NOTA TÉCNICA:

ASSESSMENT OF WORKING CONDITIONS IN AN ANIMAL FEED MILL

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ABSTRACT

Were analyzed the working conditions in a small feed mill, with identification of occupational risks (physical, chemical, biological, ergonomic and accidents) and measurement of noise levels. Data collection was performed qualitatively by using a survey, previously developed, as well as in loco observation. There was at least one factor belonging to the five occupational risks, and the ergonomic risk was associated with all activities. The feed mill assessed was not in accordance with the Regulatory Standards related to Health and Safety, and arrangements to adjust it accordingly must be taken. Corrective actions goes from the purchase and supply of appropriate personal protective equipment for worker to structural changes, such as installing handrails and repairing of electrical installations. These initiatives, if implemented could contribute to reducing the risks that affect the health and physical integrity, with opportunities to improve quality and productivity of the services performed.

Keywords: rural labor, workplace safety, accident risks.

RESUMO

AVALIAÇÃO DAS CONDIÇÕES DO AMBIENTE DE TRABALHO EM UMA FÁBRICA DE RAÇÃO ANIMAL

Foram analisadas as condições do ambiente de trabalho em uma fábrica de ração de pequeno porte, com identificação dos riscos ocupacionais (físicos, químicos, biológicos, ergonômicos e de acidentes) nela presentes e medição dos níveis de pressão sonora devido ao funcionamento dos equipamentos. Trata-se de um estudo de caso com características qualitativas e exploratória, com o objetivo de descrever as atividades da fábrica de ração e suas condições de trabalho, comparando-se os resultados com as normas regulamentadoras e outras literaturas. A coleta de dados foi realizada qualitativamente usando um questionário e observação *in loco*. Observou-se ao menos um fator pertencente às cinco classes de riscos ocupacionais, estando o risco ergonômico associado a todas as atividades desenvolvidas. De forma geral, o ambiente de trabalho não está em conformidade com as Normas Regulamentadoras referentes à Saúde e Segurança no Trabalho, devendo-se tomar providências para a sua devida adequação. Assim, sugere-se a adoção de medidas de controle que, se forem implantadas, poderão contribuir para a redução dos riscos que afetam a saúde e a integridade física do trabalhador, com possibilidades de melhoria da qualidade e produtividade dos serviços nele realizados.

Palavras-chave: trabalho rural, segurança no trabalho, riscos de acidentes.

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INTRODUCTION

According to International Labour Organization – ILO (2012) estimates, out of a worldwide total of 335,000 fatal workplace accidents each year, some 170,000 involve agricultural workers. Mortality rates have remained consistently high over the past decade. Furthermore, widespread under-reporting of deaths, injuries and occupational diseases means that reality of occupational safety and health (OSH) is likely to be worse. Thus, the rural sector is one with the highest accident rate activities in the world, next to the construction and mining.

In 2015, Brazilian animal nutrition sector produced around 69 million tons of feed (SINDIRAÇÕES, 2015). The sector ranges from large industries until so-called feed mills, usually medium or small factories, located on farms. In these factories, the responsibility for carrying out the activities belongs to a smaller number of people, whom, often, are also involved in animal handling.

Studies related to animal feed have discussed the care needed to ensure the quality and safety of the product (SANTIN, 2006), evaluate the losses (the quantity, costs and contaminations of the products) caused by the equipment maintenance in different stages of a feed production mill (CORADI et al., 2015). Predominately there are also studies related to diet formulation for different animals (SCAPINELLO et al., 2011; ZANGERONIMO et al., 2009). However, up to now, few studies were focused on workplace safety conditions for the workers, in units of animal feed mills (CARVALHO et al., 2008; SILVA et al., 2011).

Souza et al. (2004) and Longui et al. (2009) have made quantitative assessments of noise levels emitted by equipment in feed mills and concluded that the noise levels were critical in both studies. The effects of noise can cause some consequences, such as effects on the body (disrupt blood flow and psychological effects, like stress), on work performance (lack of attention and fatigue, causing loss of product quality and waste of material) and occurrence of accidents (GOSLING and ARAÚJO, 2008).

Maia and Rodrigues (2012) reported that studies about safety at work in rural environments are as recent and there is still a lack of information on assessments in some sectors and activities. Therefore, there is the need of studies aiming the facing potentials nonconformities, could providing suggestions to contribute to improvement of environmental comfort, safety and quality of life for the workers.

In Brazil, the Regulatory Standard 31 - NR 31, of the Ministry of Labor and Employment (MTE) sets out the principles to be observed in the organization and in the workplace, in order to make compatible the planning and development of agricultural activities, livestock, forestry, forestry and aquaculture with health and safety and working environment (BRASIL, 2013).

Occupational risks can be divided into: environmental (physical, chemical and biological), ergonomic and mechanical (or accidents). According to Regulatory Standard 09 - NR 09, Program for Environmental Risk Prevention, from MTE, are considered environmental risks physical, chemical and biological agents existing in the workplace, which, due to its nature, concentration or intensity and exposure time, are capable of causing damage to workers' health (BRASIL, 2014).

The physical agents are those generated by machines and physical conditions characteristics of the workplace, such as noise, vibration, pressure, temperature, radiation. The chemical agents are represented by substances, compounds or products that can enter the body through the respiratory route, in the form of dusts, fumes, mists, fogs, gases or vapors, or by the nature of exhibition activity, may have contact or be absorbed by the body through the skin or swallowed. Since biological agents are exemplified by microorganisms such as bacteria, fungi, viruses and other (BRASIL, 2014).

Ergonomic risks are known as the unconformities established in the Regulatory Standard 17 - NR 17, Ergonomics, from MTE, which require working environments suited to man, providing psychological and physical wellbeing. Such risks are related: physical stress, monotony,

long journey, lifting and manual transport weight, among others (BRASIL, 2007).

Mechanical or accidents risks are those that could jeopardize worker health and safety, regarding the workers' interaction with the machines around them and their work environment. The mechanical are those that can cause punctures, cuts, lacerations, crushing, electrical shock, and falls, among others.

According the Brazilian Classification of Occupations - CBO (2010), the feed preparer is one in a group of workers responsible for the manufacture and storage of food, encoded with No. 8414-68. Its general conditions for exercising the activities in the primary sector (agriculture, livestock, and fisheries) and the manufacture of food and beverages. They work under pressure, which can lead them to stress, and in uncomfortable positions for long periods. The development of some activities may remain exposed to the action of toxic materials, intense noise, high temperatures, dust, odors and cold chambers.

In this scenario, the risk analysis comprises an action with the capacity to develop preventive measures, and streamline the continuity of activities that the employee performs during their shift. It is possible to identify the risks, correcting problems in production processes and the ability to disseminate information to perform more assertive and sure of step work order (SASAKI, 2007).

Thus, this work aimed at analyzing the working conditions in a feed mill unit by identifying the occupational risks - physical, chemical, biological, ergonomic and accidents and by measuring the noise level in equipment.

MATERIAL AND METHODS

The animal feed mill unit is located in the Southwest region of the State of Bahia (15°15'23"S, 40°15'27"W). It has been operating for about 25 years and its production is destined for the rural complex in which it is inserted (not having thus profit), and can be considered small. It consists of two environments: the first serves as a depot, where raw material used to manufacture feed are stored. The second one, where the feed production occurs contains all the machinery used: mixer, cooler, pelletizer, hammer mill and a scale (Figure 1).

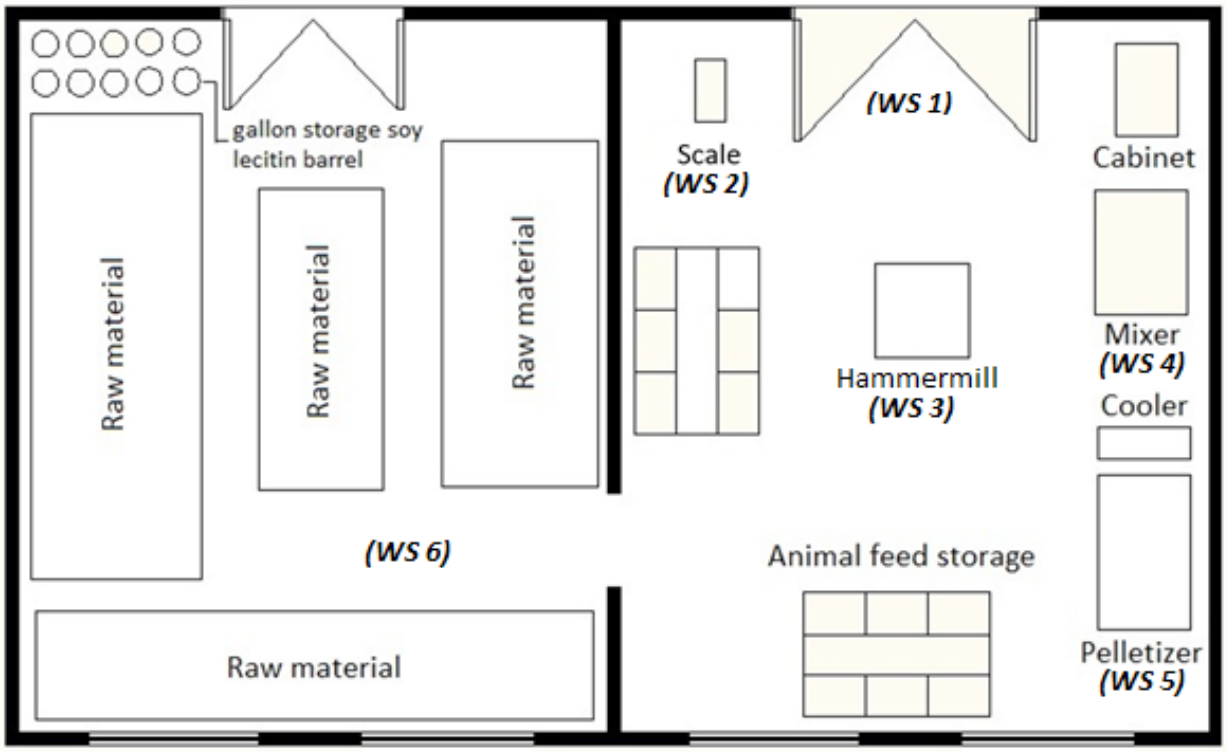

Figure 1. Floor plan of the feed factory.

In order to facilitate assessments, the feed mill was divided into workstations (WS), which were arranged and numbered as follows:

WS 1 – Loading and unloading of raw material;
WS 2 – Scale;
WS 3 – Hammer mill;
WS 4 – Mixer;
WS 5 – Pelletizer;
WS 6 – Warehouse

This was a case study with qualitative and exploratory characteristics, with the purpose to describe the feed mill activities and work conditions in the sector, comparing the results with regulatory standards and other literatures. Data collection was performed qualitatively by using a survey, previously developed, as well as *in loco* observation. In general, observations validate the result of other techniques, and through the comparison of the information allow identifying the critical points in the sector (NEUENFELD et al., 2006). Were observed the conditions of the workplace (physical installations, machinery and activities carried out by the worker) and the production process (incoming flow, the procedures involved, machinery used, required hand labor, distribution of activities in space and outflow).

The survey was composed of three parts: the first aimed to identify the sector, its characteristics, equipment and structure; the second part contained fundamental issues related to safety at work, and was based on the Regulatory Standards 6, 9, 10, 12, 15, 17 and 31, of MTE. The last part of the survey was for general comments, notes about the occupational hazards (physical, chemical, biological, mechanical, and ergonomic) and other observations identified in the workplace.

Quantitative data were also performed from the assessment of occupational risks that were identified as critical for measurement. The noise level was then measured using a digital sound level meter – SLM (MSL 1351C, Minipa), with A-weighting and slow response, for continuous or intermittent noise. The measurements were taken with the machines operating individually and jointly (hammer mill and mixer), in the source (WS 3, 4 and 5) and next to worker's ear (at 15cm distance), as recommended by the Regulatory Standard 15 - NR 15, Unhealthy Activities and Operations (BRASIL, 2011a), by the MTE.

The assessment of occupational exposure to noise was made by determining the daily dose of noise and level of exposure, as recommended by the Standard Occupational Hygiene 01 - NHO 01, Assessment of Occupational Noise Exposure (BRASIL, 2001). The daily dose was determined by the following expression 1:

$$Dose = \left(\frac{C_1}{T_1} + \frac{C_2}{T_2} + \frac{C_3}{T_3} + \cdots \frac{C_n}{T_n}\right) x\ 100\ [\%] \quad (1)$$

in which: C_n = Total daily time that the worker is exposed to a specific level of noise;
T_n = daily maximum time allowable to this level following Table 1 (from NHO 01);
Adopted the value "3" as dose doubling increment (q = 3):

RESULTS AND DISCUSSION

Production process and description of activities at the sector: a male worker conducts the manufacturing process. When there is no reception of raw materials, developed the first activity is the manual transport of the material to be used from the warehouse to the production area. The factory operates four times a week in intermittent system with production batch process. The activities are as follows:

- Day 1: grinding corn (processing time: 8 hours);
- Day 2: the previous ground corn is put in the mixer with and additional (urea, mineral salts, etc.), as stablished by a technician responsible for the formulation (processing time: 8 hours) ;
- Day 3 - pelletizing/cooling of the feed is performed (processing time: pelletizer - 4 hours; cooler - 2 hours);
- Day 4 - Finally, the finished feed is weighed and sent to the corresponding sector or stored for later use. Furthermore, the worker makes the weighing and milling of corn, restarting the processing cycle. The steps of system production are shown (Figure 2).

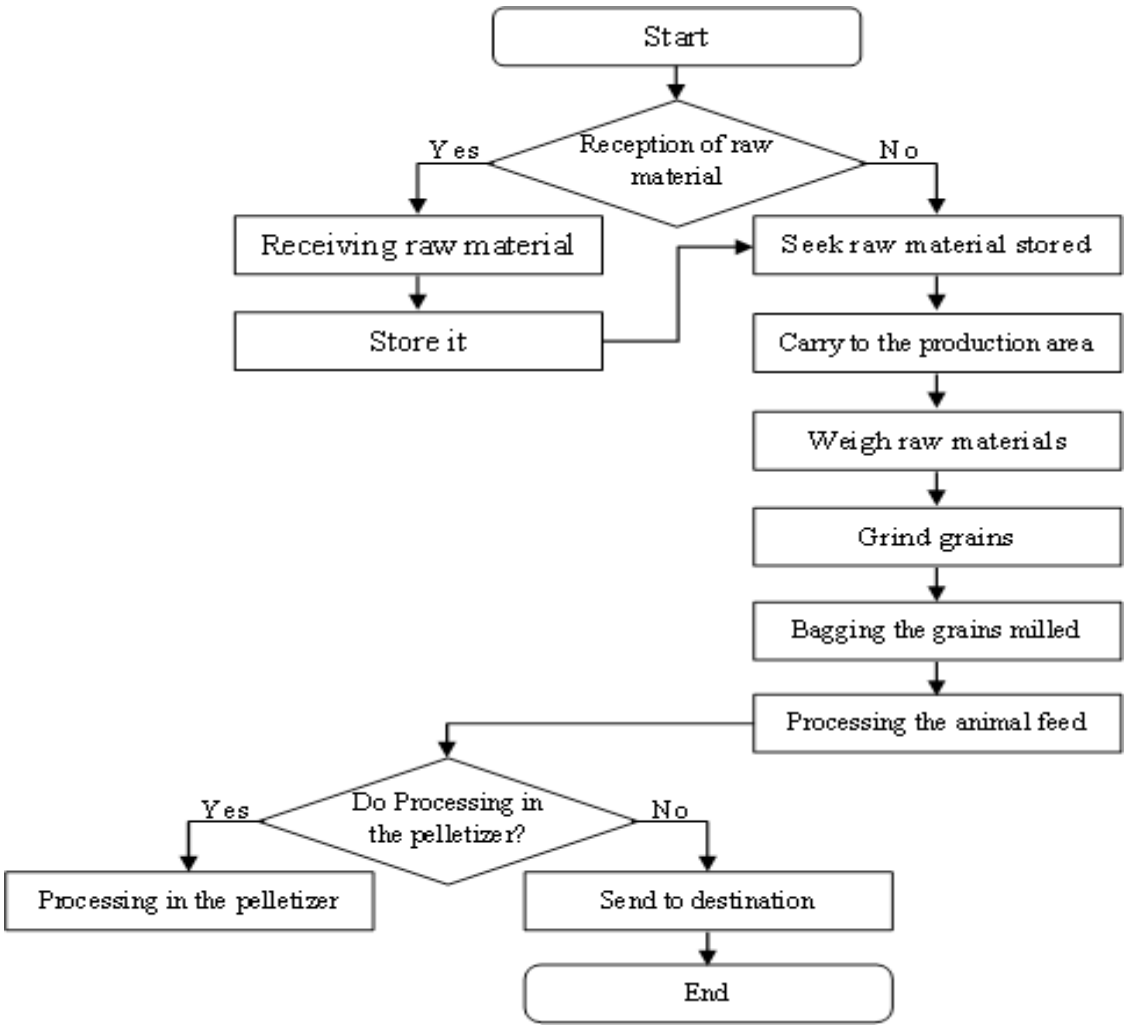

Figure 2. Flow chart of the production process

Ergonomic Risks: During the evaluation of the working day, it was found that all activities offer ergonomic risk due to postural problems. The WS 1 is, probably, the point of highest risk, due to the discharge of raw material trucks done manually by the worker. This task requires a great physical exertion from the worker, who, without proper guidance and knowledge will probably face postural problems by excessive and inadequate load transportation.

Such situations may be forerunners of body aches and fatigue, among others. The intensity of the torso tilting movements can contribute to appearance of disturbances in the spine. Currently, lumbar pain is considered the main cause of occupational absenteeism (DUL and WEERDMEESTER, 2004). As a result, the NR 31 determines that the employee responsible for manual transport of loads must receive training or proper instructions about the working methods to be used, to safeguard his health and prevent accidents (BRASIL, 2013).

It was observed, throughout the workday, that activities are performed standing, directly affecting lower limbs, which support 33% to 40% of human body weight (IIDA, 2005). The time maintaining posture should be as brief as possible because of the associated effects, possibly harmful. However, the standing posture is justified in cases where the task requires frequent operations in various workplaces, physically separated (SALIBA, 2013). The NR 17 determines that, when work activities are performed standing, seats for resting should be placed, in locations that can be used by all employees, during breaks (BRASIL, 2007). The NR 31 also provides that to activities which are performed necessarily standing, must be guaranteed rest breaks (BRASIL, 2013). Ergonomic risks were

identified in all activities observed, due to incorrect postural execution, which is a common factor in rural labor. These risks can be significantly reduced by designating more than one worker for loading and unloading activities and using a car for transport of raw materials within the feed mill. Additionally, the worker could be trained on the correct methods of work to be used, aiming at saving their health and preventing accidents.

Physical Risks: There is no uniformity and consistency of the noise level throughout the workday. To quantify these exposures uses the concept of dose, which comprises the acoustic variations according to the exposure time and the maximum time allowed during the workday.

The work is characterized by intense noise from the hammermill. The noise values measured during activities in the workplace are listed in Table 1.

While Leq expressed the instantaneous noise in dB, the noise dose represents the percentage of daily exposure. Thus, it was assessed the true worker exposure, once the dose represent the mean emitted noise during the workday.

According to NR 15, the maximum exposure value for 8-hour working day is 85 dB (A) (BRASIL, 2011a). According to NHO 01, when the level of standard exposure - NEN - exceeds 85 dB (A), the exposure limit is exceeded and require the immediate action control. Furthermore, where the daily dose of a given noise exposure exceeds 100%, the exposure limit is exceeded and require the immediate adoption of control measures. If the daily dose is between 50% and 100% exposure should be considered above the action level and should be taken preventive measures to minimize the likelihood that exposure to noise cause injury to the worker's hearing and prevent the limit exposure is exceeded (BRASIL, 2001).

For purpose of characterization of unhealthiness, WS 3 may not work under the conditions evaluated in this work, for more than 30 minutes a day, while the other workstations presented values within the limits established by the standards.

Souza et al. (2004) found that noise levels emitted by a hammermill (DPM-1) were above permitted by NR 15 to 8 hours of daily exposure, requiring initiatives aiming at reducing the noise at source, or the mandatory use of PPE, as recommended in the Regulatory Standard 6 – NR 6, Personal Protective Equipment, of MTE (BRASIL, 2011c). Longui et al. (2009) researching the noise levels in different equipment from a feed mill found that the mixer had values below the standard set by NR 15 while other equipment (silo with mill bagger) showed higher values than those established.

Chemical Risks: The presence of particulate material is frequent and common to the activities performed at the feed mill, a fact that was also observed by this study. Both physical and chemical risks identified can be mitigated by adopting simple practices, eg the use of PPE appropriate to each situation (masks, goggles, ear protectors), aiming to attenuate the effects of unavoidable exposure to its causing agents.

Biological Risks: The main risk point lying in the warehouse. All the raw material is stored

Table 1. Sound level emitted by machinery during processing.

	WS 3 (Hammermill)	WS 4 (Mixer)	WS 5 (Pelletizer)
Leq - dB(A)	100,5	80,5	65,6
TL - dB(A)	85	85	85
Dose (%)	3592	35	1
RT (h)	8	8	4
TLV - dB(A)	85	85	88

Leq = Equivalent level - dB (A). Measured with o sound level meter

TL = Threshold Level - dB (A)

RT = Processing Real-Time

TLV = Threshold Limit Value dB (A)

in four large ranks, remaining closed doors, with no ventilation or supplementary lighting, except when there is discharge material. Therefore, this workplace is conducive to the occurrence of vectors and poisonous animals and disease vectors (mosquitoes, rats, and cockroaches). According to official reports, the presence of rats can be observed in the workplace. Another important consideration is that the storage material there is ideal conditions for mold growth if occurs a humidifying in the grains. Farias et al. (2000) found that maize, the main grain used in animal feed, is subject to contamination by a fungal microbiota that, under favorable conditions, can produce mycotoxins - secondary metabolites synthesized in the late exponential phase of growth of some fungi - leading public and animal health problems.

Accident (or Mechanical) Risks: At the feed mill were identified inadequate electrical installations, use machinery without the proper maintenance and low-level lighting. Electrical wiring of some equipment found himself unprotected on traffic routes, contradicting the provisions of the Regulatory Standard 10 – NR 10, Security in Facilities and Services in Electricity establishing the adoption of preventive actions, such as renovations, repairs and inspection of the electrical network to ensure the safety and health of workers (BRASIL, 2004).

The old machinery use, on inadequate maintenance and unprotected parts, like belt grinder, and the access of employee's hands at the mixer's thread carrier, constitutes another important aspect. There is no device to the automatic shutdown of the machinery. By removing excess material stuck in the screw conveyor, the worker is vulnerable to the risk of an accident. Moreover, it was observed the use of improvised accessories to assist in the work - using a wooden handle to push the material into the crusher, to speed the process.

The Regulatory Standard 12 - NR 12, Machinery and Equipment says that the machinery and equipment shall be subject to preventive and corrective maintenance, according to the intervals determined by the manufacturer and the national technical standards in effect and, in their absence, international technical standards (BRASIL, 2011b). Structurally, the main risk found was the lack of handrails on feed mill access platforms. Thus, during the activities, the employee and any other person present at the site may be liable to imbalances, or even declines of more than a meter in height.

The suggestions aim not just comply the legislation, but also contribute to improvement of the working environment. Most suggestions represent simple measures with small investments that, when properly implemented could contribute to reduce risks that affect health and safety in the workplace and improving the quality and productivity of the services performed.

CONCLUSION

- The working conditions at a small feed mill were assessed, where at least one factor belonging to the each five occupational risks was identified. The work environment conditions are not fully in accordance with the Regulatory Standards regarding Health and Safety at Work, and arrangements to adjust it accordingly must be taken;
- According to SLM and dose assessments, the WS 3 presented values with potential to cause occupational risks due to sound exposure. It was realized that the noise dose significantly has extrapolated the value sound pressure limit (100% - equivalent to 85 dB). The difference found between the calculated dose and the tolerance limit indicates that mitigating actions should be immediate;
- Corrective actions goes from the purchase and supply of appropriate personal protective equipment for worker to structural changes, such as installing handrails and repairing of electrical installations;
- It is suggested that would be performed a training in health and safety at work with the employee, aiming to guide him about the correct way to exercise their functions, while preserves their health and integrity.

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