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OCCUPATIONAL INTOXICATION BY ANTICHOLINESTERASIC PESTICIDES IN FARMERS: LABORATORY PARAMETERS AND PERCEPTION OF SELF EXPOSURE

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ABSTRACT

Objective: The objective of this study was to evaluate occupational intoxication by anticholinesterase pesticides in farmers in their laboratory parameters and in the perception of self exposure.

Methodology: This was a quantitative exploratory study developed in the Housing Nucleus I in the Municipality of Sousa - PB, with a sample composed of 50 farmers in their work activities. The data were collected through an interview by means of a structured questionnaire, already the samples by venous puncture, in order to perform the biochemical analyses of the levels of Transaminases (TGO and TGP), Gamma GT and Plasma Cholinesterase for the hepatic evaluation, besides the hematological analyses.

Results: The highest level of schooling recorded among them was Complete High School (18%), however Incomplete Elementary School had predominance under the other levels being, therefore, the most frequent (44%). After the biochemical analyses, an arithmetic mean of the results was obtained: glutamic-oxalacetic transaminase of 25.376 U/L (reference value - 11 to 99 U/L); glutamic-piruvic transaminase of 25.64 U/L (reference value - 11 to 45 U/dL); gammaglutamyltransferase of 47.26 U/L (reference value - 7 to 45 U/L); and plasma cholinesterase of 7.615.34 U/L (reference value - 3,930 to 10,800 U/L); all hematological patterns were within the normal range. When the schooling was associated with the correct storage and disposal of the packages by the participants of the study, it is assumed that the results

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show that people with lower education level still a variable without statistical significance, with p = 0.746. However, it was noted that 15% of the participants who stated that they did not store and dispose of the packages correctly, had incomplete elementary schooling as their education.

Conclusion: After analyzing the results obtained, it was concluded that, although there is knowledge about the risks of agrochemicals to human health, some farmers still do not follow the safety standards, but that despite this, there was no case of occupational intoxication in them.

Keywords: Farmers, Agrotoxics, Anticholinesterasics, Intoxication.

INTRODUCTION

Brazil ranks as one of the ten largest economies in the world for its high agricultural potential. Technological innovations in agriculture began in the 20th century, after wars that led the chemical industry to implement in the field its market of products, until then used as chemical weapons. These direct impacts on farming increased the production and supply of large cities, while generating serious problems in public health, problems that persist to this day, with farmers being the class of high risk of occupational exposure (ROCHA et al., 2015; ANDRADE et al., 2016; VOORHEES et.al, 2017).

Phillips McDougall International Consulting, together with the National Union of Plant Protection Products Industry (SINDIVEG), of Brazil, presented an opinion of the Brazilian consumer market of pesticides, being responsible in Latin America for 28% of global consumption (SINDIVEG, 2015). In the environmental conception, the Brazilian Northeast presents an ecological multidiversity with notorious agricultural production capacity, requiring different production systems and agricultural activity supports, making the use of chemical products a necessary and quite common use (COSTA et al., 2016, SILVA; SILVA, 2016).

The most representative occupational poisoning is associated with insecticides, and the adverse effect of these products on the worker or any other exposed class depends fundamentally on the toxicological capacity of the product and the form of exposure. Among them, the classes of organophosphates and carbamates stand out, thus classifying the toxic agents of agricultural exposure, where their wide use is due to their characteristics and properties that differ from other types marketed. These compounds represent classes of high toxicological degree (I and II) because they have anticholinesterasic action under the human organism, with a range of harm and serious complications to health (MEDEIROS, MEDEIROS, SILVA, 2014; SALLES et al. 2015; ADINEW, ASRIE, BIRRU, 2017).

Serum toxicological research is of extreme importance for public health, justifying research in the corroboration of epidemiological data for the structuring and elaboration of agricultural

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practices that minimize negative effects on human health and the environment, since epidemiological data are limited to the availability of hospital reports, which do not always happen. Thus, in addition to the bibliographic benefits for the academic and scientific class regarding the theme worked, relevant data were provided for the perception of rural workers regarding the importance of IPE use, correct handling and quantities of use within the safety standards of the chemical products in question.

The research aimed to evaluate occupational intoxication by anticholinesterase pesticides in farmers in their laboratory parameters and in the perception of self exposure.

METHODOLOGY

This was a quantitative exploratory survey, carried out with farmers in their work activities in the Housing Nucleus I in the Municipality of Sousa - PB, located in the Sertão da Paraíba. According to the Brazilian Institute of Geography and Statistics (IBGE), in 2016, the municipality had an estimated population of 69,196 inhabitants, with a territorial area of 738,547 km2, presenting as a biome the caatinga with semi-arid climate.

The sample consisted of 50 farmers in their work activities carried out in Núcleo Habitacional I, Sousa - PB. As inclusion criteria, age was adopted and they worked as autonomous unionized farmers. Regarding age, the participants had to be between 30 and 80 years of age and were willing to participate in the survey before signing the Informed Consent Term.

The data were collected in April 2017 by means of a structured questionnaire and the samples by venipuncture in order to acquire the biological material (blood) for the biochemical analyses of the levels of Transaminases (TGO and TGP), Gamma GT and Plasma Cholinesterase for the hepatic evaluation, besides the hematological analyses.

After being collected, the samples were sent to the place of analysis (Laboratory of Clinical Analysis at Santa Maria College in Cajazeiras - PB). The biochemical analyses of the Transminases and GT Range were performed in the Semi Automatic equipment (BioClin100), with POP (Standard Operating Procedure) methodology of the respective reagent kits: Labtest ALT/GPT Liquiform (Ref.: 108-4/30); Labtest AST/GOT Liquiform (Ref.: 109-4/30); and Labtest GT Range Liquiform (REF.: 105-2/30); part of the samples were outsourced to perform the dosages of Plasma Cholinesterase. The hematological analyses were performed in the Hematoclin 3.0 automated device and the slides were reviewed.

The data were analyzed in the Statistical Package for the Social Sciences (SPSS) version 23. For the inferential analysis, the Chi-square test of Pearson (x^2) was adopted, with accepted statistical significance less than or equal to 5%, i.e., $p \leq 0.05$.

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It was previously submitted to the Ethics and Research Committee, having as approved opinion number 1,992,922.

RESULTS AND DISCUSSION

The sample consisted of 50 farmers in their work activities carried out in Núcleo Habitacional I, Sousa - PB, being all male participants. As for the sociodemographic classification, the average age of the farmers was 51 years. The highest level of education recorded among them was Complete High School (18%), however Incomplete Elementary School was predominant under the other levels and therefore the most frequent (44%), described in Table 1.

Table 1: Sociodemographic profile of research participants. Sousa - PB, 2017.

	Average	Frequency	Percentage
Age	**51**		
Schooling			
	Illiterate	13	26%
	Complete Fundamental	3	6%
	Middle Incomplete	3	6%
	Medium Complete	9	18%
	Fundamental Incomplete	22	44%
	Total	50	100%

Our data proved that the most affected farmers are those in the adult age group, with an average age of 51. Corroborating the analyses made by Souza and collaborators (2016), where adult males represented 63.2% of those intoxicated by agricultural pesticides. This gender and age relationship is due to the fact that agricultural activities involving the application of pesticides represent a more widespread practice among men of productive and economically active age groups, and are therefore the high risk group. However, Wylie and his collaborators and Adinew et.al (2017) showed that the average age of intoxicated farmers is among women under 30 years of age, and therefore does not match the data from our surveys in terms of gender and age.

As for the level of education, those who have a low level of schooling stand out, since of these, 44% have only incomplete primary education, as well as in the research of Sousa and his cooperators (2016), Santana et. al (2016) and Garcia et.al (2017), where 67%, 55.3% and 50%, respectively, had low schooling, which justified, in their research, the higher level of intoxication in the participants, considering that because they have a relatively low level of schooling, it is difficult to understand the technical information of the components, how they can affect the human being and also because it is an obstacle for them to obtain funding for the implementation

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of technological innovations in agriculture in order to reduce the levels of occupational intoxication.

Table 2 makes reference to the farmers' perception of the technical information on the use of insecticides, where 100% of the participants used insecticides in their plantations, predominating with 52% those who, during the applications, did not use PPE (Personal Protective Equipment), followed by caveats regarding the value of the same and about using only a tissue on the face.

Table 2: Farmers' perception of technical information on insecticide use. Sousa - PB, 2017.

		Frequency	Percentage
Uses insecticides on crops			
	Yes	50	100%
	No	0	0%
	Total	50	100%
Make use of PPE			
	Yes	24	48%
	No	26	52%
	Total	50	100%
Which PPE's			
	Respiratory mask	1	4,2%
	Protective gloves	1	4,2%
	Safety button	3	12,5%
	Helmet, Mask and Bottle	2	8,3%
	Jacket and bootie	3	12,5%
	Mask and jacket	4	16,7%
	All	8	33,3%
	Total	24	100%

The above data prove that 100% of farmers made use of insecticides. Of these, 52% did not use Personal Protective Equipment (PPE). However, since 48% of the rural workers claimed to use IPE's, the percentage of those who deny the use does not become so significant when compared to the cases of intoxications related to protection or not. It is also worth noting that of those who protect themselves during the application of pesticides, 33.3% used all the equipment listed as essential for agricultural protection. Despite this, our data corroborates the findings of the analyses carried out by Gatto and collaborators (2016), where they emphasize that the level of absorption and contamination by these chemicals increases, in view of the reduction in the use of IPE's, which is due to unfavorable climate issues. In contrast, Amaral et.al (2016) obtained in their analyses data that revealed that 80% of rural workers made use of IPE's, being gloves and masks the most used (80%).

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Figure 1 relates through graphs the perception of rural workers regarding the interference of pesticide use in their own health, in which a large majority (74%) said they knew the risks caused by pesticide poisoning, and 48% of farmers said they never presented signs and symptoms that led them to think they had been intoxicated during their use, but some stressed that they had been intoxicated several times during spraying and were admitted to hospitals soon after, commenting that they had high concentrations of pesticide in their blood.

Figure 1: Perception of rural workers regarding the interference of pesticide use in their own health. Sousa - PB, 2017.

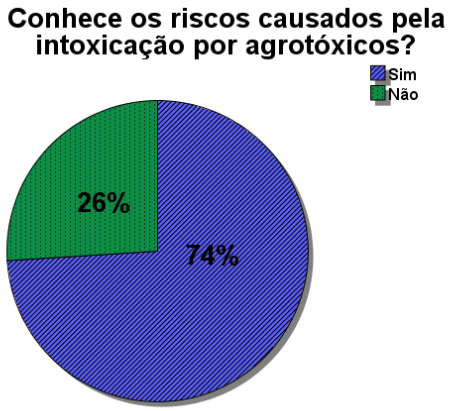

Figure 1 A: Knowledge of the risks of intoxication

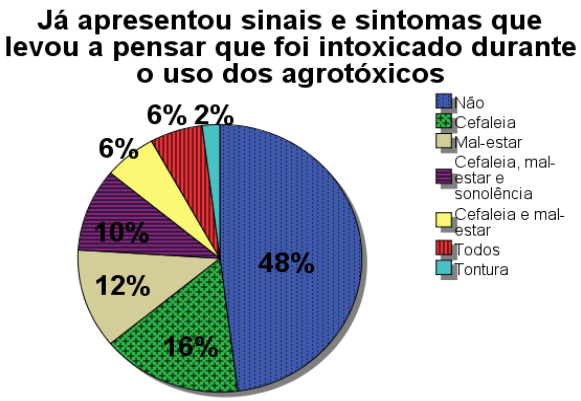

Figure 1 B: Signs and symptoms of intoxication

With regard to rural workers' knowledge of the risks caused by insecticides, 74% said they know that these risks exist and what they are. This overconfidence explains the fact that 48% of participants said they never presented signs and symptoms and only 6% presented all reactions of involvement in the intoxication by anticholinesterase pesticides. It is therefore in agreement with Viero et.al (2016), where 100% of the participants in their survey reported knowing the risks they presented, in addition to reporting the symptoms of acute intoxication, thus demonstrating that even though they were aware of the consequences, they were still intoxicated. This last information is not in accordance with our data as to which farmers have or have not already shown signs and symptoms.

As for the frequency of use, it was predominant in applications once a month (38%), but when they are used they are exposed for hours (84%) with the aid of the costal spraying pump (88%), but they pointed out that before the drought the frequency of use was much higher.

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Figure 1: Perception of rural workers regarding the interference of pesticide use in their own health. Sousa - PB, 2017.

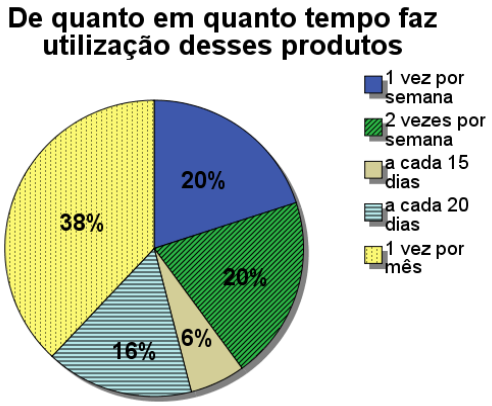

Figure 1 C: Frequency of use of agrochemicals

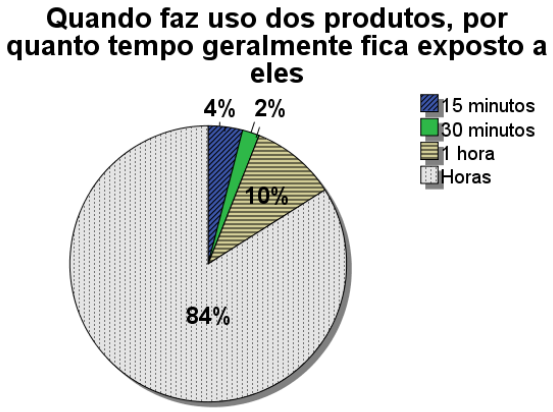

Figure 1 D: Time of exposure to pesticides

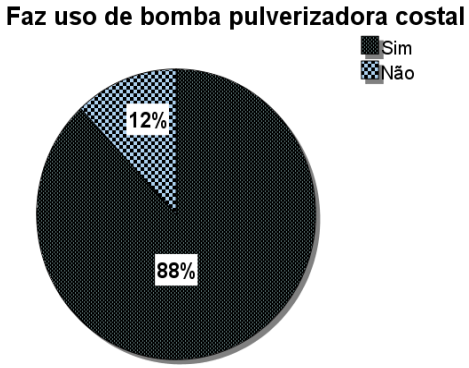

Figure 1 E: Type of application of agrochemicals

Regarding the frequency and method of application of agrochemicals and the time of exposure, 38% of the participants use it once a month with 88% using a knapsack sprayer, 84% of them being exposed for hours. Chaguri (2016), in agreement with our data, makes reservations regarding the frequency of application, demonstrating that prolonged exposure causes serious effects, and that one of the problems observed in occupational intoxication is the method of foliar spraying, where it is stressed that the frequency of use should be better researched. Like this, Gatto and collaborators (2016) took into consideration the intensity of application, frequency,

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duration and method as factors that are involved in occupational exposure, influencing absorption and consequent intoxication.

Regarding the correct storage and disposal of packaging, 62% of respondents did not do so according to the manufacturer's instructions, although they commented on having already followed the instructions, but that for example others today do not mind following them.

Figure 1: Perception of rural workers regarding the interference of pesticide use in their own health. Sousa - PB, 2017.

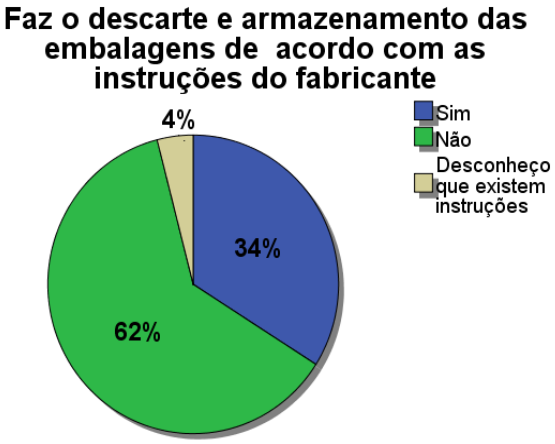

Figure 1 F: Disposal and storage of packages

As for the storage of products and the disposal of packaging, 62% of respondents said they did not follow the manufacturer's instructions. At the same time, Carvalho and collaborators (2016) exposed data that 64.9% of agrochemicals were stored incorrectly, putting the lives of their families at risk, but 80.7% of packages were disposed of correctly, thus contradicting the last analysis. Sousa et.al (2016) found that 70% of the containers are stored correctly, and 57% are mistakenly disposed of on their own land, which increases the risks of environmental contamination.

Figure 2 graphically shows the number of farmers who had their respective test results in the normal range, below and above it according to the reagent kits used for their dosage. Thus, 88%, 98%, 68% and 98% of the samples had the results of Glutamic-Oxalacetic Transaminase (GGT), Glutamic-Piruvic Transaminase (TGP), Gammaglutamyltransferase (GGT, GAMA-GT, γ-GT) and Plasma Cholinesterase, respectively, in the normal range.

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Figure 2: TGO, TGP, GT Range and Plasma Cholinesterase of research participants. Sousa - PB, 2017.

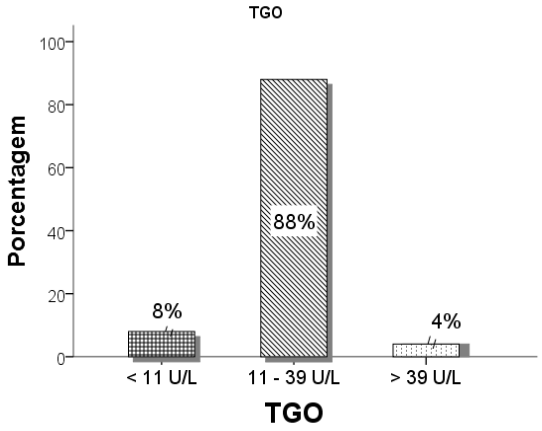

Figure 2 A: Classification of GlutamicOxalacetic Transaminase results of research participants.

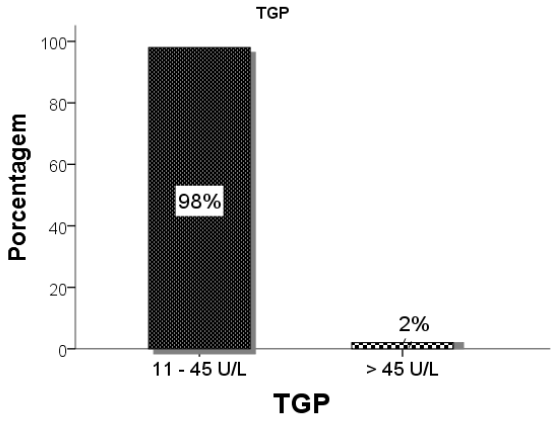

Figure 2 B: Classification of Glutamic-Pyruvic Transaminase results of research participants.

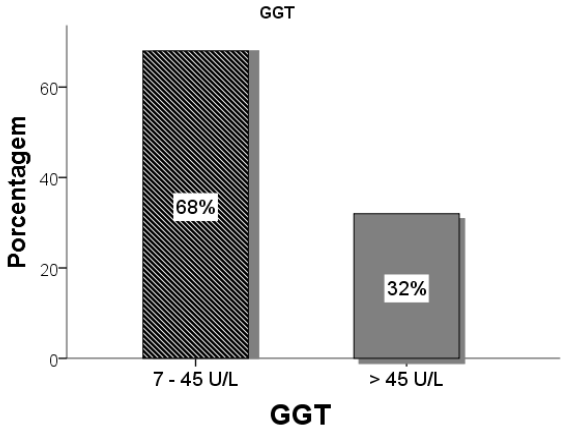

Figure 2 C: Classification of Gammaglutamyltransferase results from survey participants.

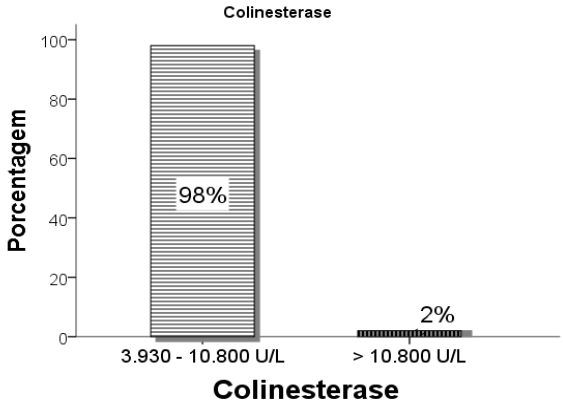

Figure 2 D: Classification of the Plasma Cholinesterase results of the research participants.

According to Selmi and collaborators (2015) and Porto et.al (2016), anticholinesterasic insecticides, as well as drugs with the same mechanism of action, suffer hepatic metabolism by

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several specific isoenzymes, such as Citocromo P450, CYP2D6 and CYP3A4 by several reaction routes. The harmful effects of these have the capacity to cause oxidative stress, thus significantly increasing the values of TGO, TGP and γ-GT being many times irreversible alterations, characterizing their hepatotoxicity. Thus, these data do not match with our studies regarding hepatic enzymes, since they have been shown to have values within normality by means of biochemical dosages.

As for the Plasma Cholinesterase sensitivity dosage, 98% of the samples had results within normality standards, in concomitance with the studies of Porto and collaborators (2016), where 0% of their respondents presented values below the toxic level of the affected enzyme activity, since the intoxication by anticholinesterase agents occurs together with the inhibition of more than 50% of its activity. However, this fact can be explained without excluding the possibility of intoxication even with normal levels of the enzyme, since it will depend on the toxicity level of the insecticide as well as the time and form of exposure.

Evidence generated in the study by Voorhees et.al (2017) suggests that even repeatedly exposed to low levels of organophosphates is not sufficient for a cholinergic crisis. Therefore, a diagnosis of acute intoxication cannot be clarified from the plasma values of the cholinesterase enzyme alone, since multiple components with different mechanisms of action are involved in the exposure, and therefore an erythrocyte cholinesterase dosage is necessary.

Figure 3 graphically refers to rural workers who had their results within normal standards regarding Erythrogram (hematocrit, VCM and HCM), Leucogram and Plaquetogram, through automatic analysis followed by slide correction. So that 70%, 90%, 68%, 72% and 96%, respectively, presented normal results through their reference values.

Figure 3: CBC of research participants. Sousa - PB, 2017.

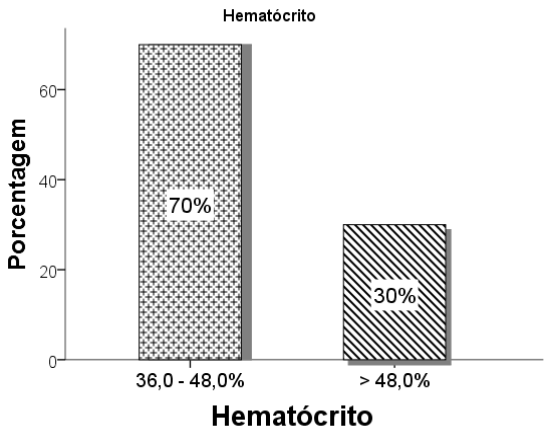

Figure 3 A: Classification of the hematocrit results of research participants.

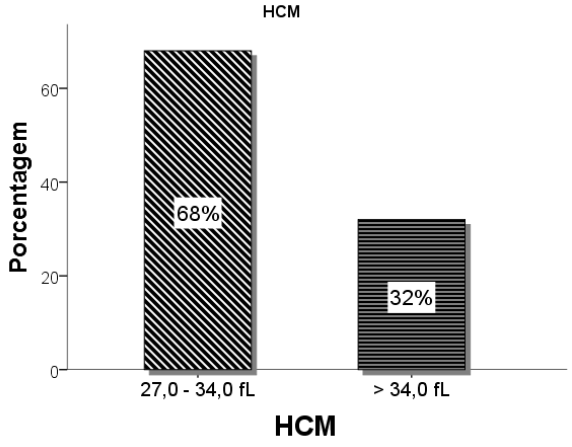

Figure 3 B: Classification of results Average Corpuscular Volume of survey participants.

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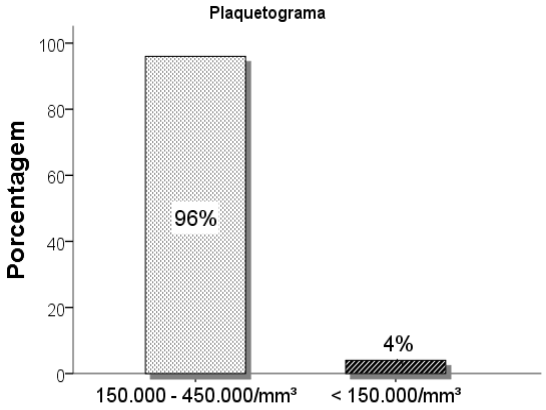

Figure 3 C: Classification of the Mean Corpuscular Hemoglobin Results of survey participants.

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Figure 3 D: Classification of results Plaquetogram of survey participants.

Figure 3 C: Classification of the Mean Corpuscular Hemoglobin Results of survey participants.

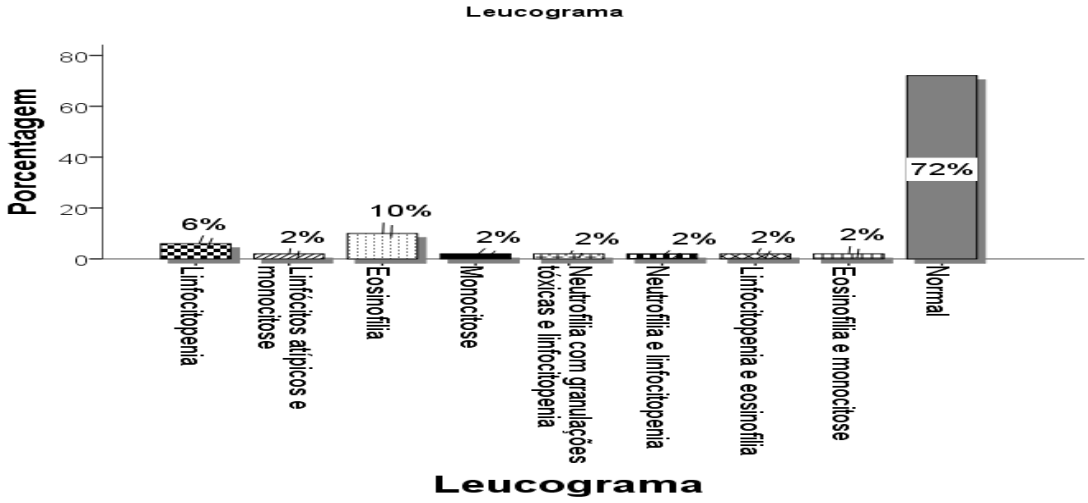

Figure 3 D: Classification of results Plaquetogram of survey participants.

According to Vemu and Dumka (2017), regardless of the form of exposure to toxic compounds, all hematological parameters were within normal standards, a fact that makes the interpretation of possible changes difficult, agreeing therefore with our data collection, where all the hematological groups that were evaluated were normal. In contrast to these, FakhhriBafgui et.al (2015) and Wang et.al (2016), reported that the red blood cells, despite having antioxidant

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molecules, their membranes are susceptible to damage caused by anticholinesterase insecticides, especially oxidative stress, which can result in the destruction of cell membrane and even hemolysis. Based on the analyses of Moura and collaborators (2016), although they present alterations in all hematological parameters, they conclude that all hematological variations should be "considered, investigated and justified".

Table 3 shows the association of the correct storage and disposal of packages with the schooling of the survey participants since, assuming the results, people with lower levels of education still show a variable without statistical significance, with p= 0.746. However, it was noted that 15% of the participants who stated that they did not store and dispose of the packages correctly, had incomplete elementary schooling as their schooling.

Table 3: Association of school use with storage and disposal of research participants. Sousa - PB, 2017.

Disposal and storage of packaging according to the manufacturer's instructions					**Total**	**p**
		Yes	**No**	**I don't know that there are instructions**		
Schooling	Illiterate	5(10%)	7(14%)	1(2%)	13	
	Complete Fundamental	0(0%)	3(6%)	0(0%)	3	
	Middle Incomplete	2(4%)	1(2%)	0(0%)	3	0,746
	Medium Complete	4(8%)	5(10%)	0(0%)	9	
	Fundamental Incomplete	6(12%)	15(30%)	1(2%)	22	
Total		17	31	2	50	

The association between the level of education and correct handling, from storage to disposal, in this study is in agreement with Souza and his collaborators (2016), carried out through an analysis of all pesticide poisoning in rural workers between the years of 2007 and 2011, where the most prevalent level of schooling among those involved was incomplete elementary education with a representation of 39.5% , and the poisoning on record was also related to the reuse of packaging and storage in disagreement with safety standards.

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So, Carvalho et.al (2016), with the application of 57 questionnaires to producers who had an ASPA (Systematic Monitoring of Agricultural Production) registration, also agrees with our research, considering that the level of education of those involved in their research was mostly that of incomplete fundamental level (68.45), that despite 65% of them claim to read the manufacturer's instructions, a satisfactory result was not expected, since 64.9% of packages were still stored and disposed of incorrectly, a fact directly related to the limited understanding of their education. Therefore, such results are justifiable.

CONCLUSION

The present study provided the identification of the laboratory profile of rural workers in the municipality of Sousa - PB, in addition to noting their perception of self-exposure to agrochemicals, highlighting, therefore, the form and duration of exposure and relating the level of education with the management of chemical compounds. From the analyses of the results obtained it was possible to conclude that, although there is knowledge about the risks of agrochemicals to human health, some farmers still do not follow safety standards, but that, despite this, there was no case of occupational intoxication in them.

This fact demonstrates the need for more applied studies in this population, given the lack of awareness of the importance of adequate protection and because there are no agricultural practices that expose them less to risks. Furthermore, the negativity of intoxication through laboratory tests does not rule out the fact that there are chronic sequelae in them, since these had the purpose of acute intoxication, and is therefore a reason for further analysis of the clinical profile of these farmers.

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