THE PHYSICOCHEMICAL AND MICROBIOLOGYCAL PROPERTIES OF WHEAT GRAIN IN ALBANIAN INDUSTRIAL MILL COMPANIES

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Abstract

The objective of this study was to assess the physicochemical and microbiological properties of wheat grain. The samples were obtained in sterile condition from industrial mill companies in 4 different locations in Albania. Wheat samples were analyzed physic chemically in terms of hectoliter weight, ash, moisture and protein amounts. Microbiological evaluation was done in 4 different media for total mesophilic aerobic bacteria (TMAB), yeasts and moulds. This study was based on fungus present in surface and epiderm of wheat. Total numbers of bacteria and fungi was determined by dilution techniques. The identification of mould was based on colony growth, cultural and phenotypic characteristics. Mould species present in wheat were determined by direct microscopic observation. In all cultivation cases, in first and second dilution, was distinguished a high microbiological weight. So the calculation of total number of bacteria, yeasts and moulds was done by third dilution in which all colonies were clearly obvious. In epiderm there was noticed that bacteria and yeasts number is almost 10 times lower than the number of bacteria and yeasts present in the surface of wheat kernel. In the case of moulds it was noticed that this number was higher in epiderm than in surface. By identification of moulds and classification in species and genus there was noticed mainly Ascomycete classes especially *Aspergillus* and *Penicillium* species. All this study was done to evaluate the quality of wheat which is the row material for most food productions as bread, pasta etc. In general wheat samples which have been analyzed were within standards.

Key words: *Physicochemical properties, microbiological quality, wheat grain*

INTRODUCTION

Cereals and cereal products are significant and important human food resources and livestock feeds worldwide. Cereal grains are food staples in many countries and are the raw materials of many of our foods and certain beverages. Because of their extensive use as human foods and livestock feeds, the microbiology and safety of cereal grains and cereal products is a very important area.

The sources of microbial contamination of cereals are many, but all are traceable to the environment in which grains are grown, handled, and processed. Microorganisms that

contaminate cereal grains may come from air, dust, soil, water, insects, rodents, birds, animals, humans, storage and shipping containers, and handling and processing equipment.

Many factors that are a part of the environment influence microbial contamination of cereals, including rainfall, drought, humidity, temperature, sunlight, frost, soil conditions, wind, insect, bird and rodent activity, harvesting equipment, use of chemicals in production versus organic production, storage and handling, and moisture control. The microflora of cereals and cereal products is varied and includes molds, yeasts and bacteria.

There are more than 150 species of filamentous fungi and yeasts on cereal grains. But again, the most important of these are the filamentous fungi or molds. The filamentous fungi that occur on cereal grains are divided into two groups, depending on when they predominate in grain in relation to available moisture in the grain.

AIM OF STUDY

The purpose of this study is to create a general overview on microbiological characteristics of grain stored in our country. The wheat samples were taken in various regions of the Republic of Albania. Experimental work was based on microbiological load control, bacteria, yeast, mold, and detailed control of mold in terms of species and genius.

MATERIALS AND METHODS

Four samples were obtained in sterile condition from industrial mill companies in different locations in Albania during Marc-June 2014 (King A.D. et al., 1979). 1kg of wheat was taken for each sample in order to prepare the sample average with diagonal division (Wright E.J. et al., 2003).

Experimental work was based on:

- ***Total number of microorganisms***

  The total number of microorganisms was determined by the method of placing the suspensions on solid medium (Czapek, Potato dox agar, Malt extract agar, Plate count agar). There was used streptomycin 30mg in czapek medium to inhibit bacteria growth. After incubation at 26 ° C (for mold,) and at 30 ° C (for bacteria), the colonies were counted.

  The concentration of m.o in the original samples was calculated (from plates with 25 - 250 colonies). Calculating the total number of microorganisms, it was done by assuming that each colony grew from a single cell. This method is conventional, because it gives approximate results, but can be judged on the density of microorganisms.

- ***The number of microorganisms on the surface of the wheat***

  10 g wheat was taken and thrown into an Erlenmeyer with 90 ml of sterile water. It were used three dilutions and It was cultivated 2 or 3 parallels with 1ml suspension in each plate (Frashëri M. et al., 1997).

$$\frac{10ml\ sample}{10ml\ sample + 90ml\ sterile\ water} = \frac{10ml}{10ml\ + 90ml} = \frac{10ml}{100ml} = 10^{-1}$$

$$\frac{10ml\ from\ 1dilution\ (1)\ x\ 10^{-1}}{10ml\ sample + 90ml\ sterile\ water} = \frac{1ml}{10ml\ + 90ml} = \frac{1ml}{100ml} = 10^{-2}$$

$$\frac{10ml\ from\ 2\ dilution\ (2)\ x\ 10^{-2}}{10ml\ sample + 90ml\ sterile\ water} = \frac{0.1ml}{10ml\ + 90ml} = \frac{0.1ml}{100ml} = 10^{-3}$$

- ***The number of microorganisms on epiderm***

  10g of wheat were treated with 90ml neutral detergent 0.1 %. The wheat was washed four times with 90 ml of sterile water. It was dumped 10 g sterile sand and 90 ml of sterile water. After shaking, it was prepared dilutions. The Petri dishes were placed in incubator (Prifti D. et al., 2007).

RESULTS

As mentioned in the methodology, there were analyzes 4 samples. There was determined the total number of microorganisms on the surface and epiderm of the wheat. Results of the definitions are presented in the following tables: Table 1, 2, 3. There were demonstrated the results from only one samples and in the end there were a summary graphs for 4 samples. In all cultivation cases, in first and second dilution, was distinguished a high microbiological weight. So the calculation of total number of bacteria, yeasts and moulds was done by third dilution in which all colonies were clearly obvious. In epiderm there was noticed that bacteria and yeasts number is almost same times lower than the number of bacteria and yeasts present in the surface of wheat kernel. In the case of moulds it was noticed that this number was higher in epiderm than in surface.

Table 1: *Comparison between the number of bacteria on the epiderm and surface of the wheat.*

The number of bakteria			On the surface		On the epiderm	
Medium	**Dilution**	**Parallels**	**Nr. of Colony**	**CFU/ml**	**Nr. of Colony**	**CFU/ml**
PCA	**Dilution 10^{-1}**	1	too many	-	too many	-
		2	too many		too many	
	Dilution 10^{-2}	1	too many	-	too many	-
		2	too many		too many	
	Dilution 10^{-3}	1	27	**25000**	20	**23000**
		2	23		24	
PDA	**Dilution 10^{-1}**	1	too many	-	too many	-
		2	too many		too many	
	Dilution 10^{-2}	1	too many	-	too many	-
		2	too many		too many	
	Dilution 10^{-3}	1	17	**12500**	6	**7000**
		2	8		8	

Table 2: *Comparison between the number of yeast on epiderm and surface of the wheat*

The number of yeast			On the surface		On the epiderm	
Medium	**Dilution**	**Parallels**	**Nr. of Colony**	**CFU/ml**	**Nr. of Colony**	**CFU/ml**
MA	**Dilution 10^{-1}**	1	too many	-	too many	-
		2	too many		too many	
	Dilution 10^{-2}	1	21	**1900**	5	**650**
		2	17		8	
	Dilution 10^{-3}	1	13	**10500**	5	**4000**
		2	8		3	

Table 3: *Comparison between the number of mold on epiderm and surface of the Wheat.*

The number of mold			On the surface		On the epiderm	
Medium	**Dilution**	**Parallels**	**Nr. of Colony**	**CFU/ml**	**Nr. of Colony**	**CFU/ml**
PCA	**Dilution 10^{-1}**	1	1	**20**	1	**5**
		2	3		1	
	Dilution 10^{-2}	1	1	**100**	3	**100**
		2	1		1	
	Dilution 10^{-3}	1	0	**0**	0	**0**
		2	0		0	
Czapek	**Dilution 10^{-1}**	1	7	**55**	3	**20**
		2	4		1	
	Dilution 10^{-2}	1	1	**50**	1	**50**
		2	0		0	
	Dilution 10^{-3}	1	0	**0**	0	**0**
		2	0		0	
PDA	**Dilution 10^{-1}**	1	7	**55**	4	**40**
		2	4		4	
	Dilution 10^{-2}	1	3	**250**	1	**150**
		2	2		2	
	Dilution 10^{-3}	1	0	**0**	1	**500**
		2	0		0	
MA	**Dilution 10^{-1}**	1	3	**50**	1	**20**
		2	7		3	
	Dilution 10^{-2}	1	2	**150**	0	**50**
		2	1		1	
	Dilution 10^{-3}	1	0	**0**	0	**500**
		2	0		1	

This graph shows the total number of microorganisms in the first sample for the third dilution calculated in CFU/ml. There was taken PCA for bacteria, MA for yeast and PDA for Mold as reference medium.

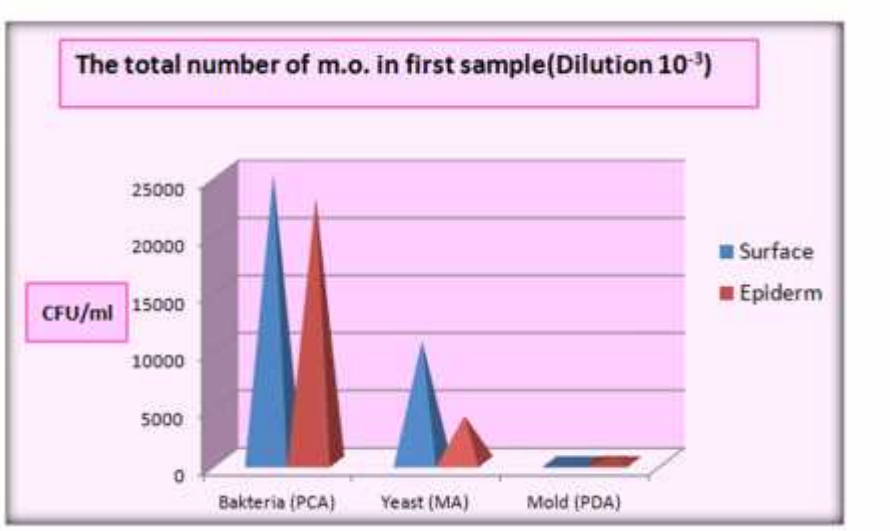

Figure 1: *The total number of microorganisms in the first sample*

The results for four samples are demonstrated in the following two graphs which show the total number of microorganisms on the surface and epiderm . In all cases it was taken third dilution . As shown in the graphs the most polluted sample is the forth.

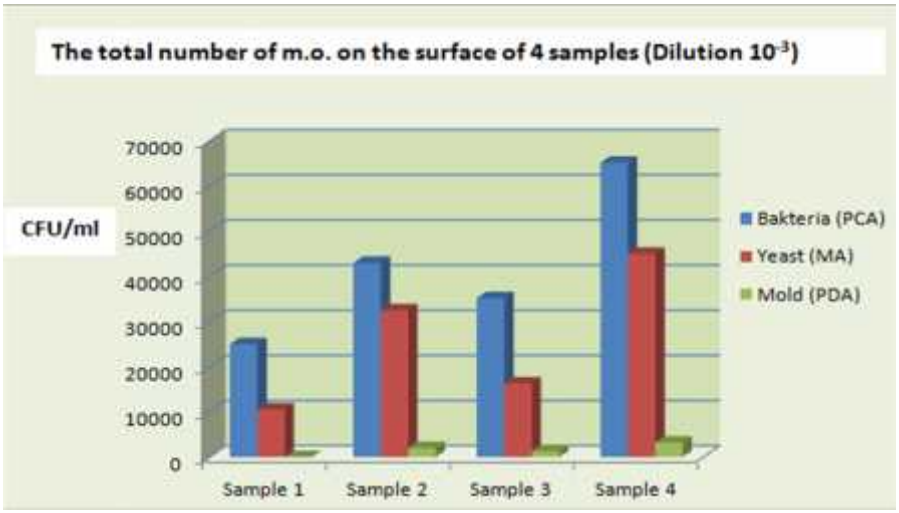

Figure 2: *The total number of microorganism on the surface of 4 samples.*

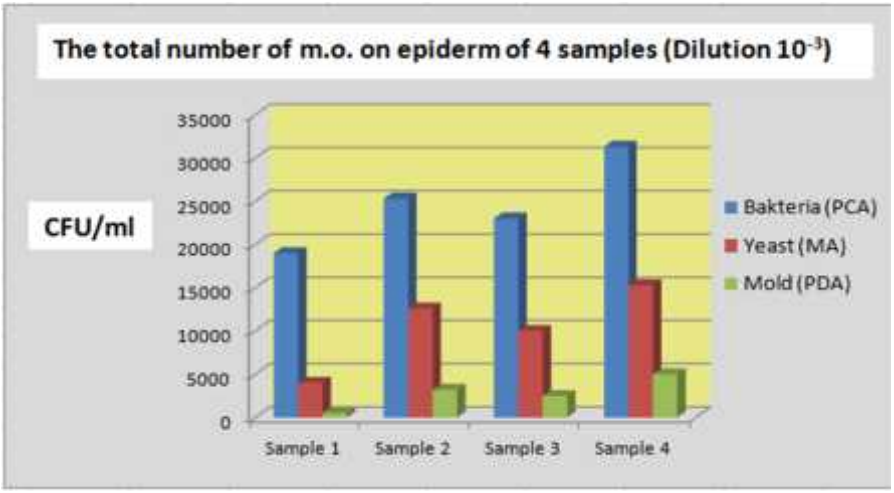

Figure 3: *The total number of microorganisms on the epiderm of 4 samples*

A very important point of this study was identifying the molds that were grown in all media. The identification of mould was based on colony growth, cultural and phenotypic characteristics. Mould species present in wheat were determined by direct microscopic observation. By identification of moulds and classification in species and genus there was noticed mainly Ascomycete classes especially *Aspergillus* and *Penicillium* species.

Table 4: *Identification of mold on the surface of the wheat*

Sample 1 - on the surface					
Class	Phycomycetes		Ascomycetes		Fungi imperfecti
Genus	Rhizopus	Mucor	Aspergillus	Penicillium	
Medium					
PCA		1-Mucor	1-A.candidus	2-Penicillium	
			1-A.flavus	1-P.cyclopium	
Czapek			4-A.candidus		
			1-A.flavus		
			1-A.terreus		
PDA			2-Aspergillus	2-Penicillium	
			5-A.candidus		
			1-A.terreus		
MA		1-M.hiemalis	8-A.candidus	1-P.rubrum	
		1-Mucor			
Total nr.		3	24	6	

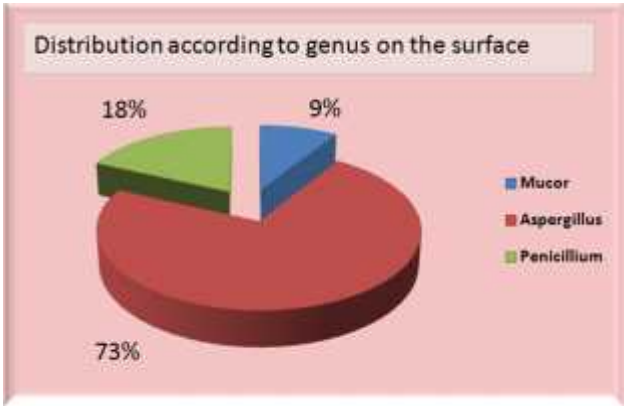

Figure 4: *Distribution of mold according to genus on the surface of the wheat*

Table 5: *Identification of mold on the epiderm of the wheat*

Sample 1 - on epiderm					
Class	Phycomycetes		Ascomycetes		Fungi imperfecti
Genius	Rhizopus	Mucor	Aspergillus	Penicillium	
Medium					
PCA			1-A.candidus	1-Penicilium	
Czapek		1-Mucor	3-A.candidus		
			1-A.terreus		
PDA		3-Mucor	1-A.terreus	3-Penicillium	
			5-A.niger		
MA		2-Mucor	4-A.candidus		
Total nr.		6	15	4	

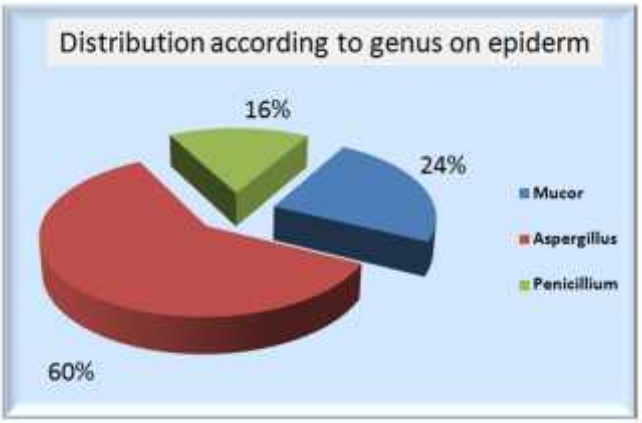

Figure 5: *Distribution of mold according to genus on the epiderm of the wheat*

CONCLUSION AND RECOMMENDATION

Wheat samples which were analyzed were within the norms prescribed for the content in terms of the microorganisms. As you seen from the graphs of all samples, bacteria and yeast is more popular on the surface than epiderm. But for the mold is the opposite, they are more popular on epiderm than the surface of the wheat. Although in low percentages, presence of Aspergillus genius, mainly *Aspergillus candidus*, is always a potential risk to grain storage. From all the experimental work, we may recommend that the industrial mill companies should pay attention to preparation for milling processes, such as : cleaning, sorting, conditioning of the wheat because wheat is the basic food in our life.

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