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STUDY ON THE INFLUENCE OF PROPHYLACTIC TREATMENT WITH PRODUCTS FROM THE T+ TOXICITY GROUP UPON WHEAT QUALITY, DURING POST-HARVEST STORAGE

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Abstract

Harvested wheat is a complex ecosystem with a rich enzymatic activity, located in the germ, contaminated with microorganisms and potentially infested with insects. Wheat quality assurance during storage represents a set of technical measures which are applied to direct the physical-chemical and biological processes within the mass of grains, to the purpose of maintaining them under good conditions, with minimum quality and quantity losses.
This work presents a study on the influence of common wheat (Triticum aestivum, ssp. vulgare) belonging to the Romanian variety Dropia, intended for the obtaining food-grade flour. The prophylactic treatments were conducted using groups from the T+ toxicity group (K-obiol EC 25), in view of preserving the wheat under optimal conditions. The obtained results prove the efficiency of the post-harvest prophylactic treatments, which contribute to the preservation of wheat quality during extended storage. The applied treatment ensured protection from pests and, according to the determinations, it did not significantly change the initial values of the quality indicators for the stored wheat.

Key words**:** *wheat, prophylactic treatment, storage, quality indicators*

INTRODUCTION

The wheat intended for the manufacture of flour for bread products influences the value and the quality of food.
Wheat is harvested in a relatively brief period of time and it is consumed in approximately constant quantities over the course of the year. That is the reason why its storage is required, to ensure that the necessary quantities are provided from one harvest to the next. The quality of grain milling products depends, to a large extent, on the storage and grain milling conditions [6].
Wheat preservation properties are determined by the pre-harvest pedoclimatic and agro-technical conditions, by the harvesting and handling method which ensure the integrity of the grains, by the botanical features of the species and by the grains' health status.
The harvested wheat does not always meet the quality conditions necessary for adequate storage. The most frequent deviations are increased humidity and infestation [1]. The pest attack most often starts in the germination period and it causes significant damage to small or large agricultural operations [10].
In view of storage, the preparation of the facilities also involves cleaning, disinsection and deratization.
The main parameters to adjust in the silo, for an optimal preservation, are related to the temperature and moisture: over 25°C temperature leads to over-heating of the wheat and over 16% wheat moisture leads to the moulding of cereal, [5].
Moisture content is one of the most important factors for the storage period, as it influences the multiplication of insects and of fungi.
During the cold season, when temperatures are around the value of zero degrees Celsius and moisture is low, the products are preserved without any problems. Starting with the temperature of 10 degrees Celsius, the occurrence of specific insects is noted, and at 25-30 degrees Celsius, the infestation rate (when no preventive treatment is conducted) is high. The targeted pests are the following: *Sitophilis Granaris, Oryzaephilus*

Surinamensis, Plodia Interpunctella, Rhizoperta Dominica, Tribolium Castaneum, Sitotroga Cerealella, Callosobruchus Chinensis, Drosophilia Melanogaster [3].

The prevention of the potential major hazards which may occur upon storage is achieved using preventive measures (monitoring procedures, procedures for the selection of providers, maintenance and repair plans for the machinery, hygienisation plans, pest control procedures), having in view the HACCP Principles, in compliance with the law in force and with the Best Practice Guidelines for work and hygiene. Aspects such as the ones below are taken into account:

(i)the existence of hazard/risk identification modalities by technological stages;

(ii)the mode in which each technological stage ensures the elimination of risks or their mitigation to an acceptable level;

(iii)the existence of possibilities for the excessive development of an identified risk, which exceeds the maximum accepted level;

(iv)whether the subsequent stages may determine the elimination or the reduction of its effects to an acceptable level.

Hazard analysis represents the basic principle of the HACCP system. In order to implement it, is necessary to identify and assess the potential hazards, in association with the steps of the production process. A further stage is the identification of the measures needed to control these potential hazards. It may take several measures to control a single hazard or, alternatively, a single specific measure can control several hazards [4].

MATERIALS AND METHODS

The research was conducted on the Romanian variety of wheat (*Triticum aestivum, ssp. vulgare)* Dropia, harvested in 2016.

The quality indicators of the harvested wheat are synthesized in Table 1.

The prophylactic treatment was applied by means of a very fine spraying of the cereal, before it was stored [9], immediately following the harvesting. A product from the T+ toxicity group was used, K-Obiol EC 25, which is the only pyrethroid insecticide approved by Directive 91/1414/EU, recommended by WHO (World Health Organisation) and approved by FAO (Food and Agriculture Organization).

Table 1. Quality indicators of the wheat harvested in 2016

Quality indicator	**U. M.**	**Obtained values, acc. to SR 13548/2013**
Organoleptic and sanitary features		Appropriate
Moisture	%	12.3
Hectolitre mass	kg/hl	80.4
Total impurities	%	3.26
Grains attacked by pests	%	1.08
Wet gluten content	%	23.2

Source: Author's results.

The insecticide has a shock effect and it ensures protection to agricultural products stored for a period of up to 12 months. The stored products, treated with K-Obiol EC 25, acquire, as a result of the treatment, a microscopic film of active substance which protects them against subsequent pest attacks.

The treatment may be conducted on the surface of the warehouse where the agricultural products are to be kept, as well as directly on the products (for long-term protection) or on the materials in which the storage is to be achieved (sacks, boxes etc.).

For the treatment conducted by direct spraying, low-pressure pump spraying is employed, directly on the cereal, before it is loaded in the silos.

Preparation of spraying solution [9]:

(a)Approximately 1/3 of the spraying equipment volume is filled with water.

(b)The necessary quantity of product is added and it is shaken very well, until the insecticide is fully dispersed, and afterwards the container is filled up with water.

When treating the cereal by direct application, the dose of 1,000 ml of product is added in 99 litres of water and it is sprayed on an area of application fit for 100 tonnes of cereal (according to the specifications from the product's technical data sheet) [8].

The cereal treated with K-Obiol EC 25 by direct application may be consumed

immediately, without any hazards to human health, without requiring a 7-10 break period, which is indicated in the case of organophosphorus insecticides [2]. With the recommended dosage, the product is not phytotoxic for the crops which it is endorsed for [7].

After the application of the treatment by spraying, directly on the wheat lot, wheat samples were taken, which were subject to the qualitative analysis, according to SR 13548/2013, at 1-year intervals, for 3 years (2017, 2018, 2019).

RESULTS AND DISCUSSIONS

The samples taken after applying the post-harvest treatment, intended to ensure protection from pests specific for straw cereal, were preserved under hygiene, moisture and temperature conditions identical to the ones existing in the wheat storage silos. The quality indicators were in agreement with the Consumption Grain Grading Handbook, published by Order of the Minister of Agriculture and Rural Development No. 2/07.01.2003, including further amendments and additions incurred by Minister's Order No. 321/12.05.2009, respectively Minister's Order No. 228/2017.

After each year of storage, a comparative study was conducted between the quality, reference indicators of the year 2016 and the quality indicators corresponding to each storage year (2017, 2018, respectively 2019).

According to the chart in Figure 1 and Figure 2, the samples saw no significant changes in the first two storage years. Variations of hectolitre weight were registered, which dropped by 0.40 kg/hl in the year 2017 as compared to the year 2016, respectively by 0.70 kg/hl in the year 2018 as compared to the year 2016. The higher percentage of impurities and of the grains attacked by pests remained relatively constant for 2016-2017 and 2017-2018.

Figure 3 shows changes in the quality indicators for the treated and then stored wheat. A 3.04% increase of impurities was registered, respectively a 1.92% increase in the grains attacked by pests. The variation of the other quality indicators in the period 2016-2019 is within the admissible values, according to SR 13548/2013, and it is presented in Table 2.

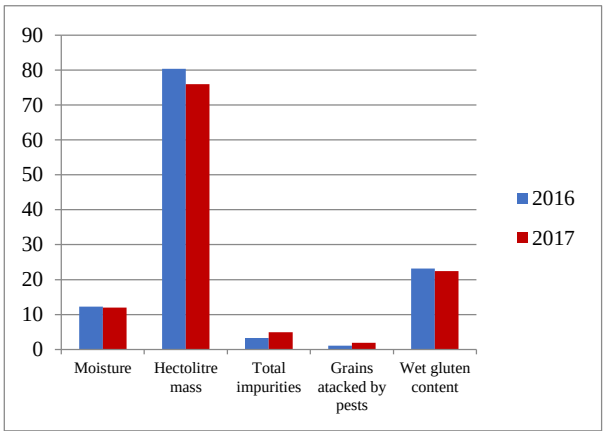

Fig. 1. Quality indicators for the treated and stored wheat, in the period 2016-2017
Source: Author's results.

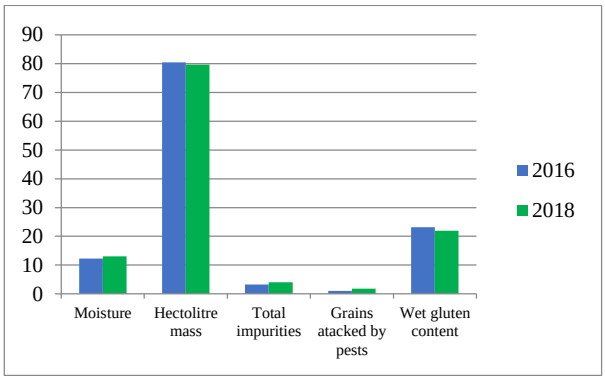

Fig. 2. Quality indicators for the treated and stored wheat, in the period 2016-2018
Source: Author's results.

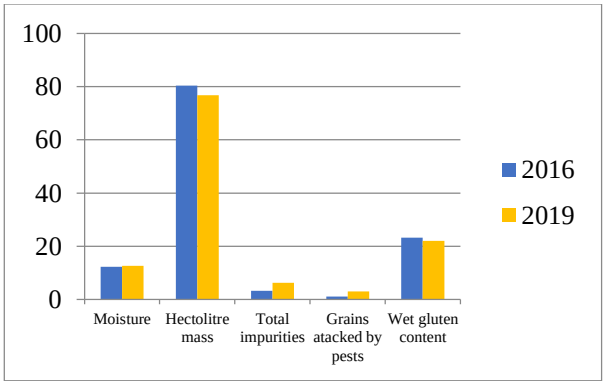

Fig. 3. Quality indicators for the treated and stored wheat, in the period 2016-2019
Source: Author's results.

Table 2. Variation of wheat quality indicators in the storage period (2016-2019), after the application of the prophylactic treatment

Quality indicators	**UM**	**Acceptable values according to SR 13548/2013**	**Va-ria-tion 2016-2017**	**Va-ria-tion 2016-2018**	**Va-ria-tion 2016-2019**
Moisture	%	*the moisture depends on the storage conditions, it is not analysed by comparison with the previous years, it must be of max. 14% throughout the storage period	-	-	-
Hectolitre mass	Kg/ hl	* hectolitre mass decrease: maximum 5 kg/hl	-0.40	-0.70	-3.70
Total impurities	%	*total impurities increase: maximum 4%	0.67	0.79	3.04
Grains attacked by pests	%	*increase in grains attacked by pests: maximum 3%	0.57	0.60	1.92
Wet gluten content	%	*decrease in wet gluten content: maximum 2%	-0.80	-1.20	-1.30

Source: Author's results.

CONCLUSIONS

The obtained results prove the efficiency of the post-harvest prophylactic treatments, which contribute to the preservation of wheat quality during extended storage. The data proves that the recommended wheat storage period, under post-harvest treatment conditions, is of 12-24 months, with an optimum 12-month period.

The applied treatment ensured protection from pests and, according to the determinations; it did not significantly change the initial values of the quality indicators for the stored wheat.

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