Working load in organic egg production with mobile chicken coops

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Abstract: *Organic eggs are sometimes produced in mobile chicken coops. The impacts of these mobile chicken coops, in particular their equipment, on the work done, have so far not been investigated. Therefore, the goal of this case study was to record the physical and mental workload of the daily activities in these stables. The data collection took place in an organic farm in Germany, which produced organic eggs with two different mobile chicken coops. The daily work in these stables was done by two male and two female workers. The working element method according to AUERNHAMMER (1976) was chosen to categorize the measurement results of the routine work and the HARVARD steptest was applied for the grading of the fitness. For the collection of data, the measuring device Movisens® was used, for the metrological recording of the heart rate for the assessment of the stress. The work-related results were evaluated descriptively and analytically. In daily routine work, mean heart rates above the continuance power rating of 110 bpm were achieved. The heart rate differed significantly according to activity, passage, gender and stable model. Similar results are confirmed by studies on other agricultural enterprises.*

Keywords: *organic, work load, mobile coops, heart rate, stress*

Introduction

The organic egg production is experiencing a steady growth in Austria and Germany. Over the past decade, mobile henhouses, such as the Hühnermobil 225 and Legehennemobil, have been developed. (Fuhrmann *et al.*, 2011).
In comparison to the conditions in cage-rearing, the working conditions for the farmer in the mobile chicken coops are more unfavourable.

Figure 1. Hühnermobil 225. *Photograph: Trieb.*

Figure 2. Legehennenmobil. *Photograph: Trieb.*

Disadvantages are caused by higher pollutant concentrations and dust levels due to moist litter and limited transparency for animal care, longer periods for egg collection and physically more demanding work due to adverse loads and ergonomic workplace deficits.
For the evaluation of the workload, identification of adverse work loads of activities, the determination of the working time requirement and heart rate can be used. A high heart rate and working time requirement relates to an increased oxygen demand of muscles and increased circulation. The heart rate is influenced by emotional and mental stress and working conditions. It records the total stress of the work and is determined by the R-wave of the electrocardiogram (ECG) (Imbeau *et al.*, 1995).
The physical and mental workload usually occurs simultaneously, but can theoretically be divided into sub-loads. The physical workload relates to the stress on the cardiovascular system, including the lungs and breathing, the muscular systems with tendons and ligaments, the skeletal system, including the spinal column, and the sense organs with nerves and glands. By means of the mental workload, the mental-informational and social-emotional stress can be quantified (Brokranz *et al.*, 1991). Commercial semi-automatic blood pressure devices from different manufacturers are available to record the heart rate and thus quantify the load. There are no study results on the workload in laying hen husbandry, such as mobile laying hen houses.
Therefore, the aim of this case study was the determination of the physical and mental stress of the daily routine work in mobile chicken coops during the autumn and winter period.

Material and methods

The data collection took place on a farm in Germany, where organic eggs were produced with the Hühnermobil 225 and Legehennemobil von Herrmannsdorf.
The Hühnermobil 225 was designed for 225 laying hens and had an area of 14 m². The pen consisted of a lower level, which served as a scratching area, and the upper warm region, where the feeding, watering, perches and nesting boxes were installed. The collection of the eggs took place exclusively from the outside area. The stable model has a manure belt.
The laying hen mobile offers space for 192 laying hens. It has a straw-interspersed space that integrates all other areas such as feeding, watering, perches and nests. The subjects entered the stable at ground

level. The eggs were taken by entering and collecting from the nests inside the house. When mucking once a month, the entire litter was removed with the feces.
The daily work during the autumn and winter months was done by two male and two female subjects aged between 16 and 31 years. Their parameters are listed in table 1.

Subject No.	Gender	Age Years	Height cm	Weight kg	BMI kg/m²
1	Male	25	178	72	22,7
2	Male	19	175	65	21,2
3	female	16	183	60	17,9
4	Female	31	173	65	21,7

Table 1. Specific parameters of the subjects (n=4) (2015). *BMI=Body-Mass-Index.*

None of them smoked.
The examined daily and weekly routines were feeding, monitoring, collecting and pre-sorting eggs, all of them were done manually. These activities, due to the frequent performance, enabled the comprehensive gender-specific data collection for men and women. The determination of fitness in the subjects was performed with the Harvard Steptest (Glaser *et al.*, 2014). To determine the activity-related workload, heart rate, the routine activities were structured according to Auernhammer's working element method (Auernhammer, 1976).
The heart rate measurement, documented over four days per subject, made it possible to determine a measure of the total load of a person. In this static and dynamic work, mental and emotional stress and environmental factors are taken into account (Groborz *et al.*, 2013). For recording the heart rate, the ECG and activity sensor of Movisens® was used. The fluctuations in heart rhythm were represented by the heart rate variability. This provides information about the stress level of a person. (Böckelmann *et al.*, 2011).
For analytical data analysis, the statistical program SAS 9.4® was used. As statistical test methods, the Generalized Linear Model (GLM) and the Logistic Regression (LR) were applied.

Results

The average working time requirement of the weekly activities was similar in both stables (Figure 3). The slightly higher demand of the laying hen mobile can be explained by the fact that there was a smaller number of chickens. In the daily work, feeding in the laying hen mobile by 12.1 MPh was more time-consuming than in the chicken mobile 225. The inspection walk in the evening took a little bit longer, which is due to the larger size of the stable. The working time requirement of the egg collecting process in the Hühnermobil 225 had a lower value, since the opening of the fence and the stable door were not necessary. The slightly higher workload of presorting the eggs in the Legehennenmobil, despite a smaller number of eggs, suggests greater differences in quality. Three of the tested subjects (1, 2, 4) had very good fitness. Subject 3, who was significantly younger and had a higher basal metabolic rate, had good fitness. The body mass index, which was also ideal, was similarly classified.
Despite this good fitness and beneficial body mass index, the mean heart rates in the Hühnermobil 225 and Legehennenmobil were 122 bpm and 120 bpm and exceeded clearly the endurance limit of 110 bpm according to Hartmann *et al.* (2013).

These threshold exceedances were caused in particular by the activities feeding, egg collection and presorting in both stable types.

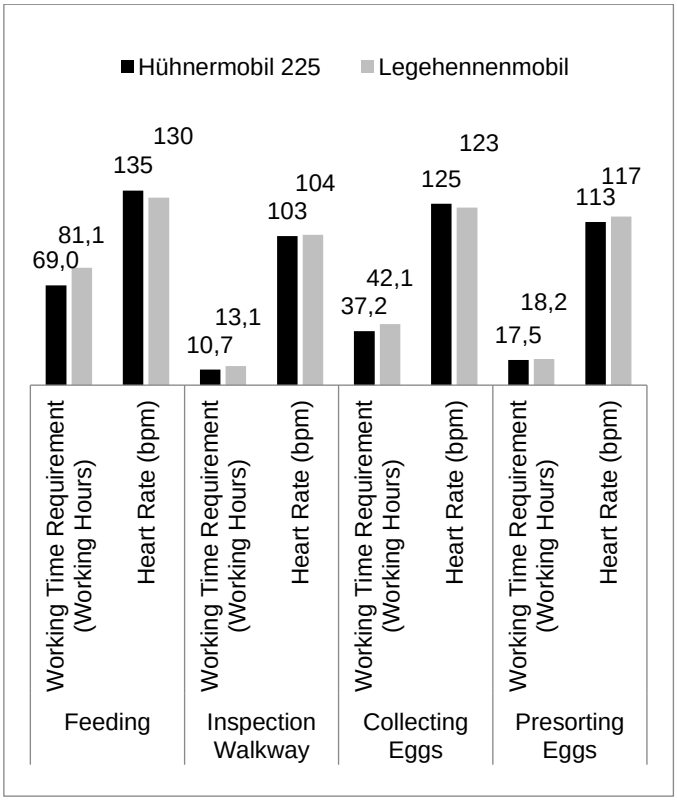

Figure 3. Working time requirement (in manpower hours (MPh)) and mean heart rate (in bpm) of daily routine work according to stable models (n = 8) (2015).

Male subjects in the Hühnermobil 225 and in the laying hen mobile exhibited a lower average heart rate than the female subjects. The male subjects were below 103 bpm and the female subjects with 137 bpm above the endurance limit. The sex and the number of measurement runs were also significantly related to the heart rate of the daily routine. There were significant interdependencies between gender (0.0001 < 0.05 h.s.), the number of measurement runs (0.0001 < 0.05 h.s.) and between the subjects (0.0001 < 0.05 h.s.) and within the sexes (0.0001 < 0.05 h.s., R = 0.99).

The female subjects had a 7.83-fold lower chance than the male subjects to exceed the heart rate limit of the endurance limit. The subjects with a lower level of fitness had a 23.1-fold higher chance to operate on the heart rate limit of the endurance limit than the subjects with better fitness.

The threshold exceedances were due to daily routine work consisting of repetitive hand and arm movements while standing with sometimes heavy load and slow walking in the henhouse. Before and after, the subjects walked the route from the chicken chamber to the stables, which was 152 meters long. Depending on the activity, this route was undertaken with or without load. In the Hühnermobil 225, even more stairs had to be overcome because of the two levels.

Mayrhofer (2015) examined in their study the entire milking process and classified it as hard work for men and women, caused by an average heart rate of 106 bpm. Pebrian *et al.* (2014) determined specific

work processes in the agricultural sector as heavy work due to an average heart rate of the workers of 133 bpm.

Conclusion

In this preliminary study, the evaluation of the physical stress indicated physical and mental strain, even for most routine activities in mobile coops. An analysis of data on the entire working process (routine and special work) of mobile henhouses should be the next step, including ergonomic evaluation.
The contribution of this case study is mainly a methodological one. For achieving a higher data quality, a larger sample and an analysis of the total work process ergonomically would be helpful.
Nevertheless, a reduction of the physical and of the mental workload, in particular in order to be able to work in a socially sustainable manner under the long-term endurance limit can be achieved through human work design (ergonomic adaptation of devices) as well as breaks, slower pace of work and division of labour.

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