# Seed Quality and Fungal Growth on Barley Seed

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## Introduction

The study was aimed at determining potential differences in seed quality of spring malting barley in relation to fungal occurence measured as a content of ergosterol in grain.

Malt production is based on controlled limited germination of barley grains. Apart from malting quality other characteristics required for malting barley are sound grain with minimal fungal contamination, absence of pre-germination, germinative capacity not less than 99% and germinative energy not less than 98% at time of malting (MORRIS, BRYCE 2000). Lower seed quality often associates with fungi infection, fungi can occur both during ripening and/or storage.

Several methods have been developed for detection and quantification of fungal contamination, i.e. sensorial evaluations (odour and visual presence of mycelium), microbiological methods (spore counting techniques), and chemical and biochemical methods incl. chitin, ergosterol and fungal secondary metabolites as mycotoxins (MAGAN 1993).

Ergosterol is widely proposed as a measure of fungal growth. Various applications of ergosterol analyses were described, e.g. for the early and accurate detection of fungal activity in stored grain, for quantification of living fungal biomass present in soil, as an early indicator of potential mycotoxin production (SCHWADORF, MÜLLER 1989).

## Material and Methods

The samples of barley seeds of six commonly grown malting varieties were obtained from the Czech Official Variety Trials, which were performed in 2002 and 2003 on six field stations with different soil and climatic conditions. No fungicides and only moderate amount of fertilizers were applied during growing. The seed quality was evaluated by the standard laboratory germination test and by the method for estimation of seed vigour. This method determined vigour as a germination rate under stress conditions, i.e. low temperature (9-10 °C) and insufficient water uptake (CHLOUPEK et al. 1997). Drought was induced by polyethyleneglycol solution, which osmotic potential of -2 bars corresponded to 100 g of PEG 6000 in 1 litre distilled water at 10 °C (BURLYN and KAUFMANN 1972). For statistical evaluations the software Statistica 7.0, StatSoft, Inc. was used.

The content of ergosterol in all seed samples was measured using HPLC technique developed in LUFA, Bonn (WOLF 1998, 1999).

## Results and Discussion

The multiple comparisons of standard germination, vigour and ergosterol content are summarised in *Table 1*. The germination rates (97.6-99.9%) and vigour estimations (96.9-99.8%) were very high in both years with the exception of stations Vysoká (germ. 80%; vig. 78.2%) and Libějovice (germ. 44.9%; vig. 37.3%) in 2002. Due to heavy rains at the beginning of August that postponed harvest at those stations the seed quality was very low and significant differences among the varieties were detected. The variety Amulet was the most tolerant to the unsuitable humidity (germ. 91.5 and 53.0%; vig. 91.0 and 49.5% Vysoká, Libějovice resp.) the varieties Kompakt (germ. 70.5 and 24.0%; vig. 70.0 and 20.5% Vysoká, Libějovice resp.) and Prestige (germ. 70.0 and 43.5%; vig. 63.5 and 30.5% Vysoká, Libějovice resp.) were the least tolerant. The crop year 2003 was generally very suitable for spring barley, the grain was well developed and all germination parameters were above standards, e.g. germination energy 98% and germination rapidity 86.2% compared to year 2002 (97.0% and 78.6% resp.) (PROKEŠ 2004).

The effect of variety on ergosterol content was not proved, only the effect of location was statistically significant (*Ta-*

*Table 1:* **Mean values for standard germination, vigour and ergosterol content in 2002 and 2003 year**

| Variety | Standard germination (%) 2002 | Standard germination (%) 2003 | Vigour (%) 2002 | Vigour (%) 2003 | Ergosterol (mg/kg) 2002 | Ergosterol (mg/kg) 2003 |
|---|---|---|---|---|---|---|
| Amulet | 90.1 NS | 98.7 NS | 88.5 NS | 98.9 NS | 6.1 NS | 7.6 NS |
| Jersey | 86.4 NS | 99.3 NS | 82.2 NS | 99.0 NS | 4.7 NS | 6.9 NS |
| Kompakt | 81.8 NS | 99.0 NS | 81.0 NS | 98.7 NS | 5.7 NS | 8.0 NS |
| Malz | 88.6 NS | 99.3 NS | 88.3 NS | 98.8 NS | 4.7 NS | 6.5 NS |
| Prestige | 84.9 NS | 99.3 NS | 81.2 NS | 98.8 NS | 5.3 NS | 7.2 NS |
| Tolar | 88.5 NS | 99.3 NS | 87.5 NS | 99.7 NS | 4.8 NS | 6.7 NS |
| Mean | 86.7 | 99.1 | 84.8 | 99.0 | 5.2 | 7.1 |
| **Location** | | | | | | |
| Chrastava | 99.0 d | 98.8 a | 97.1 c | 98.5 a | 6.2 c | 10.0 d |
| Chrlice | 97.6 c | 99.6 b | 96.9 c | 99.8 b | 3.9 bc | 8.2 c |
| Lednice | 99.3 d | 98.2 a | 99.3 d | 97.8 a | 3.8 bc | 6.9 bc |
| Libějovice | 44.9 a | 98.7 a | 37.3 a | 98.6 a | 13.7 d | 6.9 bc |
| Věrovany | 99.5 d | 99.9 b | 99.8 d | 99.6 b | 0.1 a | 4.9 a |
| Vysoká | 80.0 b | 99.7 b | 78.2 b | 99.7 b | 3.5 b | 6.1 ab |
| **Mean** | **86.7** | **99.1** | **84.8** | **99.0** | **5.2** | **7.1** |

Fischer´s LSD test, NS - non-significant; a-d letters denote significant differences at the 95% confidence level

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*ble 1*). The differences in seed lots were found in both crop years; the average ergosterol content was 5.2 mg/kg in 2002 and 7.1 mg/kg in 2003. The highest fungi contamination was proved particularly on poor quality seeds from the station Libějovice in 2002, the only samples with the visible mould (from 10,8 to 18,9 mg/kg). Although the seed quality was better in the 2003 year, the content of ergosterol was actually higher in all samples with the exception of samples from Libějovice. This study dealt with naturally contaminated grain, therefore the content of ergosterol was lower than that found in inoculated grain where can reach up to 250 mg/kg (GOURAMA, BULLERMAN 1994). The ergosterol content showed a negative correlation with the germination rate and vigour estimation in both years, -0.75 and -0.79 in 2002, and -0.33 and -0.21 in 2003. It is possible that weak correlations in 2003 were caused by small differences in seed quality of tested samples.

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