The effect of limited feed intake on carcase yield and meat quality in early weaned rabbits

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ABSTRACT
The aim of this study was to evaluate the effect of one week of intensive feed restriction (50 g and 65 g per rabbit per day for R50 and R65, respectively) on carcase traits, meat quality characteristics and muscle fibre parameters in early weaned growing rabbits. Rabbits were restricted between 32 and 39 days of age but fed ad libitum before and following feed restriction. The live weight at 81 days of age was not affected by the feeding regime. At the time of feed restriction, the daily weight gain decreased \( p < 0.001 \) to 61% in R50 and 67% in R65 compared with rabbits fed ad libitum. However, the average daily weight gain and feed intake or feed conversion ratio were not significantly affected by feeding regime over the entire experimental period. Feed restriction had no effect on dressing out a percentage or the percentages of the hind and foreparts. No effect of feeding regime was observed in meat tenderness and cooking loss, but significant interactions between feeding regime and age were detected in the cross-sectional area and diameter of bR and oW muscle fibres. Smaller type bR cross-sectional area and diameter were observed in group R50 under more intensive feed restriction. The distribution of fibre type was not significantly affected by the treatment and age interaction or by feeding regime alone. It could be concluded that one week of intensive feed restriction in early weaned rabbits affects some morphological muscle fibre characteristics but has no effect on performance, carcase traits and meat quality.

HIGHLIGHTS
- No effect on performance and meat quality.
- Smaller area of bR muscle fibres in restricted rabbits.
- Distribution of fibre type was not affected.

Introduction

In rabbits, early weaning enables the earlier provision of a diet adapted to the requirements of young rabbits, thus limiting the transmission of pathogenic agents between the mother and her young (Kovács et al. 2012), and it is one of the possible approaches for reducing digestive disorders in rabbits during fattening (Maertens and De Groote 1990). However, previous studies found that early weaning reduced growth compared with classically (on day 35) weaned rabbits (Cesari et al. 2007; Gallois et al. 2008; Kovács et al. 2012), and the early weaned rabbits had a lower live weight at the end of the experiment (Gallois et al. 2008; Bivolarski et al. 2011).

In growing rabbits, feed restriction helps prevent digestive pathologies, which are frequent in young rabbits between weaning and 10 weeks of age (Gidenne et al. 2009). Limited feed intake has a positive effect on feeding efficiency (Gondret et al. 2000; Di Meo et al. 2007; Gidenne et al. 2009, 2012), and it reduces carcase fat. Improved feed conversion ratios were observed in restricted rabbits by Gidenne and Feugier (2009), but other authors have found the feed conversion ratio of restricted rabbits to be similar to that of groups fed ad libitum (Tůmová et al. 2002; Tůmová, Volek et al. 2016). Furthermore, feed restriction influences the growth of rabbits. Gidenne et al. (2009) found that the growth rate was reduced linearly with an increase in the level of restriction by...
0.5 g per day, which decreased the slaughter weight by 4.5 g per percentage reduction of feed intake. However, during the realimentation period, when rabbits are again fed ad libitum, compensatory growth with greater future intake can be detected. Tůmová, Volek et al. (2016) observed the higher feed intake in one week after the end of feed restriction. According to the study of Gidenne et al. (2009), compensatory growth is not associated with over-eating by restricted rabbits due to the intake of numerous (30–40) smaller meals during the day. Tůmová, Volek et al. (2016) found compensatory growth to be associated with the morphological and physiological development of the small and large intestines and the caecum during the restriction period and the rapid growth of these organs in the first week of realimentation. However, in most studies, early restricted rabbits did not reach the live weight of rabbits fed ad libitum by the end of the growth period (Gondret et al. 2000; Dalle Zotte et al. 2005; Gidenne et al. 2009; Gidenne and Feugier 2009; Tůmová, Volek et al. 2016). Although the live weight of restricted rabbits decreased, the results of Tůmová et al. (2006) and Gidenne et al. (2009) showed that limited feed intake did not greatly affect carcass characteristics, but the dressing out percentage has been found to decrease with the intensity of feed restriction (Larzul et al. 2004; Gidenne et al. 2009).

In terms of meat quality, meat tenderness is one of the most important factors for consumers, but few authors have investigated the effect of feed restriction on tenderness. Carrilho et al. (2009) and Chodová et al. (2016) found that meat tenderness was not influenced by feed restriction. Similarly, feed restriction did not affect cooking loss (Gidenne et al. 2009). Meat quality depends on muscle fibres, the main parameters of which are number, cross-sectional area (CSA), diameter, perimeter and fibre type distribution, and these characteristics depend on the type of muscle in which fibres are detected. For example, the *longissimus lumbarum* muscle (LL) is more glycolytic than the *biceps femoris*. Therefore, some *ante mortem* effects, such as feed restriction, might modify the morphological, physiological and biochemical characteristics of muscles and thus meat quality (Gondret et al. 2000). Dalle Zotte et al. (2005a) reported that early restriction followed by ad libitum feed intake in rabbits reduced the proportion of oxidative fibres, and in a subsequent study, Dalle Zotte et al. (2005a) found that compensatory growth between 8 and 11 weeks of age intensely increases glycolytic metabolism, which correlates with a rapid decrease in oxidative metabolism in muscles. In our previous study (Chodová et al. 2016), we observed that feed restriction increased the percentage of glycolytic αW muscle fibres in LL, mainly in a group subjected to milder restriction compared with a group with more severe restriction and an AL group. In contrast, Dalle Zotte and Ou hayoun (1998) and Gondret et al. (2000) did not observe significant differences in CSA between restricted rabbits and those fed ad libitum.

The above studies evaluated the effect of feed restriction on normally weaned rabbits, but data are lacking on the effects of feed restriction on performance and histological muscle fibre characteristics and meat quality in early weaned rabbits. Therefore, the objective of the current study was to evaluate the effect of one week of feed restriction at two different intensities on carcase characteristics, muscle fibre characteristics, meat tenderness and cooking loss in early weaned, growing rabbits.

**Materials and methods**

The experiment was approved by the Ethics Committee of the Central Commission for Animal Welfare of the Ministry of Agriculture of the Czech Republic (Prague, Czech Republic) and was carried out in accordance with Directive 2010/63/EU for animal experiments.

**Animals and experimental design**

Ninety-six Hyplus rabbits (1:1 male and female ratio) weaned at 25 days of age were housed collectively in cages with 4 rabbits each (0.12 m² per rabbit). Rabbits were balanced for initial live weight and then randomly divided into three groups: the control group was fed ad libitum (AL); the second group was restricted with feeding reduced by 50 g per rabbit per day (R50); and the last group was restricted by 65 g per rabbit per day (R65). In both restricted groups, the restriction programme was applied from 32 to 39 days of age, and rabbits were fed ad libitum before and after feed restriction. Water was available ad libitum throughout the entire experiment, and a commercial pelleted diet was formulated to satisfy the nutritional requirements of the growing rabbits. Ingredients of the experimental diet were identical as in our previous trial (Tůmová et al. 2016a) and chemical composition is shown in Table 1. A temperature of 15–17 °C, a relative humidity of 55–60% and a 12-hour photoperiod were maintained throughout the experiment. The weight of each individual animal was recorded weekly.
during the trial period from 25 to 81 days of age. Based on the average live weight, eight rabbits per treatment were selected and slaughtered at both 39 and 81 days of age, and the carcase analysis followed the method of Blasco and Ouhayoun (1996). The carcase weight; dressing out percentage; percentages of the hind and fore parts; and the percentages of the loin, hind leg, hind leg meat and perirenal fat were determined.

**Histochemical analysis**

Immediately after slaughter, *musculus longissimus lumbarum* (LL) samples were collected for histochemical analysis. The samples were frozen in 2-methylbutane cooled by liquid nitrogen (−156 °C) and then stored at −80 °C until analysis. For each sample, cross sections (12-μm thickness) were obtained at −20 °C using a Leica CM 1850 cryostat (Leica Microsystems Nussloch GmbH, Nussloch, Germany), and each section was stained according to myofibrillar ATPase activity after preincubation in an alkaline buffer (pH 10.4) according to the methodology by Brooke and Kaiser (1970). Myofibrillar ATPase stain intensities were used for fibre classification as βR, αR and αW, according to the nomenclature of Ashmore and Doerr (1971). The number of muscle fibres per 1 mm² and CSA, diameter and perimeter were determined using the NIS Elements AR 3.1 computerised image analysis system (Nikon, Tokyo, Japan), and the fibre type distribution was subsequently calculated.

**Meat tenderness and cooking loss**

Meat tenderness was detected in LL muscle by the Warner–Bratzler method. After dissection, the LL was frozen to −20 °C, and the samples were defrosted at 4 °C for 24 hours before analysis and then packaged in zip-tied plastic bags and heated in a water bath at 75 °C for 1 hour. Cooled meat samples were cut into 2 × 1 cm² cuboids with the cuts running perpendicular to the muscle fibres. Meat tenderness was measured using an Instron Model 3342 (Instron, Norwood, MA) with a Warner–Bratzler shear blade with a triangular hole to detect maximum shear force (F_max); the load cell was 20 N with a crosshead speed of 100 mm/min. The cooking loss was calculated from the differences between the weights of the raw and cooked samples.

**Statistical analysis**

All analyses were performed using the statistical programme SAS (SAS Institute Inc., Cary, NC). Live weight, feed intake and daily weight gain were assessed by one-way analysis of variance (ANOVA), and Duncan’s multiple range test was used to assess differences between the groups. Carcase characteristics, meat tenderness, cooking loss and the histological characteristics of the muscle fibres were evaluated by two-way analysis of variance (feeding regime, age and interaction of both factors), and PDIFF was used to evaluate differences between values of treatment and age interaction. A $p \leq .05$ was considered significant for all analyses.

**Results**

At the end of the experiment, the live weight of the rabbits at 81 days of age was similar among all groups (Table 2), but the detailed changes in growth were evident from the average daily weight gain results. From 32 days of age, when feed restriction was applied in the restricted groups, the daily weight gain decreased ($p = .001$) to 61% in R50 and 67% in R65 compared with the rabbits fed ad libitum. In the first week of the realimentation period (from 39 days of age), the daily weight gain of the restricted groups increased ($p = .007$) to 118% in R50 and 110% in R65 compared with the control group. However, from 46 days of age until the end of the experiment, the differences between groups were not significant.

Furthermore, the average daily weight gain over the whole experimental period was not significantly affected by the feeding regime. The feed intake and feed conversion ratio throughout the experiment were not significantly affected by feeding regime, but feed intake was negligibly reduced (−3% in R50 and −4% in R65) compared with the AL group.

The basic carcase characteristics are shown in Table 3, and a significant effect of the feeding regime and age interaction on carcase weight was observed. The lowest carcase weight was found in R50 at 39 days of age, immediately after the end of the feed
Meat tenderness, as represented by the maximum shear force, and cooking loss are reported in Table 4. None of the evaluated factors, including their interactions, affected meat toughness. However, the cooking loss was higher in the meat of younger rabbits ($p < .001$) compared with the meat of rabbits at the end of the experiment.

The $longissimus$ $lumborum$ muscle fibre characteristics are given in Table 5. As expected, the number of muscle fibres of all types per $1\, \text{mm}^2$ significantly decreased with age. The size of both the $\beta$R and $\alpha$W fibres was significantly affected by the interactions of feeding regime and age with the greatest increase in the size of the $\beta$R fibres occurring in the AL group (175%) and the lowest in the R50 group (99%). In contrast, $\alpha$W type fibres were most enlarged in R65 (136%) and changed minimally in the AL group (100%). In addition, the CSAs of all types of muscle fibres were significantly affected by feed restriction with the lowest values in the R50 group, which was subjected to the most intensive feed restriction. With respect to age, the CSA significantly increased in all types of muscle fibres; the greatest increase in size occurred in $\beta$R fibres with the lowest in $\alpha$W. The

**Table 2. Effect of feed restriction on live weight, feed intake and daily weight gain.**

| Group | Live weight at 25 days, g | Live weight at 81 days, g | Daily weight gain, g/d |
|-------|--------------------------|--------------------------|-----------------------|
| AL    | 510                      | 514                      |                       |
| R50   | 514                      | 510                      |                       |
| R65   | 510                      | 514                      |                       |
| SEM   | 5.7                      | 5.4                      | 5.4                   |

| Group | Live weight at 25 days, g | Live weight at 81 days, g | Daily weight gain, g/d |
|-------|--------------------------|--------------------------|-----------------------|
| AL    | 510                      | 514                      |                       |
| R50   | 514                      | 510                      |                       |
| R65   | 510                      | 514                      |                       |
| SEM   | 5.7                      | 5.4                      | 5.4                   |

Means within the same row with the different superscript letter are significantly different ($p > .05$).

Feed intake and feed conversion ratio were calculated as the average per one rabbit from the cage.

SEM: standard error of the mean; AL: ad libitum; R50: 50 g of feed per rabbit per day; R65: 65 g of feed per rabbit per day.

**Table 3. Effect of feed restriction on the carcase characteristics of broiler rabbits.**

| Group | Age, days | Carcase weight, g | Dressing out, % | Hind part, % | Forepart, % | Loin, % | Hind leg, % | Hind leg meat, % | Perirenal fat, % |
|-------|-----------|-------------------|-----------------|--------------|-------------|---------|-------------|------------------|------------------|
| AL    | 39        | 510               | 53.5            | 52.7         | 47.3        | 15.0    | 30.8        | 10.6             | 1.0              |
|       | 81        | 1521              | 60.1            | 55.8         | 44.1        | 17.7    | 31.4        | 11.8             | 2.4              |
| R50   | 39        | 493               | 54.8            | 51.6         | 48.6        | 14.6    | 31.8        | 10.5             | 0.6              |
|       | 81        | 1561              | 50.5            | 57.8         | 44.4        | 18.0    | 31.8        | 12.1             | 2.5              |
| R65   | 39        | 519               | 55.5            | 52.1         | 49.7        | 15.2    | 31.2        | 12.1             | 2.5              |
|       | 81        | 1581              | 50.5            | 56.0         | 43.9        | 18.4    | 32.2        | 12.1             | 2.5              |
| SEM   |           | 75.7              | 0.4             | 0.3          | 0.4         | 0.4     | 0.3         | 0.1              | 0.1              |

Means within the same row with the different superscript letter are significantly different ($p > .05$).

SEM: standard error of the mean; AL: ad libitum; R50: 50 g of feed per rabbit per day; R65: 65 g of feed per rabbit per day.

**Table 4. Effect of feed restriction on selected meat quality characteristics.**

| Group | Age, days | $F_{\text{max}}, N$ | Cooking loss, % |
|-------|-----------|---------------------|-----------------|
| AL    | 39        | 31.2               | 38.5            |
|       | 81        | 30.9               | 29.3            |
| R50   | 39        | 28.7               | 39.5            |
|       | 81        | 32.7               | 28.1            |
| R65   | 39        | 33.7               | 39.5            |
|       | 81        | 35.2               | 29.1            |
| SEM   |           | 0.7                | 0.7             |

Means within the same row with the different superscript letter are significantly different ($p > .05$).

SEM: standard error of the mean; $F_{\text{max}}$: maximum shear force; AL: ad libitum; R50: 50 g of feed per rabbit per day; R65: 65 g of feed per rabbit per day.
Diameter is closely related to CSA, and the results for the βR and αW fibres showed similar trends. Only the perimeter of the βR fibres was affected by the treatment by age interaction ($p = .046$). At the end of feed restriction at 39 days of age, fibre perimeter did not differ among groups, but it was lowest in R50 at the end of the experiment. The fibre type distribution was not affected by feeding regime in any muscle fibre type. However, age had a significant effect on the distribution of the αR and αW muscle fibres; the distribution of αW muscle fibres increased with age to the exclusion of αR muscle fibres.

**Discussion**

Depending on the intensity and duration of the feeding restriction and thus the realimentation period, compensatory growth may affect the final live weight of normally weaned rabbits. For example, Gidenne et al. (2012) observed 5 to 10% lower slaughter weights in restricted rabbits compared with the AL group. However, when feed restriction is mild, applied early or for a shorter period followed by a longer realimentation period, the differences in live weight may disappear (Tůmová, Volek et al. 2016; Birolo et al. 2017). In the present study, one week of feed restriction applied from 32 days of age did not affect the live weight at the end of the experiment, which can be explained by the lower intensity of the feed restriction as well as the earlier age at application, so the restricted rabbits had a longer realimentation period. From the detailed growth results, as indicated by the average daily weight gain, it is evident that growth was mainly affected during the feed restriction period and in the first week of the realimentation period. Similar results were found by Tůmová, Volek et al. (2016) in normally weaned rabbits, and Gidenne et al. (2012) stated that reduced feed intake leads to a decline in growth during the feed restriction period. During the realimentation period, when animals are again fed *ad libitum*, compensatory growth is observed, and its intensity is related to the intensity of feed restriction (Gidenne et al. 2012). However, the average daily weight gain observed by most authors over the whole experimental period is lower in restricted rabbits weaned at 35 days of age than in rabbits fed *ad libitum* (Gidenne and Feugier 2009; Gidenne et al. 2009; Oliveira et al. 2012; Alabiso et al. 2016; Tůmová, Volek et al. 2016). In the present study, feed intake was similar for restricted rabbits and those fed *ad libitum*, and this result agrees with those of Tůmová et al. (2003) and Romero et al. (2010).

| Group | Age, days | Number of muscle fibres per 1 mm² | Fibre cross-sectional area, µm² | Diameter, µm | Perimeter, µm | Fibre type distribution, % |
|-------|-----------|---------------------------------|--------------------------------|-------------|--------------|--------------------------|
| AL    | 39        | 112                             | 513                            | 1327        | 287          | αR 14.9                 |
|       |           |                                 |                                |             |              | αW 85.1                 |
|       |           |                                 |                                |             |              | βR 40.0                 |
| R50   | 39        | 24                              | 513                            | 1327        | 287          | αR 14.9                 |
|       |           |                                 |                                |             |              | αW 85.1                 |
|       |           |                                 |                                |             |              | βR 40.0                 |
| R65   | 39        | 127                             | 513                            | 1327        | 287          | αR 14.9                 |
|       |           |                                 |                                |             |              | αW 85.1                 |
|       |           |                                 |                                |             |              | βR 40.0                 |

Means within the same row with the different superscript letter are significantly different ($p < .05$).

| SEM: standard error of the mean; AL: *ad libitum*; R50: 50 g of feed per rabbit per day; R65: 65 g of feed per rabbit per day. |
different feed consumption results might be related to modified feeding behaviours (Gidenne et al. 2012). The compensatory growth was not associated with improved feed conversion as in the study by Gidenne et al. (2009).

As with growth, the feeding regime can modify body composition, and carcase weights differed immediately after feed restriction in this study. The group with the most intensive feed restriction had the lowest carcase weight, but at the end of the experiment, the differences were not significant. Similarly, Bovera et al. (2013) and Birollo et al. (2017) reported no effect of feed restriction on the final carcase weight. These results are in contrast with our previous findings (Chodová et al. 2016) of lower carcase weights in the restricted group than in an ad libitum control, both weaned at 35 days. Therefore, it seems that the longer realimentation period of early weaned rabbits allowed for carcase weight compensation compared with rabbits weaned at 35 days.

Our feeding regime did not affect the dressing out percentage, as was also observed by Tůmová et al. (2003, 2006), Oliveira et al. (2012) and Alabiso et al. (2016). In contrast, the application of feed restriction at 35 days of age, one week after weaning, resulted in a lower dressing out percentage in restricted rabbits (Chodová et al. 2016). These contrasting results could be due to different feed restriction intensities; the intensity was lower in the present experiment. According to Ouhayoun (1998), the dressing out percentage can decrease in rabbits under feed restriction due to the longer feed retention time in the digestive tract. Consequently, the weight of the full digestive tract is greater, thus reducing the dressing out percentage. Another assumption related to the digestive tract is that the guts enlarge during feed restriction and the realimentation period of restricted rabbits (Tůmová, Volek et al. 2016).

Feeding regime did not affect the percentages of the carcase parts (hind part, forepart, loin, hind leg and hind leg meat), and these results are consistent with the data of Tůmová et al. (2006). However, differences in rabbit carcase traits have been observed under severe or long restriction periods (Gidenne et al. 2009; Metzger et al. 2009). Differences in the development of carcase parts with increasing age may be due to growth allometry; the fore part develops earlier than the late-maturing back part (Pascual et al. 2008). The perirenal fat percentage was similar in all groups, but when the feed was restricted one week after normal weaning, the restricted rabbits had a significantly lower percentage of perirenal fat (Chodová et al. 2016). It has been established that early developing tissues should be more impaired during restriction than the late-developing ones, including adipose tissue (Gidenne et al. 2012). The reason for no difference in the perirenal fat could be the longer realimentation period, during which restricted rabbits are again fed ad libitum and store the energy from the feed as fat.

In terms of meat quality characteristics, tenderness is the most important factor for consumers. Feed restriction did not affect the meat toughness and was consistent with Carrilho et al. (2009), Alabiso et al. (2016) and our previous results (Chodová et al. 2016). The cooking loss is one of the parameters by which the water holding capacity is expressed, and there was no effect of feeding regime on cooking loss, which corresponds with the observations of Gidenne et al. (2009). However, Pla et al. (1998) reported that water-holding capacity is affected by the live weight of rabbits. The meat of rabbits with less mass, according to these authors, has a higher cooking loss and, therefore, meat that is less juicy.

Skeletal muscle is composed of a large variety of functionally diverse fibre types, and their morphological characteristics are one of the important factors affecting the postmortem conversion of muscle to meat (Choi and Kim 2009). In cattle, Cassar-Malek et al. (2004) in their study found, that the different muscles reacted contrarily to the feed restriction, suggesting that muscle types display a differential nutritional sensitivity. However, in rabbits, the musculus longissimus lumborum is one of the main valuable parts of the carcase. It is homogeneous and usually, the meat quality and muscle fibre characteristics are measured in it.

In the LL muscle, αW is the predominant type of muscle fibre, and it generally has a larger CSA than type βR. The CSA of type αW correlated with meat tenderness in nutrias (Tůmová, Volek et al. 2016) and in pigs (Lee et al. 2012), but the meat of pigs with αW muscle fibres with a larger CSA exhibited low tenderness (Kim et al. 2013), but this was not the case in nutrias (Tůmová, Chodová et al. 2016). In our experiment, there were significant effects of the interactions between group and age on the CSA and diameter of βR and αW muscle fibres. Type βR with smaller CSA and diameter was observed in group R50, which was subjected to the most intensive feed restriction, and this agrees with the study by Dalle Zotte and Ouhayoun (1998), who described a reduction in the CSA of all muscle fibre types in the LL of restricted rabbits. In contrast, there was no effect of feed restriction applied one week after weaning, at 35 days, on
the CSA of all types of muscle fibres (Chodová et al. 2016). It seems that earlier feed restriction has a greater impact on the growth, and thus the CSA, of muscle fibres than later application. As expected, the CSA, diameter and perimeter of muscle fibres increased with age, which reflects hypertrophy. The type of muscle fibre affects the energy metabolism within the skeletal muscles of living animals, as well as the post-mortem change from muscle to meat (Ryu and Kim 2005). A key factor in determining meat quality is the proportion of muscle fibre types (Bianospino et al. 2008), and the percentage of type βR is related to live weight; heavier rabbits have a greater percentage of βR muscle fibres (Bianospino et al. 2008). The percentage of type βR was related to high sensory scores in nutrias (Tůmová, Chodová et al. 2016), which may be because βR muscle fibres contain more intramuscular fat (Choi and Kim 2009), which promotes taste and juiciness. In rabbits, Gondret et al. (2000) did not observe differences in the distribution of fibre types between restricted individuals and those fed ad libitum, and this is supported by the results of the current study. In contrast, Dalle Zotte et al. (2005a) and Chodová et al. (2016) found a lower percentage of αR muscle fibres in restricted rabbits. However, the distribution of type αR and αW muscle fibres changes with age; in rabbits, all the LL muscle fibres are typed as αR at birth and can change to type αW with age (Dalle Zotte et al. 2005b). In the present study, the proportion of αW muscle fibres increased with advancing age to the exclusion of αR muscle fibres, and this trend was similar to that observed in our previous study (Chodová et al. 2016). The higher amount of glycolytic muscle fibres was found to negatively correlate with cooking loss in rabbits (Chodová et al. 2016).

Conclusions

It can be concluded that one week of intensive feed restriction in early weaned rabbits did not affect live weight, average daily weight gain, feed intake, feed conversion ratio and most carcase characteristics. Limiting feed intake in early versus normally weaned rabbits influences the size of muscle fibres, especially in groups under the most intensive restriction, but meat tenderness and cooking loss were not negatively affected. Contrary to the normal weaning time, early weaned rabbits under feed restriction or fed ad libitum had similar fibre type distributions in the longissimus lumbarum muscle. This study provided new information about feed restriction in early weaned rabbits and its effect on meat quality and muscle fibre characteristics.

Disclosure statement

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