# INVESTIGATION OF THE BIOLOGICAL STATE AS GOOD INDICATOR OF THE QUALITY OF COMMON WHEAT

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**Abstract**

*Biological state of some purified common wheat samples was investigated. All were contaminated while the total count was usually normal. The grains were mainly contaminated with field molds: Fusarium and Alternaria, both ephemeric toxinogenic molds changed with persistent Mucorales under storage. The low presence of Penicillium and Aspergillus genus in the purified samples indicated the short time under storage and the cleanliness of the store.*

**Key words:** wheat, purity, germination, toxigenic fungi, storage.

## INTRODUCTION

Wheat with around the one million hectares production area and 3-5 million tons per hectares yield per year has a great impact on economy and food industry (Balogh Á. and Hornok M., 2006). Theoretically, stable quality of wheat is sustainable for a longer period without any problem if the grains are harvested in time and put through purification and treatment on the basis of the regulations, and the storage conditions are also suitable. The quality of the stored crop depends on the temperature and the moisture content of the crop (Komka G., 2005).

The quality of the grains can be decreased by microorganisms, which are mostly molds. Molds decrease the germination ability, the dry matter and nutriments of the grains, decolourize, and the grains became stuffy and fusty, and toxic secondary metabolites (mycotoxins) can be produced (Veres E., et al. 2002; Mezei Z. and Győri Z., 2007, Sohár P., 2007). The contaminating molds, can be originated from the crop land (field molds, *e.g. Alternaria, Fusarium, Helminthosporium, Stachybotrys, Chaetomium, Trichoderma, Trichotecium*), which have a need for higher water activity, or from the storage place (storage molds), where their propagation is helped by the contaminating insects, or tramping rodents. Where the water content of the dried grains is too low for the field molds, storage molds, *e.g. Aspergilli* and *Penicilli*, have the possibility to overgrowth field molds; however, the species composition changes by the microclimate differences (Győri M.I., 2005). The exception is the *Mucorales* which contain usually hydrophilic species but are considered as storage molds in Hungary.

Mycotoxins are produced on the field or under storage. The relation between the mold contamination and the mycotoxin content of the grains is usually not linear. The chemically stable mycotoxins persist without degradation throughout the processing and storage of the crop (Veres E. and Borbély M., 2003) even without detectable mold contamination. Besides the moisture content of the crop, climate has also effect on the production of mycotoxins (Paterson R.R.M. and Lima N., 2010). Feeding with mycotoxin contaminated food and feed can cause different severe health problems (Paterson R.R.M. and Lima N., 2010) because mycotoxins can damage protein synthesis, parenchymal tissues and neuron systems because of the cytotoxic, mutagenic or teratogen characteristics. Usually food-borne molds can cause human illnesses like allergic reactions, immunosuppression and even tumours (Pitt J.I., 2000).

In this work we characterized the biological quality of some wheat samples, regarding the purity and the changes of the mold contamination of the samples.

**MATERIALS AND METHODS**

The wheat samples were originated from the North East Hungary. The samples were freshly purified, dried and Samples 4 and 5 were stored for 2 months and one year, respectively.

The purity was investigated from 100 grams of the samples and the contaminated grains were separated and measured. Results were given as weight per cent of the original sample.

The fungal flora was investigated from 10 g of wheat. The grains were washed in 90 ml of buffered peptone water and the suspension was spread onto surface of malate agar medium: 10 g $l^{-1}$ malate extract, 5 g $l^{-1}$ yeast extract, 20 g $l^{-1}$ glucose, 20 g $l^{-1}$ agar. After 5 days of incubation (25 °C) the flora was investigated and the colonies were inoculated onto new malate agar media. After 9 days the genus of the colonies was determined microscopically.

Total counts of the samples were determined on TGE medium: 5 g $l^{-1}$ tryptone, 1 g $l^{-1}$ glucose, 2.5 g $l^{-1}$ yeast extract, 15 g $l^{-1}$ agar. Decimal dilutions of the samples were applied onto the surface of the medium. After 2 days of the incubation (30 °C) the total counts were determined.

To investigate the germination ability, 50 grains were put onto the surface of malate agar medium in Petri dishes. Germination ability was determined by checking the presence of leaves after 9 days incubation at room temperature.

**RESULTS AND DISCUSSIONS**

Visual investigation revealed living insects and even Nematode worms in the samples except Sample 3, which was contaminated mainly with other seeds. The contamination was the highest in the Samples 4 and 5 (Table 1) and these Samples was stored before the examination.

*Table 1*

Summary of the characterization of the wheat samples.

| **Sample No.** | **1** | **2** | **3** | **4** | **5** |
|---|---|---|---|---|---|
| **Germination (%)** | 45 | 10 | 50 | 35 | 27 |
| **Contamination (%)** | 16.22 | 12.38 | 16.51 | 24.53 | 26.72 |
| **Total count ($10^4$ CFU[1]/g)** | 3.90 | 9.05 | 6.25 | 3.65 | 6.65 |
| **Fungal isolates (total)** | 16 | 21 | 23 | 21 | 36 |
| *Fusarium sp.* | 7 | 8 | 13 | 5 | 16 |
| *Mucorales* | 1 | 1 | 4 | 14 | 14 |
| *Cladosporium sp.* | 0 | 1 | 0 | 0 | 0 |
| *Trichoderma sp.* | 0 | 1 | 0 | 0 | 0 |
| *Verticillium sp.* | 0 | 1 | 0 | 0 | 0 |
| *Alternaria sp.* | 8 | 6 | 4 | 3 | 3 |
| *Aspergillus sp.* | 0 | 0 | 0 | 0 | 3 |
| *Penicillium sp.* | 0 | 3 | 2 | 0 | 0 |

← **Demand for water activity**

[1]CFU: colony forming unit

The germination ability of the grains was different, 10-50 % of the grains were able to grow (Table1). The low ability of the Sample 2 indicated high moisture content after an unsuitable drying, that was also strengthened by the high total count (Table 1) of the sample.

Investigation of the contaminating fungal flora revealed that *Alternaria, Fusarium* and the *Mucorales* spores spread through all the samples. In Sample 5 wheat stored for one year, *Fusarium* and *Mucorales* isolates were equally present, while in freshly stored wheat the ratio changes in opposite ways, as high number of *Fusarium* isolates with low number of *Mucorales* isolates was detected. The Samples 1 and 5 originated from the same field that were also indicated by the similar contaminating flora with the exception of a storage mold *Aspergillus*, which indicated that the Sample 5 was contaminated under storage. The most complex flora was detected in Sample 2, since from the 8 genus detected in all samples 7 was found there. Another toxigenic mold *Penicillium* was isolated only from Samples 2 and 3. *Penicilli* and *Aspergilli* are considered as important toxigenic molds of stock. Since all samples were purified before storage, the number of storage molds indicated the quality of the storage. The low number of fungal isolates indicated the short time spent in the store-house and/or the quality of the storage. Small quantities of spores of storage fungi may be present on grains going into storage or may be present on spilled

grain, present in harvest, handling and storage equipment or structures. Meanwhile, such a high presence of the field mold *Fusarium* genus indicated clearly the high number of propagula that presented the general quality of the common wheat of that year. In Sample 5 that stored for one year the high number of *Fusarium* isolates, that usually have a shorter half-life, indicated the much higher original *Fusarium* contamination. Interestingly, *Alternaria* species were not as dominant in the sample as *Fusarium*, however, both genus usually possess ephemeric characteristics. The viability of the spores is very important in the consideration of the biological state of the stocks. *Mucorales*, *Fusarium* and *Alternaria* are all hydrophilic molds, while the viability of the spores is quite different. *Mucorales* usually show persistence that means longer half-life of the spores than that of *Fusarium* or *Alternaria*. Spores of ephemeric species lost their viability after the harvest; however, mycotoxins that produced on the field remain intact.

The presence of the persistent *Mucorales* could be dangerous as microclimatic changes under possible unsuitable storage conditions can support their growth, what could lead to a significant damage by decreasing the nutriment and increasing the secondary metabolite such as mycotoxin content. Meanwhile, persistent *Mucorales* are important in the considerations of the biological state of common wheat as *Mucorales* were able to detoxify ochratoxin, zearalenone (F-2) and also patulin (Varga J. et al, 2005), and therefore they could be an important part of the toxin elimination.

**CONCLUSIONS**

Biological investigation of common wheat samples is an important part of the quality control as its results characterize the quality of the purification, storage and even the time of the storage.

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