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SOUND EFFECTS OF OCCUPATIONAL NOISE EXPOSURE ON PERSONNEL IN BURR MILL PROCESSING CENTRES

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ABSTRACT

Noise pollution is almost everywhere in human day to day living; occupational noise exposure is a rampant problem facing different occupation with many not knowing the extent of damage that is been done to personnel working in a noisy environment. In Nigeria little is the research that has been carried out in area of noise pollution, recognizing this; this project was aimed at assessing and comparing the level of noise generated and its exposure effect on the personnel working in agro-processing center with emphasis on a burr mill processing center. Noise generated in the milling centers were read at different spatial location within Bodija Market that makes use of burr milling machine for particle size reduction of agro-based produce with Testo 815 sound level meter. The sound level read was compared to that specified by United State Occupational Safety and Health Administration (OSHA) and National Institute of Occupational Safety and Health (NIOSH), these standards were used because it has been adopted by Nigeria's National Environmental Standards and Regulations Enforcement Agency (NESREA). Result shows that noise generated from dry milling operation varies from 89.9dBA-99.3dBA; on the average these levels exceeded the standards specified by the various regulating authorities. Burr mill operators are exposed to excessive occupational noise as showed by the sound level readings, which results into noise induced hearing loss NIHL as corroborated by the response of 26% of the respondents that reported high severity in loss of hearing and other non-auditory health implication which affects them. Observation made during data collection shows that not a single operator wears personal protective equipment PPE, therefore its recommended that burr mill operators should wear PPE like ear plugs, ear muffs, and nose guard. Also they should endeavor to maintain the burr mill machine by lubricating regularly, replace worn out parts and pads the machine and engine seat to reduce noise generation from vibration.

Keywords: *Noise, Noise Pollution, Burr Mill, Sound Level Meter, Noise-Induced-Hearing-Loss*

INTRODUCTION

The gradual increase in the world's population has a direct impact on the numbers of mouth to be fed, thereby resulting into ineffectiveness of subsistence farming method, as well as crude ways of farming. Mechanized agriculture which was introduced in the 19th century created a huge effect on commercialization of agriculture leading to profound impact on the industry (Srivastava *et al.,* 1993). Large increase in agricultural produce were recorded as an effect of the introduction of tractors and implements as well as the harvesting and processing equipment. Mechanization increases agro-production but introduces hazardous noise level which farmers and processors are subjected to in their working environment. Environment is that which surrounds an individual or community, both the physical and cultural surroundings (Pramendra and Vartika, 2011). The undesired change in physical, chemical or biological characteristics of air, land, and water that may or will harmfully affect human life or that of other desirable species, industrial processes, living conditions cultural assets that may or will waste or deteriorate raw material resources is term pollution according to United State National Research Council (1965) as reported by Evelyn and Tyav (2012). Pollution problems can said to be universal as what happens in one area of the world directly or indirectly affects other part of the world, water pollution, air pollution, while noise pollution, land pollution can said to be localized.

Noise pollution is recognized as a major problem for the quality of life (Marius *et al.,* 2005). According to Atmaca *et al,* (2005), noise is one of the physical environmental factors affecting human's health in our civilized world. Noise is generally defined as the unpleasant sounds which disturb the human being physically and physiologically and cause environmental pollution by destroying environmental properties (Oyedepo, 2012). Noise generally consists of three inter-related elements - the source, receiver and transmission path followed by the noise to reach the receiver (Dawei, 2012).

The simple expression of the term noise is an unnecessary sound and important form of energy, which is emitted by a vibrating body and on reaching the ear causes sensation of hearing through nervous system.

Road traffic, jet planes, garbage trucks, construction equipment, manufacturing processes, agricultural processes and lawn movers are some of the major sources of this unwanted sound that are routinely transmitted in to the air (Birgitta and Thomas, 1995).

Food production through agricultural activities encompasses many processes, starting from the clearing of arable land for the purpose of cultivation to land preparation, to planting; to harvesting all generates noise in different intensity due to the use of machinery. Processing of agricultural produce with the use of machines also add to the noise pollution level in an environment, as these machines vibrates causing noise level increase which adversely affects individuals working in the processing centers these assertion was corroborated by The need for studies regarding agro-noise pollution and its consequences on environment and persons has motivated various researchers on the problem in several countries. Mijinyawa *et al.,* (2012) in a study conducted, reported that noise sources are enormous depending on the location and in agricultural environments and activities with noise level reading in selected feed mills in Ibadan ranging between 82.5- 113.9dB. Pazzona and Murgia (2002) in an occupational noise hazard study ascertained that workers are exposed to an average of 89.8 dB(A) Leq in a sheep farm in Sardinia Italy, while Thepaksorn *et al.,* (2018) put the prevalence rate of noise induced hearing loss (NIHL) at 22.8% at a level well higher than the allowable recommended limit of 85dB(A) with male workers having significant higher risk than female workers in sawmills industries in Thailand, Elias *et al.*,(2014) confirmed in their study of maize milling SME with noise level readings ranging between 89- 103 dBA, other researchers like Prasanna *et al.,* (2008).; Owoyemi *et al.,* (2016).; Miyakiti *et al.,* (2004); all looked at the risk of over-exposure to noise in different agro-proessing activities, but more needs to be done in this area in Nigeria, with this in mind, this study investigates the noise level generated in the course of utilizing the burr mill during size reduction process of some agro-produce.

MATERIALS AND METHODS

The research was carried out with the aim of obtaining information on noise in processing centers with the use of a well-structured questionnaire to obtain needed information. Bodija market being the research site is a well-recognized and patronized market in the South Western, Nigeria. It is located within Ibadan North Local Government Area, Ibadan with coordinates 7.451º N and 3.9143º E (latlong.net, 2018). The market is a major market within Ibadan thereby making it a beehive of activities on a regular basis with different sections part of which is the burr mill section that deals with the size reduction of agro-based products like pepper, making of yam flour and other agricultural produce that needs reduction in size.

Field Survey

Statistical data on noise generation and susceptibility of the operator to adverse effect of the noise were collected from the field survey. The questionnaires evaluate the following issues:

- General awareness level about noise;
- Policies related to and influencing noise generation and suppression;
- Level of health implication of excessive noise exposure etc.

Questionnaire Sampling

Data for this study were collected through the distribution of 50 well-structured questionnaires distributed among randomly selected respondents ranging from processors in wet milling and those carrying out dry milling operation in the market, although few operators that carry out both milling operations were also considered. The survey instrument focused on the various respondents' level of awareness of government regulation and their adherence to it on noise exposure as well as their concern about their health. The questionnaires were distributed randomly through visitation to the processing centers and this also afforded a one on one interaction with the respondents, hence some clarifications were made and some were assisted in completing the questionnaires.

Statistical Analysis

Statistical approach adopted for the analysis of the respondents was carried out using structured questionnaires and the analysis was done using the SPSS programming in which responses were coded using figures to quantify the responses. Tables were also used for better understanding of available data as well as, the demographic information of respondents.

Sound Level Measurement

The sound level meter (testo 815 Compact Class 2 sound level meter) having been calibrated is placed at a distance of approximated 10cm away from the ear of the operator of the locally fabricated burr mill during operation of the machine in accordance to Occupational Safety and Health Authority OSHA (USA) and the National Institute for Occupational Safety and Health (NIOSH).

Plate 1: Sound Level Meter Calibration & Sound Level Reading at Dry Milling Section

Noise level or loudness is generally measured as the equivalent continuous sound level or Leq. Measured in decibel (dB), Leq captures the sound pressure level of a constant noise source over the time interval T that has the same acoustic energy as the actual varying sound level pressure over the same interval. Furthermore the human ear perceives the loudness differently depending on the frequency of the sound. Standard "weighted scale" frequency functions have been developed to reflect human perception, notably the A-weighting scale, written dB(A) is commonly used.

$$Leq = 10log\frac{1}{T}\int_0^T \frac{P^2}{PO^2}dt$$ -----(Noisetube, 2009)

Where

P = sound level pressure (SLP) recorded

P_0 = minimal audible SLP

RESULTS AND DISCUSSION

Personal Data

Table 1 in the Appendix, shows demographic information of respondents. The factors are grouped as shown in the questionnaire with sex, age, marital status and educational qualification as factors to be considered.

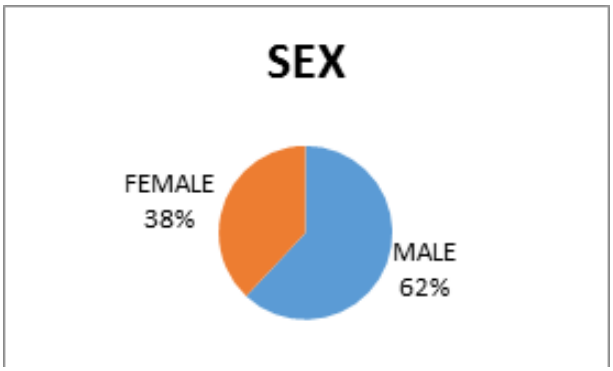

Figure 1: Pie Chart of gender of Respondents.

Figure 1 shows that 62.0% of the respondents were male and 38.0% were female with their frequencies as 31 and 19 respectively. This implies most of the respondents are male and are susceptible more to noise induced hearing loss (NIHL) than women, this finding was in tone with that of Thepaksorn *et al* (2018).

Involvement in the use of Burr Mill Processing Machine

The numbers of years in the business of size reduction as well as the association they belongs to, the level of participation and their knowledge of government regulations were all determined and result presented in table in Appendix. It was observed that the majority

of the respondent belongs to the association called Onitesiwaju Grinders & Millers Association although others belongs to Asejere Grinders Association, it is observed that the respondents belongs to different association in reference to the type of milling being carried out and the different zones in which the market was partitioned. Few of the respondents replied that they are aware of government regulations on noise level exposure but they insist that these regulations are not enforced while others are not aware of any regulations.

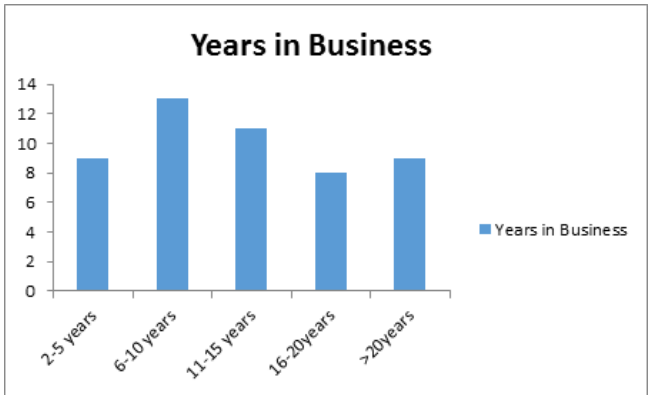

Fig 2: Bar Chart showing the Numbers of Year using Burr Milling Machine

From figure 2 above it could be deduced that 18% of the respondents have been in the business for a period between 2-5 years, 26% with 6-10years in business, 22% with 11-15years, 16% with 16-20years while 18% with 20years and above. This result means that people with good numbers of years in the used of the machine has exposed themselves to noise, averagely of 8hrs per on a daily basis to that corresponding numbers of years making them more susceptible to noise induced hearing loss NIHL and other non-auditory health effects.

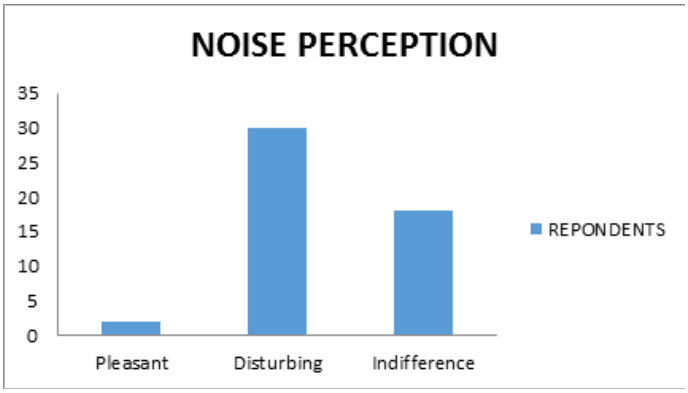

Fig 3: Noise Perception

Although noise sound differently to each individual depending on the distance to the source and how healthy the listening of individuals is, respondents to this research work vary their reply to this work, 4% of which either purposely or unknowingly ticked that the noise was pleasant to their ear drum, 60% strictly selected that the noise level has a disturbing effect on their hearing faculty, although 36% are indifferent to the noise as shown fig 3 above. Observation made at the survey site shows that those that feel indifferent to the perception of noise are majorly operators with verse years of operating the machine making them to have made the noise part of their life i.e. they don't care about the noise level, also operators that just joined the business were having difficulties adjusting to the level of noise being generated from the machine they worked with.

Physiological and Psychological Effects

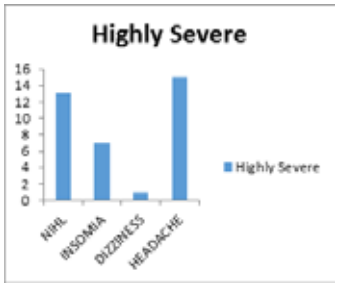

Fig 4

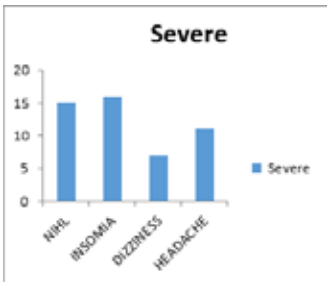

Fig 5

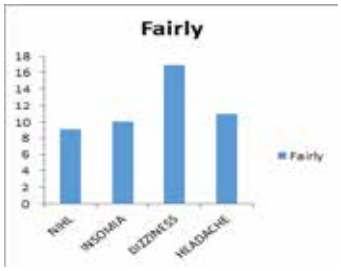

Fig 6,

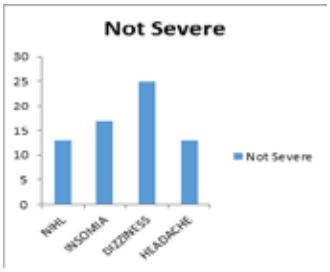

Fig 7

Fig 4, fig 5, fig 6, and fig 7: Comparative illustrations of the severity of different health effect of excessive exposure to noise generated.

Tables 4 to 7 shows the data obtained from respondent on the level of their health in relation to the noise exposure and figures 4 to 7 shows the comparison of the different health implication that respondent are exposed to in line of their business. In terms of severity of these effects fig 4 shows that most respondents feel headache during and sometimes outside the business environs sometimes highly intense followed by noise induced hearing loss NIHL resulting to the loss of auditory sensory cells in the cochlea of the ear, these hair cells cannot regenerate in mammals, no remission can occur; prevention of noise-induced hearing loss is the only option to preserve hearing. In regards to less severity effect of insomnia is rampant as shown in fig 5, dizziness during the day resulting in less productive man-hour is more pronounced among the respondents as shown in fig 6 and fig 7 respectively.

MEASURED NOISE LEVEL (dBA)

The noise level in the processing center visited was measured using the sound level meter and the value is as presented in table below;

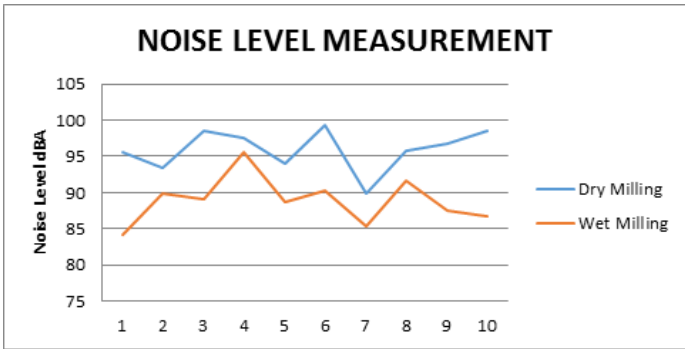

Fig 8: Noise Level

Noise level recorded from the sound level meter is as shown in fig 8 above, it is observed that there was variation in the noise level generated during dry milling and wet milling with that of dry milling recording higher values with 99.3dBA as the highest recorded while wet milling recorded 95.5dBA as highest value these could be as a result in the difference in operating engine capacity. Although there is variation in sound level read, these values are way above the recommended sound level that an individual is expected to be exposed (i.e. recommended exposure limit REL) to as stipulated by National Institute of Occupational Safety and Health NIOSH, USA Occupational Safety and Health Administration OSHA and other regulation bodies that pegged exposure level at 85dB in an average of 8hrs in A-weighted reading (TWA), any level greater than this is term harmful to the hearing. Occupational noise exposure does not cause mortality, but does induce significant morbidity through deafness and other health issues (WHO, 2004). Also over exposure of this type of noise level leads to reduction in productive man-hour and makes life unbearable.

CONCLUSION

This research work affirms to the fact that the noise generated by burr mill processing center are beyond the recommended exposure limit REL which is 85decibels, A-weighted, at an 8-hr time-weighted average (85dBA at an 8-hr TWA). The sound level obtained ranged between 84.1dBA to 99.8dBA, the exposure limit too in some instances are way beyond that which is recommended by American National Standard Measurement of Occupational Noise Exposure, ANSI S12.19- 1996 ANSI which pegged exposure time to nothing more than 8-hr TWA. These values are higher than the stipulated sound level of 85dBA limit as specified by National Institute of Occupational Safety and Health NIOSH, USA Occupational Safety and Health Administration OSHA, NESREA Exposures at and above this level are considered hazardous. Effective reduction in noise exposure can be achieved by regular lubrication and replacement of parts (worn out bearings, cracked joining, the control lever, etc.,) which reduces friction and lower noise levels, vibration isolation pads may be installed under frame of the burr mill machine and also personnel working with the machine should wear personal protective equipment (PPE) which could include ear plugs, ear muffs as means of reducing overexposure to noise.

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Appendix

	Frequency	Percentage	Cumulative percentage
Gender: Male	31	62	62
Female	19	38	100
Years in Business: 2-5years	9	18	18
6-10years	13	26	44
11-15years	11	22	66
16-20years	8	16	82
>20years	9	18	100
Noise perception: Pleasant	2	4	4
Disturbing	30	60	64
Indifference	18	36	100
Severity in Headache: Highly	15	30	30
Severe	11	22	52
Fairly	11	22	74
Not Severe	13	26	100
Dizziness: Highly	1	2	2
Severe	7	14	16
Fairly	17	34	50
Not Severe	25	50	100
Insomnia Level: Highly severe	7	14	14
Severe	16	32	46
Fairly	10	20	66
Not Severe	17	34	100
NIHL: Highly Severe	13	26	26
Severe	15	30	56
Fairly Severe	9	18	74
Not Severe	13	26	100

Measured Noise Level (dB)

Location	Dry Milling Noise Level	Wet Milling Noise Level
1	95.5	84.1
2	93.5	89.9
3	98.6	89.1
4	97.5	95.5
5	94.0	88.7
6	99.3	90.2
7	89.9	85.4
8	95.7	91.7
9	96.8	87.5
10	98.5	86.7