Mortality In Laying Hens – A Comparison Of Different Housing Systems

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ABSTRACT

The observation of the mortality in laying hens is a commonly used instrument to estimate the flock welfare. Several new housing systems have been developed to fulfill the new legal regulations within the European Community and Germany. In our study we examined laying hens mortality rates in relation to different housing systems and layer lines by survival analyses techniques.
The Ruthe university research farm regularly changes the housing systems for scientific purposes having concurrently different housing types through a certain period of time. In this case the systems evaluated were: Conventional Cages, 2 different furnished cages A and B, and Aviary System. Daily mortality was recorded between week 18 and 66 of hens' life. Statistical analyses included survival analyses via Cox Regression.
The lowest weekly mortality rates was found in Aviary (0.078%), while the highest mortality was in Furnished B (0.161%). Beyond the overall mortality rate calculations, the survival analysis gives a more detailed description of the events of death.
In addition to the discussion that conventional cages will be prohibited from 2012 within the European Community, the new furnished cages do not seem to result in lower mortality than the classical systems. The flock size, the space per hen and the structure of the environment are factors under future investigation.

KEYWORDS

Laying hens, housing systems, survival analysis

INTRODUCTION

Mortality observation in laying hens is a commonly used instrument to estimate the welfare of the flock. Increased mortality rates are often linked to cannibalism or septicaemia (Klaczinski, 1992, Tauson et al., 1999). Weitzenburger et al. (2005) examined dead and moribund animals and found cannibalism in 65.5% of all cases and enteritis in 37.5% of the animal at necropsy. Cloacal pecking often causes ascending infections which lead to coli enteritis, salpingitis or salpingitis-peritonitis (Abrahamsson and Tauson, 1997).
Several new housing systems have been developed to fulfill the new and upcoming legal EU regulations (1999). In Germany, conventional cages are prohibited since the end of 2008. In conventional cage systems only five hens are housed per cage, whereas newly furnished cages provide nest boxes, litter-areas and claw-shortening devices. Aviaries as non-cage systems provide the opportunity for hens to fly up and to move within several tiers. Housing systems differ regarding their mortality rate (Tauson, 2002). Flock size and stocking density are important influence factors that have an impact on mortality (Nicol et al., 2006). Weber et al. (2003) found that mortality was high in conventional cages (11.0%) as well as in aviaries with access to outside (11.7%). Housing systems with space outside always are exposed to losses by predators. Furnished cages showed the lowest mortality in this trial (8.7%).
In our study we examined the influence of different housing systems using survival analyses.

MATERIAL AND METHODS

Laying hens were kept on the university research farm Ruthe with different housing systems concurrently during two independent laying periods (2000 – 2004; 2005 – 2008). Apart from conventional cages and an aviary system, two different furnished cages were used for this study: Furnished Cage A was used with group sizes between 10 and 30 hens per cage, and Furnished Cage B housing 40 or 60 hens per cage. The "Lohmann Silver" layer line was used within the study period.
Weekly mortality rate was recorded as "number of dead hens per 1000 hens at the beginning of the week" between week 18 and 66. Overall mortality rate was calculated by summarizing the number of dead hens and dividing them by the number of hens at the beginning of the trial. Kaplan-Meier survival curves as well as the Cox regression was used to estimate the influence of housing system on survival (Ziegler et al., 2007). Statistical analyses were performed using SAS (version 9.1. TS Level 1M3).

Combinations of housing systems varied between the laying periods. Therefore, the comparison was conducted in two trials. Each trial includes data of two laying periods (table 1).

Table 1 Overview of the number of hens per housing system (layer line: Lohmann Silver) in the trials

	Housing system			
			Furnished	
Trial	**Con**	**Aviary**	**A**	**B**
1	4,446		4,629	
2		5,028		4,500

RESULTS

The Aviary housing type had the lowest mortality rates of all housing systems evaluated. No significant differences could be found between conventional cages and Furnished Cage A (table 2). The Aviary system had significantly lower weekly mortality rates (table 2) than Furnished Cage B, which can be also observed in the Kaplan-Meier curves (figure 1).

Table 2 Mortality rates of the housing systems conventional and Furnished Cage A, and Cox Regression Model (trial 1)

Trial	Housing System	Overall Mortality (%)	Weekly Mortality[1] (%)	Cox Regression Model			
				Hazard Ratio	Confidence Limits		p-value[2]
1	**Conventional**	7.35	0.151	-	-	-	-
	Furnished A	7.19	0.150	0.972	0.835	1.132	0.7166
2	**Aviary**	3.72	0.078	-	-	-	-
	Furnished B	8.56	0.161	0.382	0.321	0.455	<0.0001*

[1]Weekly mortality: Dead hens per week per 1000 hens at the beginning of this week. Displayed in the table as mean of all weeks.
[2]LR χ^2: Likelihood ratio chi-square value; level of significance: 0.05.

DISCUSSION

The mortality rate is a general indicator of welfare, and is therefore a useful variate to assess housing systems. Mortality rates between 1 and 28 % are considered average (Vits et al., 2005). In our study, we observed mortality rates between 3.7 and 8.6 %, which is within the "lower normal range" of data under discussion. The record of weekly mortality rates may help to control increasing mortality and to differentiate between sudden death occasions and permanent increased rates (Elson and Croxall, 2006, Nicol et al., 2006).

In the conventional cage, problems like bumble foot lesions and keel bone deviation enhance the mortality (Tauson et al., 1999), while fewer losses from cannibalism occur. Our results of 7.35% mortality fit to the reports of mortality rates in conventional cages range from 2.4% to 27.9% (Galtz and Barnett, 1996, Vits et al., 2005).

In general, furnished cages are an attempt to retain economic and hygienic standards of conventional housing and to offer the hens the possibility to fulfil natural behaviours (Vits et al., 2005). Other authors found mortality rates in furnished cages between 3.6% and 8.7% (Vits et al., 2005), which correspond to our study results (Furnished Cage A 7.19%, Furnished Cage B 8.56%).

Aviaries with one or several tiers provide the opportunity to fly and to show normal hen behaviour, but the problems linked to large flock sizes are also common in this housing system. Mortality rates published in several studies and range from 3.4 to 20.9% (Abrahamsson et al., 1998). In our trials, we found 3.72% overall mortality which were the lowest results of all housing systems tested.

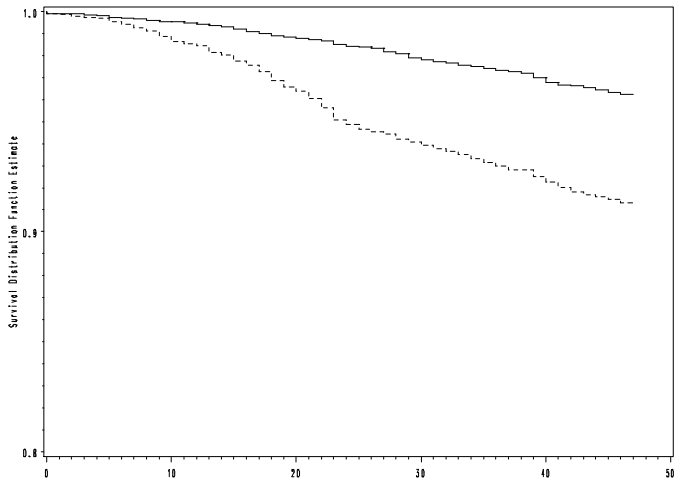

Figure 1 Kaplan-Meier curves of the housing systems Aviary and Furnished Cage B per week (layer line LS); ——— Aviary, - - - - - Furnished Cage 2

CONCLUSIONS

Beyond the calculation of the overall cumulative mortality rate, the method of survival analysis gives a more detailed description of the events of death. The housing systems differed significantly in the survival time of laying hens. The flock size, the space per hen and the structure of the environment are probably influence factors.

REFERENCES

(1999) Council Directive 1999/74/EC: Laying down minimum standards for the protection of laying hens. IN COMMUNITIES, O. J. O. T. E. (Ed.), Council of the European Union.

ABRAHAMSSON, P., FOSSUM, O. & TAUSON, R. (1998) Health of laying hens in an aviary system over five batches of birds. *Acta veterinaria scandinavica,* 39**,** 367-379.

ABRAHAMSSON, P. & TAUSON, R. (1997) Effects of group size on performance, health and birds' use of facilities in furnished cages for laying hens. *Acta Agricultura Scandinavica, Section A,* 47**,** 254-260.

ELSON, L. A. & CROXALL, R. A. (2006) Vergleichende europäische Studie zum Wohlbefinden von Legehennen in Käfig- und Nicht-Käfig-Systemen. *Archiv für Geflügelkunde,* 70**,** 194-198.

GALTZ, P. C. & BARNETT, J. L. (1996) Effect of perches and solid sides on production, plumage and foot condition of laying hens housed in conventional cages in a naturally ventilated shed. *Australian Journal of Experimental Agriculture,* 36**,** 269-275.

KLACZINSKI, K. (1992) Erkrankungen der eibildenen und -ableitenden Organe. IN HEIDER, G. & MONREAL, G. (Eds.) *Krankheiten des Wirtschaftsgefluegels.* Jena, Stuttgart, Verlag Gustav Fischer.

NICOL, C. J., BROWN, S. N., GLEN, E., POPE, S. J., SHORT, F. J., WARRISS, P. D., ZIMMERMAN, P. H. & WILKINS, L. J. (2006) Effects of stocking density, flock size and management on the welfare of laying hens in single-tier aviaries. *British poultry science* 47**,** 135-146.

TAUSON, R. (2002) Furnished cages and aviaries: production and health. *World's Poultry Science Journal,* 58**,** 49-63.

TAUSON, R., WAHLSTRÖM, A. & ABRAHAMSSON, P. (1999) Effect of two floor housing systems and cages on health, production, and fear response in layers. *Journal of applied poultry research,* 8**,** 152-159.

VITS, A., WEITZENBURGER, D. & DISTL, O. (2005) Comparison of different housing systems for laying hens in respect of economic, health and welfare aspects with special regard to furnished cages (Review article). *Deutsche Tieraerztliche Wochenschrift,* 112**,** 332-342.

WEBER, R. M., NOGOSSEK, M., SANDER, I., WANDT, B., NEUMANN, U. & GLUENDER, G. (2003) Investigations of laying hen health in enriched cages as compared to conventional cages and a floor pen system. *Wiener Tieraerztliche Monatsschrift,* 90**,** 257-266.

WEITZENBURGER, D., VITS, A., HAMANN, H. & DISTL, O. (2005) Effect of furnished small group housing systems and furnished cages on mortality and causes of death in two layer strains. *British poultry science* 46**,** 553-559.

ZIEGLER, A., LANGE, S. & BENDER, R. (2007) Überlebenszeitanalyse: Die Cox-Regression. *Deutsche Medizinische Wochenschrift,* 132**,** e42-e44.