

PREVALENCE OF *POST MORTEM* LESIONS RECORDED IN A LARGE ITALIAN RABBIT SLAUGHTERHOUSE OVER A FIFTEEN-YEAR PERIOD (2003-2017)

CONFICONI D.^{ib*}, CULLERE M.^{ib*}, LAGO N.[†], ALBERGHINI L.^{*}, ROSSIN T.[‡], DALLE ZOTTE A.^{*}, GIACCONE V.^{*}

*Department of Animal Medicine, Production and Health, Università degli Studi di Padova, Viale dell'Università 16, 35020, LEGNARO, Padova, Italy.

[†]Azienda ULSS 6 Euganea, Via Enrico degli Scrovegni 14, 35131, PADOVA, Italy.

[‡]Azienda ULSS 5 Polesana, Viale Tre Martiri 89, 45100, ROVIGO, Italy.

Abstract: The present research was aimed at evaluating the prevalence of gross lesions in condemned rabbit carcasses by analysing data recorded in a large Italian slaughterhouse. From 2003 until 2017, a total of 103080019 rabbits were processed: 101722673 were finishing rabbits and 1357346 were breeding females. A total of 742397 carcasses were condemned due to lesions. Condemned carcasses from young rabbits (n=545070) evidenced: 33.6% enteritis, 31.5% subcutaneous abscesses, 29.7% cachexia and 3.84% lung disease. Among breeding rabbits (n=197327) there were 38.9% cachexia, followed by 35.8% uterine pathologies (breeding females), 14.9% subcutaneous abscesses, 5.42% ulcerative pododermatitis, 2.61% chronic nephritis and 2.47% lung disease. Regarding season-related lesions, for growing rabbits the total prevalence of lesions and diseases was the highest in winter (enteritis increased in winter, but subcutaneous abscesses were higher in summer). Rabbit does showed the highest prevalence of subcutaneous abscesses in summer and ulcerative pododermatitis in winter. From 2003 to 2017, the overall number of condemned carcasses doubled in both categories, with a sharp increase from 2012 till 2017. The prevalence of lesions among slaughtered rabbits differed between growing and breeding categories, which was attributable to different farming conditions, physiological status and slaughter age. Based on the above-mentioned findings, better management strategies at different stages of the rabbit production chain seem to be a necessary way to manage resulting waste and address possible economic concerns.

Key Words: meat inspection, slaughterhouse study, *post mortem* lesions, rabbit.

INTRODUCTION

Rabbit meat can be considered a healthy food for consumers from the nutritional perspective (Dalle Zotte and Szendrő, 2011). Despite being considered a specialty market, rabbit production plays an important role in the national economy of many countries. China is the world's largest producer, although Europe currently holds almost 93 and 67% of the world's rabbit meat imports and exports, respectively (Cullere and Dalle Zotte, 2018). The European rabbit production figure for 2016 was 119075086/head, of which 4.9% (24500000 head) was provided by Italy (European Commission Directorate-General For Health And Food Safety DG (SANTE), 2017).

Rabbit slaughter plants have key activities in public health, in addition to animal welfare and environment protection practices. Besides their ordinary activities (processing rabbits, supplying retailers, and so on), they also collect epidemiological data. Such information is important to monitor farm qualitative standards and, indirectly, to sustain consumers' confidence in rabbit meat (Rosell *et al.*, 2009). In Italy, finishing rabbits represent the majority of slaughtered animals, while breeders (does and bucks at the end of their career) account for less than 2% of the total processed carcasses (Rampin *et al.*, 2008). Young rabbits are typically slaughtered at 9-13 wk of age

Correspondence: D. Conficoni, daniele.conficoni@unipd.it. Received March 2019 - Accepted October 2019.
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(2.0-2.6 kg body weight), whereas females are culled for rendering or for the abattoir at the end of their breeding life: they are usually older than 6 mo of age. Rosell *et al.* (2009) provided a report about the on-farm prevalence of rabbit diseases, highlighting the most frequent diseases affecting rabbits for meat production: epizootic rabbit enteropathy, enteritis-diarrhoea, myxomatosis, reproductive issues, respiratory diseases, staphylococcosis and other disorders. Losses of growing rabbits have been mainly associated with enteric and respiratory disorders caused by pathogenic microorganisms such as *Pasteurella multocida* and *Bordetella bronchiseptica* (Coudert *et al.*, 2006). In addition to the above-mentioned diseases, rabbit does are also typically culled due to infertility, productive diseases such as mastitis and sore hocks caused by *Staphylococcus aureus* (Rosell and de la Fuente, 2009).

Animal transportation to the slaughterhouse was described as a critical stage for pre-slaughter lesions and mortality, especially for rabbits (Petracci *et al.*, 2010). Voslarova *et al.* (2018) investigated the transport-related mortality of rabbits in different seasons, but no significant differences were found. Petracci *et al.* (2010) highlighted how a long transportation time could lead to an increase in rabbit lesions, even if bruising rates were lower than lesions after transport of other animals, such as turkeys and chickens.

A Polish study described a high condemnation rate (21.17%) in a sample of 280 686 rabbit carcasses (Szkucik and Paszkiewicz, 2010). In Portugal, Ferreira *et al.* (2014) found that the major cause of carcass condemnation were subcutaneous abscesses (0.48% of 281 423 rabbits). In Spain, Tantiñá *et al.* (2000) reported 0.5-1% of condemnations of the 185 483 inspected carcasses, with cachexia, abscesses and respiratory diseases as the main causes. Another research (Kozák *et al.*, 2018) work, evaluating the condemnation rate of rabbits at a slaughterhouse in the Czech Republic, found a decreasing trend over the years (from 3.04% of the period 1989-1994, to 1.20% of the period 1995-2000, possibly achieved through an increase in animal welfare knowledge and attention. In Italy, Rampin *et al.* (2008) described a 1% *post mortem* condemnation rate of rabbit carcasses, with lesions mainly affecting the tegumentary, digestive and urinary systems. In particular, the most common lesions were subcutaneous abscess and chronic nephritis.

Despite some information about the lesions determining carcass condemnation in Italian slaughterhouses, up to now no research has considered a long-term and routine-based approach to assess the prevalence of lesions and diseases in slaughtered young rabbits and breeding does.

The aims of this retrospective study were a) to evaluate the occurrence of diseases and lesions at *post mortem* meat inspections carried out in a rabbit slaughterhouse from 2003 to 2017, and b) describe the season and year effect.

MATERIALS AND METHODS

Data collection

Data were collected from January 2003 to December 2017, in a large Italian rabbit slaughterhouse located in the north-eastern part of Italy (Veneto Region). In that period, the plant received and slaughtered about 103 080 000 rabbits, of which 101 723 000 were finishing rabbits and 1 358 000 were females; males were not processed. The slaughter rate ranged between 1600 and 2400 head/h, resulting in a minimum of about 21 000 and a maximum of 31 000 head/d.

During the experimental period, specialised slaughterhouse personnel daily registered the results of the rabbit carcasses *post mortem* inspections, according to European Regulation (CE) N 854/2004. In detail, the official veterinarians daily inspected a number of rabbit carcasses corresponding to a minimum of 10% of the overall slaughtered animals: sanitary conditions of the overall carcass as well as those of the internal organs were carefully examined. All the remaining carcasses were checked by qualified slaughterhouse technicians and staff (technicians with at least 10 yr of experience, trained by the official veterinarians). In the case of carcasses with visual abnormalities, these were removed from the slaughter chain by the technicians and given to the official vets for a sanitary inspection (once a day). The carcasses were then condemned according to the highest detected gross lesion. The data gathering method was designed by the official veterinarians and divided into two productive categories: young rabbits and females, and the most common lesions were listed for each category.

Lesion were classified daily by the official veterinarians, according to the following criteria: in fattening rabbits, the lesions were classified as:

- Enteritis: defined as such when the swelling of intestine was present with or without reddening of the part.
- Subcutaneous abscesses: they were detected after skinning.
- Cachexia: was registered when loss of muscle mass was evident; usually this lesion is the result of previous diseases.
- Lung lesions: gross lesions showing pneumonia, pleuritis or both.
- Other lesions: included liver lesions (mainly parasitic), followed by subcutaneous haemorrhages and muscular bruising due to poor rabbit handling.

In breeding females, the recorded lesions were also cachexia and subcutaneous lesions, followed by uterine lesions (metritis, pyometra and mummified fetuses, among others). There were condemnations due to lung lesions, ulcerative pododermatitis and nephritis (with shrinking or inflammation).

The results of each inspection were uploaded daily into the database, from which the data were subsequently downloaded for the present research.

Statistical analysis

The percentage of animals with lesions from the total subjects of the categories considered (young and females) were analysed using a two-way ANOVA linear model of the SAS 9.1.3 statistical analysis software for Windows (SAS Institute, 2008). The model included the fixed effects of the year (from 2003 to 2017) and season (spring: March to May; summer: June to August; autumn: September to November; winter: December to February). Post-hoc pairwise contrasts among the levels of the season effect were performed using Bonferroni correction. The hypotheses of the linear model were verified by visual inspection on the residuals. Values were considered statistically different when $P < 0.05$. The risk ratio between condemned finishing rabbits and females was evaluated using the P -value according to the risk ratio, using Microsoft Excel (Microsoft Corp., Redmond, WA, USA).

RESULTS

A total of 742397 condemned carcasses (0.72% of 103080019 slaughtered rabbits, Table 1) were categorised for lesions during the *post mortem* inspection, of which 545070 were finishing rabbits (73%) and 197327 were breeding females (27%). Overall, young rabbits presented a condemnation rate of 0.54% of total slaughtered young animals, whereas the condemned females accounted for 14.5% of the category. The risk ratio for a breeder to be condemned in comparison to a young was 23.5 times higher (range 23.4-23.6, $P < 0.001$).

The most common diseases and lesions recorded for condemned finishing rabbits were: enteritis (33.6%), subcutaneous abscesses (31.5%), cachexia (29.7%), lung lesions (3.8%) and other lesions and disorders (e.g., coccidiosis-cysticercosis: 1.4%), whereas the reasons for culling females were: cachexia 38.9%, uterine lesions 35.8%, subcutaneous abscesses 14.9%, ulcerative pododermatitis 5.4%, nephritis 2.6% and lung lesions 2.5% (Table 2).

In general, the season significantly affected ($P = 0.002$) the occurrence of condemnations; they were higher in winter than in summer, with autumn and spring being intermediate (Table 3). Specifically, the young rabbits' diseases and lesions whose prevalence was affected by season were enteritis ($P < 0.001$) and subcutaneous abscesses ($P = 0.011$). Enteritis prevalence was the following: winter > autumn, spring > summer (0.24, 0.18, 0.17 and 0.14%, respectively).

Table 1: Slaughtered rabbit heads for the period 2003-2017 (young, breeding and their sum): total rabbit carcasses, condemned carcasses and carcasses for human consumptions.

Rabbit category	Total slaughtered		Condemned		Human consumption	
	n		n	%	n	%
Young	101 722 673		545 070	0.54	101 177 603	99.5
Breeding	1 357 346		197 327	14.5	1 160 019	85.5
Young + Breeding	103 080 019		742 397	0.72	102 337 622	99.3

Table 2: Prevalence of diseases and lesions of young rabbits and breeding does, expressed as condemned and all slaughtered carcasses.

	Prevalence,% of condemned carcasses	Prevalence,% of all carcasses
Young rabbits:		
Enteritis	33.6	0.18
Subcutaneous abscesses	31.5	0.17
Cachexia	29.7	0.16
Lung diseases	3.84	0.02
Others diseases or lesions	1.41	0.01
Breeding does:		
Cachexia	38.9	5.65
Uterine lesions	35.8	5.20
Subcutaneous abscesses	14.9	2.16
Ulcerative pododermatitis	5.42	0.79
Nephritis	2.61	0.38
Lung lesions	2.47	0.36

The prevalence of subcutaneous abscesses was higher in summer compared to winter, but not different from spring and autumn seasons (0.18, 0.17, 0.17 and 0.16% for summer, spring, autumn and winter, respectively).

In contrast to the young rabbits, the percentage of does affected by diseases or lesions considered altogether was independent from the season. However, the season did affect subcutaneous abscesses (higher in summer than winter; $P=0.008$) and ulcerative pododermatitis (higher in winter than summer; $P=0.043$) prevalence.

In general, the year of slaughter significantly influenced the condemnation rate ($P<0.001$) for both young rabbits and breeding females. Considering the first category (Figure 1a), the period 2003-2007 showed the lowest rate of condemnations; from 2007 onwards the rate increased, reaching a maximum in 2016. Females (Figure 1b) followed a similar trend as, starting from 2006, a sharp increase in carcass condemnations was observed. For this rabbit category, the highest risk was observed in 2016, as observed for finishing rabbits. The rising condemnation risk in finishing rabbits was mainly due to a consistent increase of enteritis, subcutaneous abscesses and cachexia (Figure 2), whereas for breeding does it was mainly attributable to uterine lesions, subcutaneous abscesses and cachexia (Figure 3).

Table 3: Condemned young rabbit and breeding doe carcasses evaluated during the period 2003-2017: effect of the season on the prevalence (%) of lesions.

	Season				SEM	P-value
	Winter	Spring	Summer	Autumn		
Young, total	0.60 ^b	0.54 ^{ab}	0.49 ^a	0.55 ^{ab}	0.017	0.002
Enteritis	0.24 ^c	0.17 ^{ab}	0.14 ^a	0.18 ^b	0.011	<0.001
Subcutaneous abscesses	0.16 ^a	0.17 ^{ab}	0.18 ^b	0.17 ^{ab}	0.005	0.011
Cachexia	0.17	0.16	0.15	0.17	0.008	0.312
Lung lesions	0.02	0.02	0.02	0.02	0.001	0.164
Other lesions	0.01	0.01	0.01	0.01	0.002	0.790
Breeding, total	15.8	14.9	15.6	15.4	0.466	0.536
Cachexia	6.03	5.25	5.80	6.09	0.312	0.228
Uterine lesions	5.77	5.69	6.02	5.77	0.267	0.833
Subcutaneous abscesses	2.05 ^a	2.32 ^{ab}	2.47 ^b	2.16 ^{ab}	0.086	0.008
Ulcerative pododermatitis	0.94 ^b	0.86 ^{ab}	0.65 ^a	0.75 ^{ab}	0.073	0.043
Nephritis	0.46	0.34	0.35	0.37	0.052	0.358
Lung lesions	0.56	0.42	0.29	0.00	0.330	0.236

SEM: standard error of the mean. Letters ^{a,b,c} in the same row with different superscript differ for $P<0.05$.

SLAUGHTERHOUSE PREVALENCE OF *POST MORTEM* RABBIT LESIONS

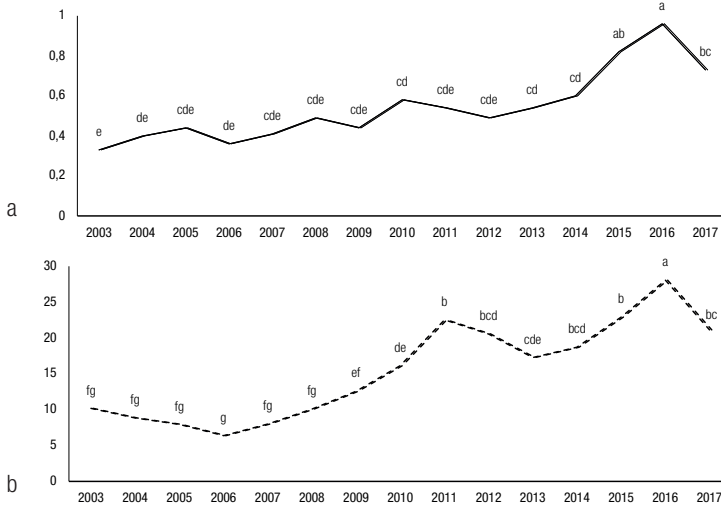


Figure 1: Effect of the year on the condemnation rate (%) in the period 2003-2017 for young rabbits (Figure 1a) and breeding females (Figure 1b) categories. Significant ($P < 0.05$) differences among years are indicated by letters ^{a, b, c, d, e}.

DISCUSSION

Slaughterhouses are sources of data for epidemiological studies and are useful to understand the distribution of lesions, as well as in developing possible strategies to improve animal health. In this study, 0.7% of all the carcasses analysed were condemned (Table 1), which is lower than previously reported by Rampin *et al.* (2008), who found 1% of recorded lesions and 1.9% of condemned rabbits. This discrepancy could be determined by the different sample

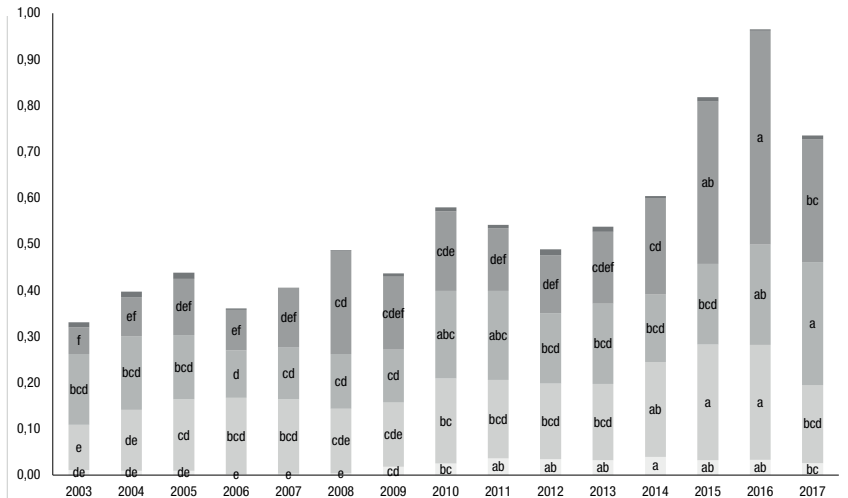


Figure 2: Effect of the year on lesions prevalence distribution (%) in condemned young rabbit carcasses. Lung lesions: $P < 0.0001$, standard error of mean (SEM)=0.002; Subcutaneous abscesses: $P < 0.0001$, SEM=0.009; Cachexia: $P < 0.0001$, SEM=0.015; Enteritis: $P < 0.0001$, SEM=0.021; Others: $P = 0.045$, SEM=0.045; Significant ($P \leq 0.05$) differences among years are indicated by letters ^{a, b, c, d, e}. □ Lung diseases; ■ Subcutaneous abscesses; ■ Cachexia; ■ Enteritis; ■ Others.

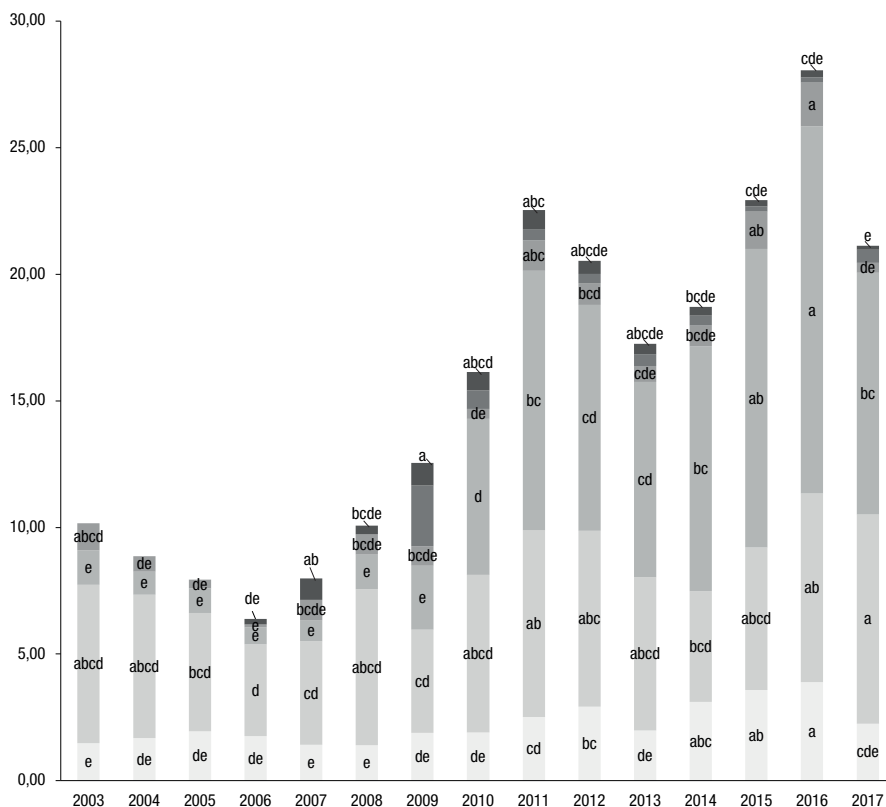


Figure 3: Effect of the year on lesions prevalence distribution (%) in condemned females rabbit carcasses. Subcutaneous abscesses: $P < 0.0001$, Standard error of the mean (SEM)=0.166; Cachexia: $P < 0.0001$, SEM=0.604; Uterine lesions: $P < 0.0001$, SEM=0.517; Ulcerative pododermatitis: $P < 0.0001$, SEM=0.141; Lung lesions: $P = 0.039$, SEM=0.640; Nephritis: $P < 0.0001$, SEM=0.101. Significant ($P \leq 0.05$) differences among years are indicated by letters ^{a, b, c, d, e}. □ Subcutaneous abscesses; □ Cachexia; □ Uterine lesions; □ Ulcerative pododermatitis; □ Lung lesions; □ Nephritis.

size of the two studies; data shown in the present research considered a total of 103 080 019 carcasses over a 15-yr period, whereas the previously cited study involved a total of 59 440 carcasses (of which 944 were does). Numbers in the present research also exhibited a lower magnitude compared to the outcomes in the Czech Republic (Kozák *et al.*, 2018), where a condemnation rate of 3.04% was found in the period 1989-1994, and 1.20% in the period 1995-2000.

The current research showed that young rabbits presented fewer lesions (0.5% of total young rabbit carcasses) than breeding does (14.5% of total female carcasses), thus differing in the number of carcasses discarded from human consumption (Table 1). Despite the low prevalence of discarded carcasses, the total number of condemned finishing rabbit carcasses in 15 yr accounted for nearly 1 150 800 kg, while female carcasses accounted for almost 637 900 kg, thus possibly representing relevant wastage and consequently economic damage. Furthermore, the increase in condemnation risk from 2003 to 2017 deserves special attention, as it led to rising growth in waste generation and thus economic damage. When a carcass is condemned, together with the cost for the producers, it should also be considered that the slaughterhouse must pay for disposal of the carcass, as it falls within the category 2 material cited in Regulation 1774/2002 of the EC (EC, 2002). For these reasons, the increase in condemnation risk from 2003 to 2017 merits special attention.

The higher condemnation level of does in comparison to that of young rabbits was expected, as the former mostly consists of culled females. A wide spectrum of different on-farm diseases was reported (Rosell and de la Fuente, 2009), with a median monthly removal risk of 9.3%, consisting of 3.4% animals dead and 5.7% of culled rabbits. Age is a key factor for the high condemnation risk in females, as they also develop several chronic lesions and disorders throughout their reproductive life such as ulcerative pododermatitis, metritis, fertility problems, nephritis and others (Rosell *et al.*, 2009). In the present study, young rabbits were slaughtered at 9-13 wk and, for this reason, most of their lesions were those typical of young animals such as enteritis, mostly linked to the weaning phase, and lung disorders. Due to the presence of chronic diseases and culling for infertility, the condemnation risk for breeding doe carcasses was 23.5 times higher than that of a younger animal; young rabbits were more likely to be valuable from a commercial point of view and they presented a low risk of condemnation.

All farmed animals are susceptible to several disorders: in the current study, the collected data showed that the most frequent disorder recorded for young rabbits was enteritis (33.6%, Table 2), which is in line with the findings of Rampin *et al.* (2008) – enteritis is a typical disorder of growing animals.

Subcutaneous abscesses were the second most common lesion (31.5%, Table 2), which had also been previously described as present among 63% of rabbit farms (EFSA, 2005). This kind of lesion was of particular concern in the slaughterhouses, as during carcass skinning the purulent content of the abscesses could be spread all over the carcass, resulting in surface microbial contamination. In farms, social interactions (e.g., fights), poor maintenance and low hygiene conditions are all enabling factors for the contamination of skin lesions with consequent formation of abscesses (Ferreira *et al.*, 2014). The increasing trend of subcutaneous abscesses over the years could also have been partly favoured by new rabbit farming systems in which, in response to the emerging animal welfare requirements (Prinz *et al.*, 2008), larger rabbit groups were formed, favouring social interactions, including fights (Cullere and Dalle Zotte, 2018). Rampin *et al.* (2008) detected a higher prevalence for subcutaneous abscesses (37.7% of recorded lesions) compared to the present study, but they did not distinguish the rabbit category (finishing rabbits and females), thus perhaps affecting the outcome. Similarly, the total number of abscesses recorded by Ferreira *et al.* (2014) in a rabbit slaughterhouse in the central region of Portugal was 44.2% of the condemned young rabbit carcasses, higher than that of the present study.

Finisher's cachexia was the third most frequent lesion recorded (29.7%, Table 2); it is associated with non-specific diseases and is a consequence of other diseases such as pneumonia and enteritis. In the present study, cachexia prevalence was higher than that found by Ferreira *et al.* (2014), likely due to the different sample type and size in the two studies. The category "Lung lesions", which includes all disorders involving the respiratory system, was much lower (3.8%) than for the other disorders observed (Table 2). Farm management is crucial for the different prevalence of diseases or lesions and, specifically, the impact of the lesion has been associated with a correct litter management. In the study by Ferreira *et al.* (2014), pneumonia prevalence was higher than that in this study (6.8%), whereas Rampin *et al.* (2008) reported a prevalence similar to our data (2.8%). The category "Other diseases or lesions" accounted for 1.4% and collects other infrequent diseases and other "technopathies", such as broken bones with wide bruises (Table 2).

As previously mentioned, female categories showed a higher condemnation rate than young rabbits, because females mainly consisted of animals at the end of their reproductive career or culled. The most frequent cause of carcass condemnation for females was cachexia (38.9% of condemned carcasses, Table 2), which is linked to non-specific diseases (e.g., sore hocks, rhinitis and mastitis) as it is a typical consequence of these, but also to the intensive reproductive cycle of rabbit does. In fact, the body condition is a good indicator of health in does, and is thus a criterion in farm management (Rosell and de la Fuente, 2008). Even though in our study the cachexia was present to such a high degree, unfortunately this condition was not recorded by other authors. Uterine lesions (e.g., metritis), were the second most common lesion (35.8%, Table 2) of the breeding category, which was expected, as it is documented as one of the main causes of infertility, including insemination failures which lead to culling (Rosell and de la Fuente, 2009). Rabbit does at the end of their reproductive career frequently have uterine lesions; in fact, more than 55% of does are culled before their fifth kindling (EFSA, 2005). The prevalence of subcutaneous abscesses in breeders was lower than the relative prevalence of this pathology in finishing rabbits (14.9%, Table 2). As rabbit does are usually singly caged, the probability to develop skin lesions is lower compared to finishers, which are usually caged in small or large groups (Cullere and Dalle Zotte, 2018). Poor animal handling is among the principal risk factors for skin lesions,

with the consequent possibility for carcasses to become contaminated during slaughter (EFSA, 2005). Ulcerative pododermatitis is typical of heavy animals and strongly associated with age and poor hygiene, and favoured in wire net floors not provided with foot-rests (Rosell and de la Fuente, 2009). According to the collected data, the prevalence of paw lesions in rabbit does during the 15 yr of monitoring was low (5.4%, Table 2) compared to that found in other studies, where the prevalence of ulcerative pododermatitis was the third cause of doe culling (EFSA, 2005).

Cases of nephritis accounted for a small part of the total lesions that led to condemnation of rabbit does (3%) and this prevalence is much lower than that previously reported by Rampin *et al.* (2008). Despite lung diseases being described in breeding rabbits (Rosell *et al.*, 2009) and commonly observed on-farm, their prevalence among the condemned carcasses of the present study was low (2.47%), which could be due to the fact that such lesions, unless of great severity, do not directly generate carcass downgrading/condemnation.

Results of this study show that there was a significant seasonal effect ($P=0.002$) on the prevalence of some lesions in finishing rabbits from 2003 till 2017 (Table 3). A correct management both in farm and during transportation to slaughter is fundamental to prevent excessive losses. During winter season, finisher carcasses were condemned more frequently than in summer, in contrast to the results of Voslarova *et al.* (2018), which evidenced a higher—but not statistically significant—mortality in both summer and winter transported animals. In contrast, the prevalence of lesions and diseases in females was not associated with season ($P=0.536$), which may be explained, for example, by the higher resistance to weather conditions compared to younger animals, as well as to a fully developed immune system. In finishing rabbits, subcutaneous abscesses (P -value = 0.011) and enteritis (P -value < 0.001) were typical season-associated diseases, whereas in rabbit does, the season-related lesions and disorders were subcutaneous abscesses (P -value = 0.008) and ulcerative pododermatitis (P -value = 0.043) (Table 3).

Subcutaneous abscesses were more often observed during hot seasons in carcasses of both finishers and females. Ulcerative pododermatitis cases found during inspection at the abattoir were more frequent during winter than summer. Other recorded disorders were not influenced by season; nevertheless, they must be taken into consideration on-farm throughout the year.

The results of the present study showed that, in 2016, the condemnation occurrence in females was two times higher than 2003, and, in 2016, finisher rabbit carcasses condemned were three times the number of carcasses condemned in 2003, highlighting an increasing trend in condemnation risk. As slaughterhouse procedures did not change throughout the observation period, this increase in condemnation cases of both young rabbit and female carcasses could be associated with on-farm disorders (EFSA, 2005).

CONCLUSIONS

Results of the present study, considering a routine-based sanitary inspection of rabbit carcasses in a commercial Italian slaughterhouse, highlighted that the recorded condemnation rate of rabbit carcasses was overall low (0.72% of the slaughtered animals). The outcomes reveal that the carcass condemnation risk increased from 2003 till 2017, thus stressing that a further improvement in rabbit production chain management should be achieved. Rabbit producers must always remember that only clinically-healthy rabbits should be presented for slaughter. In addition, the information that seasons had significant effects on the occurrence of lesions was useful for both rabbit producers and rabbit abattoirs, with a view to improving the homogeneity of finishing rabbits and meat quality.

Conflict of interest: The authors declare no conflict of interest.

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