OCCUPATIONAL NOISE LEVEL IN MECHANIZED SQUARING AND SWEEPING IN COFFEE CROP

NÍVEL DE RUÍDO OCUPACIONAL NA QUADRATURA MECANIZADA E NA VARREDURA DA CULTURA DO CAFÉ

ABSTRACT

The objective of this study was to evaluate the occupational exposure to noise emitted by the squaring and sweeping equipment and coffee collector coupled to the tractor and to compare the applicable standards NR 15 and NHO 01. The data was obtained in a coffee plantation. The assay was divided into two stages: the first was carried out in the municipality of Varginha / MG and the second in Fama / MG. In the first stage, data were collected on the squaring / blowing equipment coupled to a 575.4 Compact Agrale Tractor, with 75 hp. In the second stage, the data were obtained in the coffee collector equipment coupled to the Massey Ferguson 275 XE Advanced tractor, with 75 hp. The noises emitted by the squaring / blowing equipment were within the specified limits (85 dB) for the complete 8-hour day. However, noise emissions by the collector were above 85 dB. There was no difference between the standards studied in noise assessment. The collector emitted greater noise in relation to the squaring / blowing equipment.

KEYWORDS: Agricultural Mechanization, NHO 01, NR 15, Worker’s Health.
ABSTRACT
O objetivo deste estudo foi avaliar a exposição ocupacional ao ruído emitido pelo equipamento de esquadrejamento e varredura e pelo coletor de café acoplado ao trator e comparar as normas aplicáveis NR 15 e NHO 01. Os dados foram obtidos em uma plantação de café. O ensaio foi dividido em duas etapas: a primeira foi realizada no município de Varginha / MG e a segunda em Fama / MG. Na primeira etapa, foram coletados dados sobre o equipamento de quadrado/sopro acoplado a um trator agrícola compacto de 575,4 cv, com 75 cv. Na segunda etapa, os dados foram obtidos no equipamento de coleta de café acoplado ao trator Massey Ferguson 275 XE Advanced, com 75 cv. Os ruídos emitidos pelo equipamento de quadrado/sopro estavam dentro dos limites especificados (85 dB) para o dia completo de 8 horas. Entretanto, as emissões de ruído pelo coletor estavam acima de 85 dB. Não houve diferença entre as normas estudadas na avaliação de ruído. O coletor emitia maior ruído em relação ao equipamento de esquadria/sopro.

Palavras-Chave: Mecanização Agrícola, NHO 01, NR 15, Saúde do Trabalhador.

1 INTRODUCTION
To exemplify the role of agricultural mechanization, specifically in coffee, the fruit harvest can be highlighted. In order to harvest coffee, two important crop treatments are necessary for squaring and sweeping. Squaring consists of removing crop remains present under the coffee skirt; this activity was carried out before harvest. Sweeping is an activity carried out at post-harvest that aims to remove the remaining coffee fruits present in the soil. The activities described can be done using a squaring/sweeping equipment and a coffee collector, respectively (TAVARES, 2015).

Since it is driven and operated by agricultural tractors, and also due to the turbine, the flow and high volume of air, this equipment can produce noise above the legal limit, exposing the workers to stress and health risks, in addition to the induced hearing loss by noise (PAIR) (MATIELLO, 2019).

To avoid health problems for workers, the protection rules are designed to specify the maximum daily exposure in which the operator may be exposed to the influence of these noises. Standards NR 15 (Regulatory Standard) and NHO 01 (Standard Hygiene and Occupational Health) regulate the guidelines for exposure to occupational noise, aiming to stipulate the maximum time of exposure according to the intensity of the noise (FUNDACENTRO, 2001). Thus, the objective of this study was to assess occupational exposure to noise emitted by the squaring/sweeping equipment and coffee collector, coupled to a tractor and to compare the applicable standards NR 15 and NHO 01.
To conduct the study, two data surveys were carried out on different properties. In the first survey, the noise emission was evaluated by the sweeping/blowing equipment on a farm located in the city of Varginha-MG. In the second survey, the coffee collector was evaluated in the city of Fama-MG, both in the South of Minas Gerais. Data collections were carried out in coffee plantations, using cv. Mundo Novo, with an average height of 2 m, implanted with spacing of 3.5 m between rows and 0.8 m between plants; both crops were set on flat ground.

The following is the description of the data collection of the first survey for the assessment of noise emission:

- **Activity**: Squaring; **Machinery**: 575.4 Compact Agrale tractor, with 75 hp (2400 rpm) power and 27 kgf.m torque (1400 rpm), with power take-off with nominal rotation of 540 rpm, at 2000 rpm of the engine; **Implement**: Squaring/blowing equipment, Adapted, similar to that produced by the company ASA – Arruadores Sopradores Agrícolas LTDA; **Time of data collection**: 4 hours; **Replications**: 4.

Below, there is the description of the data collection of the second survey:

- **Activity**: Coffee collection; **Machinery**: Massey Ferguson 275 XE Advanced tractor, with 75 hp (2400 rpm) power and 28 kgf.m torque (1400 rpm), with power take-off with nominal rotation of 540 rpm, at 2000 rpm of the engine; **Implement**: Coffee collector MIAC Master 2C, necessary power of 60 hp, coupling with a rotation of 540 rpm and bulk carrier capacity of 2500 L; **Collection time**: 4 hours; **Replications**: 4.

Data collections were performed with the tractor working at a speed of approximately 2000 rpm on the engine and of 540 rpm at the output of the power take-off.

The noise levels were collected using an integrating meter for personal use, a DOS-700 noise dosimeter (INSTRUTHERM), which was electronically calibrated with a certificate from the Brazilian Calibration Network (RBC) with field measurement, before and after the measurements, using a CAL - 4000 INSTRUTHERM IEC 942/CLASS 2 calibrator, with sound pressure levels between 94 and 114 dB, with the noise classified as continuous. The device was installed with a microphone close to the operator’s hearing area, at a distance of 15 cm from the ear.

In order to quantify the noise doses to which the operator may be exposed, the equipment was configured to comply with the FUNDACENTRO NHO-01 Occupational Hygiene Standard and the NR-15 Regulatory Standard. After data collection, the equipment issued two reports related to NHO-01 and NR-15. The equipment makes the
collections with a minimum value (threshold level) of 80 dB (decibels) and, below this value, there was no data interaction. The criterion level for both standards is 85 dB; under this condition, the operator can be subjected to an 8-hour working day. The NHO-01 standard requires that for each increase of 3 dB above the criterion level, the time of the working day is reduced by half. In relation to NR-15, with an increase of 5 dB above the criterion level, the working day time must also be reduced by half.

As determined by NHO-01, for dosimeter tests and assays, the appropriate temperature range, when performing the noise level measurement, must be between -5 and 30ºC, and the wind speed must be less than 5.0 ms⁻¹.

The data were submitted to the Shapiro-Wilk test for normality analysis. Subsequently, they were submitted to analysis of variance and the means were compared by the Tukey test, at a significance of 5%, using the software R, version 3.2.4 (R CORE TEAM, 2016).

There was no significant difference between the norms evaluated in the noise emission by the squaring/blowing equipment (p>0.05) (Figure 1). The noise emission was the same when evaluated by NR 15 and NHO 01, and the requirement standard of NHO 01 did not influence the results. This demonstrates that the standards for evaluating norms do not differ in data analysis, both of which can be used for the assessment of noise emission. It should be observed that NR 15 takes into account whether the environment is unhealthy, different from NHO 01. In the study in question, the operational conditions of the equipment and the environment are within the normal range for a healthy environment.

The noise emission by the squaring/blowing equipment did not exceed the exposure limit used by the studied standards (85 dB) (Figure 1). Therefore, under this condition, the worker is allowed to have a normal workday, without health risks. However, it is important for the worker to use Personal Protective Equipment (PPE) as a preventive measure since, according to FUNDACENTRO (2001), the values found are associated with a region of uncertainty, and which require preventive measures.

In the data collections related to the coffee collector, there was no significant difference between the Standards (p>0.05) (Figure 2). The values were above that allowed for a full 8-hour day (85 dB). Under these conditions, the worker would be allowed to be exposed to noise for only 02 hours and 35 minutes, considering Standard NHO 01 and 03 hours and 30 minutes, considering NR 15, without the use of PPE. However, with the use
of hearing protectors, the operator could be exposed to this noise for 8 hours, since this protector reduces noise by 15 dB.

Figure 1 - Noise level per coffee squaring/blowing equipment compared between Standards NR 15 and NHO 01.

![Figure 1 - Noise level per coffee squaring/blowing equipment compared between Standards NR 15 and NHO 01.](image1)

Figure 2 - Noise emission per coffee collector compared between Standards NR 15 and NHO 01.

![Figure 2 - Noise emission per coffee collector compared between Standards NR 15 and NHO 01.](image2)

Regarding the comparison between the agricultural implements evaluated, there was a significant difference in noise emission (p <0.05) (Figure 3). Noise emission was higher in the coffee collector in relation to the squaring/blowing equipment.
Figure 3 - Comparison in noise emission between implements squaring/blowing equipment and coffee collector.

2 CONCLUSION

The occupational risks to which operators are exposed are increasingly evident in the professional environment. These risks, when associated with other effects, such as stress, fatigue and loss of attention, can be a trigger for major accidents. Therefore, this study showed that the activity of collecting coffee with the collector is above the permitted level and demonstrated that there was no significant variation between the main Standards that regulate and control occupational risk for noise.

The Standards do not differ in the evaluation of the noise emitted by the squaring/blowing equipment and the collector. The noise emitted by the squaring/blowing equipment was within the specified limits (85 dB) for the full 8-hour day. However, noise emissions by the collector were above 85 dB. The collector emitted more noise in relation to the squaring/blowing equipment.

ACKNOWLEDGEMENTS

The authors would like to thank the Minas Gerais Research Foundation (Fundação de Amparo a Pesquisa do Estado de Minas Gerais - FAPEMIG) for the financial support.
REFERENCES


