

Effect of *Fusarium* infection of wheat on the fatty acid composition of wheat lipids

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Introduction

Fusarium head blight (FHB) is presently one of the most important fungal diseases affecting small grain cereals, e.g. wheat, barley and maize. An outbreak of FHB is often accompanied by mycotoxin contamination (e.g. deoxynivalenol), which is reduced neither during milling nor baking (Gilbert and Tekauz, 2000). However, the *Fusarium* (*F.*) infection and grow can also affect the nutrient composition of the grain as well as the processing quality. *F. graminearum* infection can cause significant compositional changes in carbohydrates and proteins of wheat grains (Wang et al., 2005a, b). Wheat infected by *F. culmorum* exhibited inferior baking quality because of a degradation in the gluten proteins (Wang et al., 2005a). However, also lipids are degraded by fungal lipases that may lead to increasing content of free fatty acids. *F. graminearum* is characterized by high lipolytic activities (Voigt et al., 2005). The objective of the present study was to investigate the effect of three different *F. culmorum* infection levels on the free fatty acid composition in winter wheat and potential effects on the processing quality of wheat flour.

Material and Methods

Field experiment: Wheat of cultivar Hanseat (quality class A according to the German “Bundessortenamt”) was commercially grown and harvested from the field station Reinshof, Göttingen, Germany. In order to induce an infection of the wheat plants with *Fusarium*, the wheat spikes were sprayed artificially with a conidio-spore suspension (2.5 x 10⁵ spores ml⁻¹) of *F. culmorum* at the beginning of flowering.

Methods: The degree of infection, expressed as Fusarium Protein Equivalent concentration (FPE in µg g⁻¹ DM) was determined according Al-Kubrusli (2000): slight infection: FPE <12 µg g⁻¹; moderate infection: 12 µg g⁻¹ < FPE <20 µg g⁻¹; serious infection: FPE > 20 µg g⁻¹. Three samples from each group were selected for the present study. The fatty acid composition was determined by gas chromatography (Thies, 1971).

Results

Changes in the **fatty acid composition** are part of protective mechanisms of the invaded grain to fungi. Lipases of pathogenic fungi are expressed during infection of the host cells. Voigt et al. (2005) found for *F. graminearum* lipase higher substrate specificity against palmitate than against stearate. In the present study, certainly as a result of *F. culmorum* lipase, the content of C_{16:0} decreased with increasing infection, whereas the content of C_{18:0} increased. From the unsaturated fatty acids, only C_{18:3} was significantly affected by *Fusarium* infection (**Table 1**).

Table 1: Relationship between *F. culmorum* infection grade and fatty acid composition in wheat grain

FPE (µg g ⁻¹ DM)	Infection grade	Fatty acid composition (%)						
		C _{16:0}	C _{18:0}	C _{18:1}	C _{18:2}	C _{18:3}	C _{20:0}	C _{20:1}
7.29	Light	19.12	0.67	12.97	61.65	5.00	0.00	0.59
11.07		19.36	0.72	12.86	61.34	5.09	0.00	0.56
11.34		19.33	0.71	12.86	61.50	4.98	0.00	0.56
12.69		19.69	0.73	12.95	60.98	5.00	0.00	0.57
14.58		19.39	0.69	13.08	61.15	5.06	0.00	0.58
16.20	Moderate	19.47	0.72	12.75	61.48	4.99	0.00	0.57
25.92		18.53	0.89	13.06	61.50	5.00	0.14	0.57
39.15	Serious	19.09	0.87	12.90	61.39	5.10	0.07	0.56
49.95		17.79	0.97	12.92	62.14	5.12	0.13	0.56
	r	-0.807**	0.944***	0.030	0.599	0.671*	0.820**	-0.566

*, **, *** p < 0.05, p < 0.01; p < 0.001

It can be expected that the transformation and degradation of fatty acids by fungal lipase may lead to changes in properties of the grain lipids and those changes may affect also the rheological properties of dough that are influenced by nonstarch-bound lipids. Meyer et al. (1986) found both increased content of free fatty acids and decreased contents of digalactosyldiacyl-glycerols and phosphatidyl cholins in infected wheat grain.



Figure 1: Minibrads obtained from *Fusarium* infected wheat

In our studies about *Fusarium* infection related to wheat quality, close negative correlations between dough stability (r = -0.841**), resistance (r = -0.822**), elasticity (r = -0.717*) and the degree of *Fusarium* infection indicate the deterioration in dough quality due to the fungus infection. The observed significant positive relationship between dough softening and FPE (Wang et al., 2005a) could be another indication of changes in bread quality as in **Figure 1** presented.

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