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RESEARCH REGARDING THE CHANGES IN THE CONTENT OF MICRO-ELEMENTS (Cu, Zn, Mn) IN STORED WHEAT AFTER INFESTATION BY *RHIZOPERTHA DOMINICA* F.

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ABSTRACT

***Rhizopertha dominica* F. infests cereals and develops inside the grains thus producing the 'hidden infestation' of cereals. The purpose of this work was to determine the content of microelements in grain of wheat infested by *Rhizopertha dominica* F. depnding on the number of insects that had infested the sample. Quantitative changes the microelements were monitored on a number of 5 sample variants infested with 25, 50, 75, and 100 insects of *Rhizopertha dominica*, respectively. According to our results, after a month of attack by *Rhizopertha dominica* F. the content in the mineral substances decreased with increasing number of individuals who had infested the wheat sample.**

Key words: wheat, infestation, *Rhizopertha dominica* L., changes, micro-elements.

INTRODUCTION

The infestation with insect pests of stored agricultural products, besides the quantitative losses, which can be evaluated accurately enough, can have other consequences as well, such as qualitative depreciation of the stored products, diminished germination capacity, apparition of toxic products.

The insect presence inside the grains is not manifest until adults appear. Consumed from the inside by larvae and adults, cereal grains are often reduced to thin skins and bran.

Bran that come mainly from the grain coat contain more ashes (6%), while white flour only contains 0.3% (Săulescu, 1965). Mineral substances in the wheat grain are represented by phosphorus, potassium, magnesium, copper, zinc, manganese, etc. as compounds of chlorine, sodium, etc. Wheat grain ashes are low in calcium. Minerals are mainly found around the peripheral parts of the grain, which makes whole meal much richer in minerals than pure white flour.

The protection of stored agricultural products implies complex research on various aspects, many of which are little known or have not been solved yet (Boieriu et al., 1966).

In order to determine bio-chemical changes occurring in the wheat contaminated with storehouse insects we carried out analyses concerning the content in hydro-soluble (B_1, B_2, B_3) and liposoluble (E) vitamins, in protein, essential and non-essential amino acids, starch and free glucose, lipids and fatty acids, as well as macro-elements (Micu and Petanec, 2009a, 2009b).

In 1995, Jodd et al. analysed vitamin contents of cereal grains affected by storehouse insects and recorded substantial loss of thiamine, riboflavin, and niacin in wheat, maize, and sorghum.

MATERIAL AND METHODS

Samples from Dropia wheat cultivar were infested with a variable number of individuals belonging to the species *Rhizopertha dominica* F., in laboratory conditions. The insects were raised in laboratory conditions, at the necessary parameters for their development (temperature of 26°C and relative humidity of 65%) (Jood et al., 1995).

We introduced 100 grams of wheat in jars and infested them with 25, 50, 75, and 100

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insects respectively in 3 repetitions. The observations were made thirty days after infestation.

After a month, insects were removed from jars, and wheat was milled to be used in laboratory tests.

Determining raw ash was done by incinerating wheat samples at 900ºC. The incineration of the product at 900ºC ± 25ºC was performed in a calcination oven with air ventilation, until the organic matter was completely burnt (the cooled residue being white or almost white). Dosing micro-elements was done by spectroscopy of atomic absorption, with the help of a CONTR AA300 Spectrometer of atomic absorption from Analytikjena (Gergen, 2004).

The spectrophotometry of atomic absorption has higher sensitivity than flame photometry. The atoms that are volatilized in the flame are excited by the energy of a radiation source, having a frequency equal with the frequency of the resonance line of the respective atoms. This frequency is absorbed by the atoms in the composition, and so the intensity of the radiation that passes through the flame is decreased.

The intensity of the absorbed radiation is proportional with the number of atoms present in the flame, with the thickness of the absorbent layer (the flame width), and is independent from the temperature of the flame and the excitation energy of the atoms (Gergen, 2004). Each sample of wheat was ground using a mill and resulted grist was passed through the sieve with 0.1 mm diameter, packed in sealed plastic bags and stored at -20°C until proper analysis.

5 g sample was weighed dry and finely ground in a porcelain crucible and was carbonized on the sand bath until the end of smoking. Next, samples were placed in the electrical furnace and calcinated overnight at 500°C. After cooling, the ash was treated with 5 cm^3 hydrochloric acid 1/1 and was brought to dryness in a water bath. The residue was resumed with 10 cm^3 of hydrochloric acid 1/1, was left to cool, was made a mark with deionized water and was filtered through a dry filter into a suitable vial. Cu, Zn, Mn were then determined from the obtained solution.

Standards were prepared so as to contain the analyzed cations, phosphate and chloride anions in amounts close to those of the sample.

RESULTS AND DISCUSSIONS

After 30 days, the micro-elements content of the control samples were: copper content - 3.68 mg/kg; zinc content - 25.78 mg/kg; manganese content - 34.72 mg/kg (Table 1).

Table 1. Changes in the micro-elements contained in the wheat grains, 30 days after the attack of *Rhizopertha dominica* F.

Control sample	No. insects	Cu (mg/kg)		Zn (mg/kg)		Mn (mg/kg)	
		Average	Significance	Average	Significance	Average	Significance
1 - control	0	3.68		25.78		34.72	
2	25	3.51	-	25.32	-	33.23	000
3	50	3.45	0	25.07	000	33.21	000
4	75	2.99	00	24.96	000	33.05	000
5	100	2.89	000	23.78	000	31.4	000
		LSD 5% - 0.215 mg 1% - 0.312 mg 0.1% - 0.469 mg		LSD 5% - 0.186 mg 1% - 0.271 mg 0.1% - 0.407 mg		LSD 5% - 0.052 mg 1% - 0.076 mg 0.1% - 0.114 mg	
- non-significant; 0 – significant (P<5%); 00 – distinctly significant (P<1%); 000 – very significant (P<0.1%)							

After a month of attack by species *Rhizopertha dominica* F., the wheat sample attacked by 25 insects presented a copper content 0.17 mg/kg lower than the control; the quantity of zinc decreased by 0.46 mg/kg (1.78%) and the manganese was lower by 1.49 mg/kg. When compared to the clean sample, the one attacked by 50 insects had a copper

content lower by 0.23 mg/kg; a quantity of zinc smaller by 0.71 mg/kg (2.75%) and manganese content smaller by 1.51 mg/kg. The sample degraded by 75 insects had a quantity of copper smaller by 0.69 mg/kg; the zinc content decreased by 0.82 mg/kg (3.18%), and the quantity of manganese was smaller by 1.67 mg/kg. The sample attacked by 100 *Rhizopertha dominica* F. insects had a copper content smaller by 0.79 mg/kg than the control; a zinc content lower by 0.82 mg/kg (7.75%) and a quantity of manganese smaller by 3.32 mg/kg.

After measurements made one month after the attack by 25 and 50 insects of the species *Rhizopertha dominica* F. of the microelements content of the samples, we noticed a decrease compared to the control.

In what the quantity of zinc in the wheat samples degraded by insects is concerned, we registered a decline as compared to the values of the sample that had not been infested: the sample attacked by 25 insects had a lower zinc content by 1.78%; the wheat sample degraded by 50 insects registered a zinc content lower by 2.75%; the sample infested by 75 insects *Rhizopertha dominica* F. had its zinc content diminished by 3.18%; the zinc content of the sample attacked by 100 insects was smaller by 7.75%.

The statistical analysis point out the involvement of *Rhizopertha dominica* insect in diminishing the content of Cu, Zn, Mn in the Dropia wheat cultivar sample.

Differences from the control sample were significant for all analyzed micro-elements, especially for samples 3, 4 and 5 (50, 75, 100 insects). For sample 2 (25 insects), the difference from the control sample was significant only in manganese content (Table 1).

CONCLUSIONS

Micu and Petanec (2009a) analyzed the content of macro-elements (Ca, Mg, K, Na, Fe) in cereals grains infested and attacked by *Rhizopertha dominica* after 30 days. According to their results concerning ashes content and macro-elements content (Na, K, Ca, and Fe, except Mg) of the analysed wheat grains, an increase of the value compared to the sample control (non-infested) was noted. This increase can be explained by the fact that the insects eliminated macroelements through excrements and exuviae as well as part of the amount of macroelements existing in their bodies during the infestations. A fairly large proportion of mineral compounds were eliminated by insects in a non-modified state. Analyzing the data obtained regarding of the content of microelements of the wheat grains was found that after a month of infestation and attack of the species *Rhizopertha dominica* F., the contents in these minerals decreased with the growing number of insects infesting the wheat samples. So, in the infested samples, the content in microelements was less than in the control sample, because the individuals of the species *Rhizopertha dominica* F., metabolized these microelements. Comparing the results of determinations, regarding main macro- and micronutrients of the wheat grain attacked by *Rhizopertha dominica* one can conclude that after a month of infestation the microelements were metabolized while macroelements were eliminated.

REFERENCES

Arbogast, T.R., Kendra, P.E., Mankin, R.W., McGovern, J.E., 2000. *Monitoring insect pests in retail stores by trapping and spatial analysis*, Journal Econ. Entomol., 93: 1531 -1542.

Beratlief, C., Boguleanu, Gh., 1975. *Dăunătorii produselor agroalimentare din depozite (Pests food products in storages)*. Edit. Ceres, Bucureşti: 89-90.

Boieriu, I., Eustatiu, N., 1966. *Cultura grâului*, Edit. Agro-Silvică Press, Bucureşti: 34.

Gergen, I., 2004. *Analiza produselor agroalimentare (Analysis the products food)*. Edit. Eurostampa, Timişoara: 79.

Jood, S., Kapoor, A., Singh, R., 1995. *Amino acid composition chemical evaluation of protein quality of cereals as affected by insect infestation*. Plant Foods for Human Nutrition, Kluwer Academic Publishers, 48: 159-167.

Jood, S., Kapoor, A., Singh, R., 1995. *Polyphenol and phytic acid contents of cereal grains as affected by insect infestation*: Journal of Agricultural and Food Chemistry, ISSN 0021-8561: 435-438.

Micu, L., Petanec, D., 2009a. *Researchs regarding the changes in the content of macroelements in stored wheat after infestation by Rhizopertha dominica F.,* Lozenec, Bulgaria: 44-47.

Micu, L. and Petanec, D., 2009b. *Changes in the fat-soluble vitamin E*, Rom. Agric. Res., 26: 75-79.

Săulescu, N., 1965. *Grâul. (The wheat)*. In: Fitotehnie. Edit. Agro-Silvică, Bucureşti: 579-580.