c) also reported that the rabbits of different weaning

Table 5. Carcass analysis at 84 days of age

| Characteristic | Group (days of age) | | | | Significance | SEM |
|---|---|---|---|---|---|---|
| | 25 | 28 | 31 | 35 | | |
| Live weight (g) | 3 184.00 | 3 153.00 | 3 091.00 | 3 167.00 | NS | 33.760 |
| Carcass weight (g) | 1 689.00 | 1 657.00 | 1 626.17 | 1 676.83 | NS | 19.270 |
| Dressing percentage (%) | 53.11 | 50.89 | 52.67 | 53.07 | NS | 0.708 |
| Fore part of the carcass (%) | 51.72 | 51.59 | 51.77 | 51.01 | NS | 0.303 |
| Hind part of the carcass (%) | 48.27 | 45.20 | 48.28 | 49.01 | NS | 0.905 |
| Loin (%) | 16.90$^{b}$ | 16.76$^{b}$ | 17.02$^{ab}$ | 18.28$^{a}$ | * | 0.240 |
| Hind legs (%) | 31.39 | 31.67 | 31.27 | 30.73 | NS | 0.216 |
| Thigh muscles (%) | 24.17 | 24.15 | 23.18 | 23.23 | NS | 0.213 |
| Kidney (%) | 1.24 | 1.23 | 1.28 | 1.31 | NS | 0.020 |
| Renal fat (%) | 2.25 | 2.06 | 1.95 | 2.25 | NS | 0.139 |
| Heart (%) | 0.64$^{a}$ | 0.52$^{b}$ | 0.50$^{b}$ | 0.52$^{b}$ | * | 0.022 |
| Liver (%) | 5.86 | 5.97 | 5.89 | 6.21 | NS | 0.287 |
| Lung (%) | 0.74$^{b}$ | 0.72$^{b}$ | 0.98$^{a}$ | 0.77$^{ab}$ | ** | 0.034 |
| Skin from live weight (%) | 15.60 | 15.95 | 16.80 | 15.77 | NS | 0.260 |

*$P \leq 0.05$, **$P \leq 0.01$; NS = not significant; SEM = standard error mean

$^{a,b}$means with common superscripts do not differ significantly, determined by Scheffe's test

age had similar dressing percentage at the end of the experiment. Differences between groups in the proportion of single parts from the carcass were not significant except the loin. The proportion of loin from carcass decreased with weaning age. An insignificantly lower proportion of renal fat was in the group weaned at 31 days of age. The age of weaning had a significant ($P \leq 0.05$, 0.01) effect on the proportion of heart and lungs from the carcass. A higher proportion of heart was in rabbits weaned at 25 days of age while in rabbits weaned at 31 days of age a higher proportion of lungs from the carcass was recorded.

There was no significant effect of weaning age on mortality (Table 3). This result coincides with findings of Piattoni et al. (1999), Trocino et al. (2001) and Xiccato et al. (2003), who did not report the effect of weaning age on mortality either.

During the experiment, oocysts of *Passalurus ambiguus*, *Eimeria magna*, *Eimeria perforans*, *Eimeria*

Table 6. Parasite incidence per rabbit (OPG – oocysts per gram of faeces)

| Age at sampling (days of age) | Parasite | Group (days of age) | | | |
|---|---|---|---|---|---|
| | | 25 | 28 | 31 | 35 |
| 26 | *Eimeria magna* | 184.7 | – | – | – |
| | *Eimeria perforans* | 396 | x | – | – |
| 29 | *Passalurus ambiguus* | xx | 6.6 | – | – |
| 32 | | xx | xx | N | – |
| | *Eimeria exigua* | xx | xx | xx | 176 |
| 36 | *Eimeria media* | xx | xx | xx | 58 088.9 |
| | *Eimeria perforans* | xx | xx | xx | 75 515.6 |
| 42 | *Eimeria magna* | N | N | N | 28.3 |
| 49 | | N | N | N | N |
| 56 | *Passalurus ambiguus* | 346.5 | 488.4 | N | N |
| 63 | *Passalurus ambiguus* | N | 6.6 | N | N |

xx = parasite incidence not determined; N = negative

*exiqua* and *Eimeria media* were found (Table 6). The incidence of *Eimeria* ssp. was highest in rabbits weaned at the age of 35 days.

In the present study, the age of weaning did not have an significant effect on the majority of the parameters of performance. Rabbits weaned at 25 days of age had significantly higher live weight at the age of 35 days and then the live weight was not significantly affected till the end of fattening. It is possible to draw a conclusion that weaning age and collection period affected digestibility of dry matter and fat and that the digestibility of nutrients decreased with age. The age of weaning did not influence carcass characteristics (except the proportion of loin, heart and lungs from carcass) and mortality. The highest incidence of *Eimeria* ssp. was in rabbits at the age of 35 days, probably being caused by a longer time of coexistence with does.

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