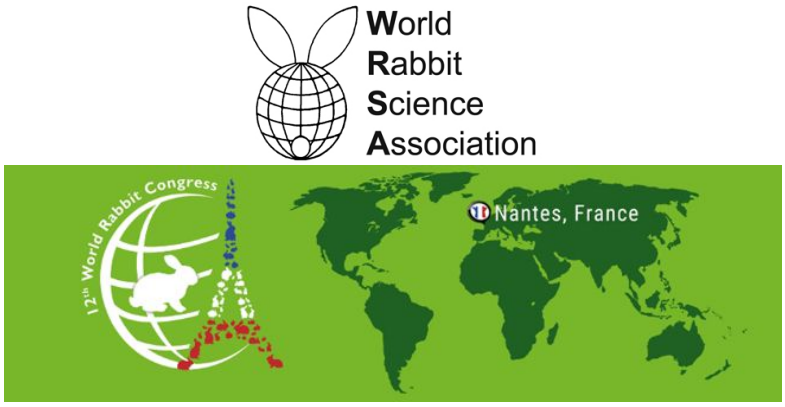

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RHINITIS IN DOES: PREVALENCE AND SEASONAL EFFECT

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ABSTRACT

In this cross-sectional study, prevalence of clinical rhinitis (CR) of rabbit females and yearly-seasonal risk factors were determined on 539 doe rabbit farms in Spain and Portugal, from January 2001 through December 2018. The information was obtained by carrying out 2622 visits and doing physical examinations of 159,093 lactating does, sorted in 3003 cohorts. Overall mean prevalence of CR was 18.03% ($CI_{95\%}$ [17.07-18.99]), (minimum to maximum: 0–95% prevalence of CR). This result may be considered a baseline on commercial rabbitries in Spain and Portugal. In addition, our study suggests that season is an enabling risk factor for rhinitis ($p<0.001$); farmed domestic rabbit does have more snuffles during summer.

Key words: Animal Welfare, Disease prevention, Rabbit, Respiratory diseases, Rhinitis prevalence

INTRODUCTION

Rhinitis is inflammation of the nasal tissue (Caswell and Williams, 2007); it often produces secretions, in which case it is known as *snuffles*, although this also includes sinusitis (Hoskins, 1920). Another term used is *coryza* (contagious), mainly in Europe (Löliger *et al*., 1972). Rhinitis and sinusitis affect the upper respiratory tract (URT) in rabbits commercially farmed (Deeb and DiGiacomo, 2000), for meat (Rosell *et al.*, 1992), fur (Boucher and Thébault, 2000), as pets (Mancinelli, 2019), or for laboratory purposes (Flatt, 1974). Signs of rhinosinusitis often include nasal secretion and sneezing. Severe cases affect the general condition of the animal, e.g., hyperthermia or anorexia; but more importantly, it can lead to other disorders, e.g., in lungs, ears or genitals (Coudert *et al*., 2006). Diagnosis forms part of the control of rhinitis, based on observing nasal, mucosal, purulent and sometimes scabby secretions in the nasal orifice, on the medial surface of the forelimbs, or both. Health monitoring of farmed domestic rabbits includes checking for rhinitis (Morisse *et al.*, 1984), whereas sinusitis and other URT disorders are diagnosed when examining individual animals on the veterinary clinic (Divers, 2015) or at necropsy (Rosell and de la Fuente, 2016). Infectious rhinitis is compatible, e.g., with pasteurellosis or staphylococcosis and also myxomatosis (Badiola *et al.*, 2000).
The aims of the study were a) to assess the prevalence of rhinitis in the examination of lactating does on commercial farms between 2001 and 2018, and b) to investigate year and season effects as risk factors of rhinitis in does.

MATERIALS AND METHODS

Farms visited, does and season

Our study covered the period between 1st January, 2001 and 31st December, 2018. We visited 539 farms in Spain and Portugal. We formed a database with the information on, a) breeding does, b) does at risk and c) does examined per farm, plus the results of the clinical examination. In this study, the does were lactating, from first parturition onwards. Therefore, a farm could have, e.g., 1000 does in

two batches; one with 400 on the point of parturition and another with 400 lactating does, 40-50 of which we examined.

Diagnostic procedures on the farms

Data collected correspond to does on farms free from clinical myxomatosis. We examined one or more cohorts of lactating does per farm. The females in each cohort were at the same lactation stage, belonged to the same line, or were housed in the same barn. When sampling, we do not usually include does in the week following service. We began with a clinical examination of 10-15% of the primiparous does, when they were all grouped together, followed by directed random sampling; e.g., in a population of 400 lactating does, we examined 4-5 primiparous does, then one in every 10, until 40-50 does had been examined.

The does were taken from their housing and examined for productive clinical rhinitis. We observed secretions from the nasal cavities, on the medial surface of the forelimbs, or both. The records for rhinitis were binary and excluded different types of nasal secretions. The only additional factor in these diagnoses was apparent atrophic rhinitis or other lesions on the nose.

Statistical Analysis

Sample size (n) calculation was done with WinEpi software (de Blas, 2006), using the following data: population at risk (nl lactating does), degree of expected confidence (95%), and expected prevalence (p%); when the examination was made, we calculated apparent prevalence with the population at risk, sample examined (ne does), sick does found (ns), and degree of expected confidence (95%). We converted our anonymized raw data to Microsoft Excel 2010 (Microsoft Corp., Redmond, WA, USA). Statistical analysis was by SAS (2003), utilizing GENMOD procedure. Statistical significance was indicated by a p-value < 0.05.The dependent variable: prevalence of clinical rhinitis (CR) was binomial (proportion) distribution in the GENMOD procedure. The units of analysis were the cohorts, (proportion: ns sick does /nl at risk).The factors of variation on the dependent variable (prevalence of CR) were estimated with the following model:

$$Y_{ijm} = \mu + A_i + S_j + e_{ijm}$$

where μ was the population mean, A_i was explained by the effect of the i^{th} year (18 levels), S_j was explained by the effect of the j^{th} season (4 levels), and e_{ijm} was the residual effect.

RESULTS AND DISCUSSION

Over the 18-year period, we examined 159,093 lactating does, distributed in 3003 cohorts and 2622 visits to 539 farms; that is, 53 does examined in each cohort with 60 on each visit. Figure 1 shows mean annual prevalence during this time.

Apparent mean prevalence of rhinitis was 18.03% ($CI_{95\%}$ [17.07-18.99]), ranging between 0 and 95%. Differences between year were significant (p<0.001). The prevalences found during 2001-2018 were clearly lower than those of previous years. Thus, from 1986 to 1991 mean prevalence on 435 farms decreased from 43.6% to 33.1%, reaching 31.7% in 1995 (Badiola et al., 2000) and 26.7% in 1997, determined on 153 farms (results not presented).

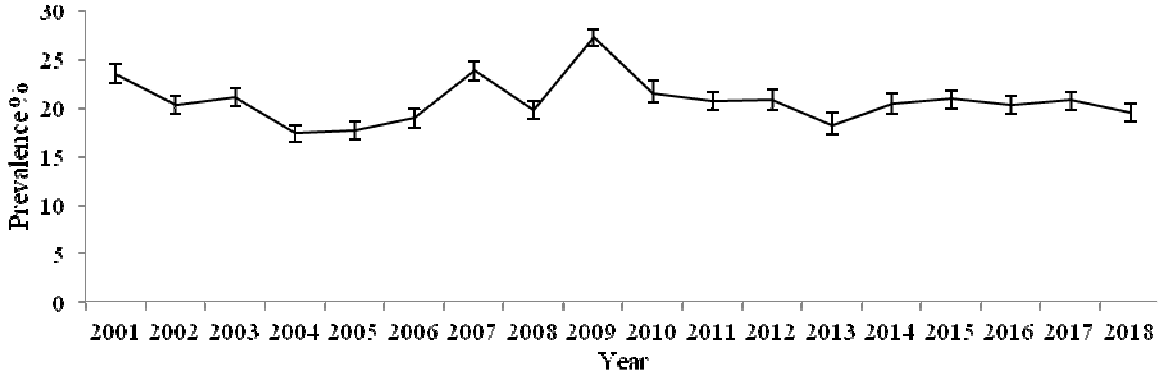

Figure 1: Mean annual prevalence of rhinitis and mean standard error, based on the clinical examination of 159,093 lactating rabbit does during 2622 visits to 539 farms, between 2001 and 2018, in Spain and Portugal.

Prevalence also differed with the season ($p<0.001$). The results are shown in table 1.

Table 1: GENMOD of the *season* risk factor in the mean prevalence of rhinitis in does. 2001-2018.

Months	N cohorts	Prevalence %
January-March	770	15.2[c]
April-June	715	18.0[b]
July-September	758	20.9[a]
October-December	760	17.0[b]

Means with different letters on the same column differ significantly

The prevalence of sick does was lower in winter and higher in summer. Unlike these results, spring and autumn show no differences between each other and can be considered as transition periods. Previous results have also revealed higher prevalence in summer (Rosell *et al.*, 1992, Badiola *et al*., 2000). Our results contrast with those found by Webster (1924), who observed minimum prevalence in July and August and maximum in September and October. According to Coudert *et al*., (2006), *in countries with very low relative humidity due to very low winter temperatures (Canada, Poland), pasteurellosis rages endemically during this season when large numbers of rabbits are concentrated indoors.* The same authors believe that high air velocity and low relative humidity (in addition to dust in the environment or > 5 ppm of ammonia, for example), enable the onset of coryza; that may explain the higher apparent prevalence of clinical rhinitis observed in our studies, during the summers from 1986 to 2018.

CONCLUSIONS

Based on this study of commercial rabbitries, we can infer that the apparent mean prevalence of rhinitis in lactating does was 18% within the area analysed. This can be taken as a baseline for health assessments on farms, though ranges vary considerably (0 to >90% sick does). Nevertheless, the situation has evolved favourably over the years. In Spain and Portugal, the prevalence of rhinitis on commercial farms is higher in summer than in winter, the other seasons being considered as transition seasons.

ACKNOWLEDGEMENTS

This study was made possible by the producers who allowed us to visit their farms. Visits were shared with many technicians and veterinarian peers. Catherine R. Martin assisted us with the English language editing. Our recognition goes to all of them. This paper is in memory of late Pierre Coudert (1942- 2018).

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Rhinitis in does: prevalence and seasonal effect

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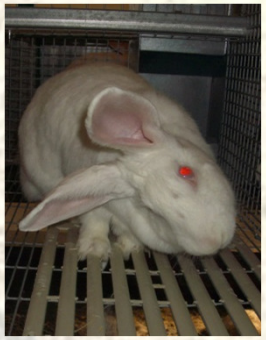
This is a retrospective study related wit rhinitis, that is the inflammation of the nasal tissue. It often produces secretions, in which case it is known as snuffles. This clinical sign is the one we evaluate, looking secretions in the nasal orifice, on the medial surface of the forelimbs, or both.

Rhinitis can lead to added disorders, e.g., in lungs, eyes, ears, genitals, or subcutaneous (Coudert *et al.*, 2006)



Rhinitis in does: prevalence and seasonal effect

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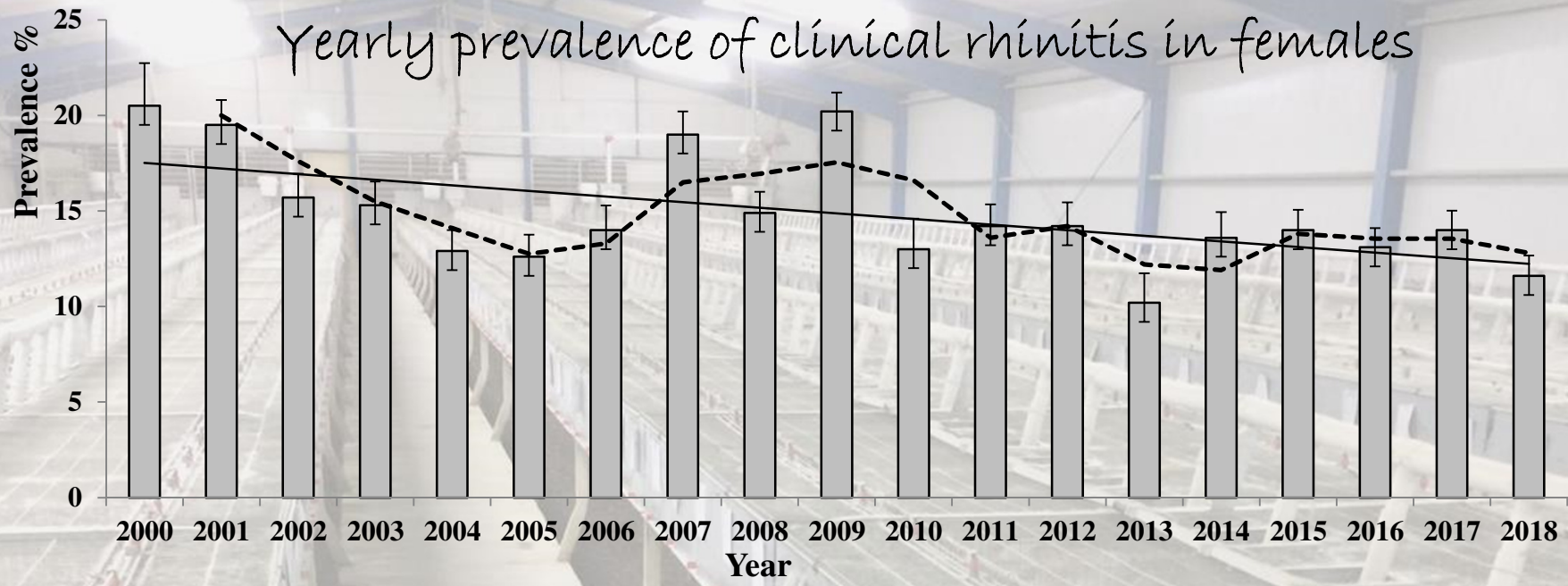
We converted our anonymized raw data to Microsoft Excel 2010. Statistical analysis was by SAS (2003), utilizing GENMOD procedure.



Mean relative and annual prevalence of rhinitis and mean standard error, rolling average for 2 years (dotted line) and trend, based on the clinical examination of 159,093 lactating rabbit does during 2600 visits to 539 farms, between 2001 and 2018, in Spain and Portugal.

According to our results, 18% of rhinitis can be taken as a baseline for health assessments on farms in our area, though ranges vary greatly, from 0% to >90% sick does. Differences between year were significant ($p<0.001$).

In a subset of 212 farms with females and males , and in 26 insemination centers, we examined 37,396 does and 22,247 males. We diagnosed clinical atrophic rhinitis in 15 females (0.04%) and in 25 males (0.11%), which are very low occurrences.

Prevalence also differed for the season effect ($p<0.001$).

The prevalence of sick does was lower in winter and higher in summer.
Our previous observations were also similar (Rosell, J.M., Badiola, J.I., de la Fuente, L.F., Cármenes, P., Badiola, J.J., 1992. W.R.Congress in Oregon, USA)

Months	N cohorts	Prevalence
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Rhinitis in does: prevalence and seasonal effect

Rhinitis is only a step in the evaluation of the problem, it's evident; in addition to mortality rates, weight gain of weaned rabbits (besides signs such as body condition, snuffles and lesions: external otitis), necropsy findings and also abattoir information.

In our practice on commercial rabbit farms, respiratory diseases and related disorders are of great interest. Nevertheless, from 1986 onwards, the situation has evolved favourably over the years.

In our opinion, it should be investigated in various aspects : genetic resistance to respiratory diseases, improvements in the environment, in the rabbit management, and other prevention measures, such as vaccines.

Thank you for your attention!

Rhinitis in does: prevalence and seasonal effect

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