EFFICASY STUDY OF PRESERVATIVE CONTAINING PROPIONIC ACID, SODIUM BENZOATE AND SODIUM PROPIONATE (1A700) FOR CONTROLLING MOULDS IN DIFFERENT MOIST GRAINS

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ABSTRACT

One of the principal challenges in preserving high-moisture grains is the extensive development of moulds, which significantly compromises storage stability. This study investigated the efficacy of the feed additive 1a700 containing propionic acid, sodium benzoate and sodium propionate (commercial product: KofaGrain pH5) in controlling mould growth in moist wheat, barley, and maize during extended storage. Wheat, barley, and maize obtained from commercial farms were adjusted to defined moisture levels and treated with different application rates of 1a700 and with water for a control. Treated and untreated grains were stored under controlled conditions at 25 °C and analysed after 6, 12, and up to 24 months of storage. Mould counts were determined according to VDLUFA methods at multiple storage intervals (VDLUFA, 2012). Untreated controls showed a strong, time-dependent increase in mould contamination, frequently exceeding 10^6 CFU/g. In contrast, 1a700 significantly reduced mould development in all grain types and at all storage periods ($p = 0.05$). Higher application rates consistently resulted in greater mould reduction, demonstrating a clear dose–response effect. The results confirm that 1a700 is an effective preservative for improving the storage stability of moist grains under conditions unsuitable for long-term storage.

Keywords: high-moisture grains, moulds, preservation, feed additive 1a700

INTRODUCTION

Preservation of high-moisture cereal grains represents a significant post-harvest challenge because elevated moisture levels create conditions that are highly conducive to fungal proliferation, leading to rapid spoilage, diminished nutritional quality, and increased risks of mycotoxin contamination. Propionic acid and its salts are widely recognized for their antifungal properties – they inhibit mold growth by penetrating and acidifying microbial cells, thereby disrupting metabolic functions that are critical for proliferation (Lückstädt, 2007). However, direct application of propionic acid can present practical challenges – including corrosiveness, volatility, and potential handling hazards – which has led to interest in buffered salts such as sodium propionate that offer comparable antifungal effects with improved handling characteristics (Rutenberg *et al.* 2018). In addition to propionates, sodium benzoate serves as antifungal preservatives by lowering pH and inhibiting metabolic pathways in fungi and yeasts. Although sodium benzoate is most effective under acidic conditions and its incorporation into grain preservation strategies can complement propionate-based approaches by broadening the spectrum of antifungal activity (Sofos, 2008).

Despite the widespread use of these preservatives, their effectiveness depends on multiple factors, including moisture level, application rate, storage duration, and microbial load. In order to validate the efficacy for controlling moulds of a non-corrosive preservative based on propionic acid, sodium benzoate and sodium propionate (KofaGrain pH5) a trial was conducted.

MATERIAL AND METHODS

The grains used in this study came from commercial farms close to the ADDCON plant in Bitterfeld, Germany. The study was started in July of 2023 and finished in March of 2025. The grain moisture for wheat and barley was analysed and re-moisten according to the attended grain moisture of 18 and 22 %. The necessary amount of water was sprayed onto the grain in a rotating material mixer. After spraying the grain remained in the mixer for 30 minutes. Afterwards the moisture was measured. If the grain was still to dry this procedure was repeated. In case of the corn grains, the natural given moisture was used. For each grain species and moisture level 5 kg were treated with 22.5 and 45.0 ml 1a700 for 4.5 and 9.0 l/t, respectively. The corn grains were treated with 60 and 75 ml for 12 and 15 litres per ton, respectively. The control was treated with the amount of 4.5 ml water for wheat and barley and 70 ml water for maize per 5 kg grain respectively. The grains were placed into a food processor, and the feed additive was added with a hand sprayer continuously during the mixing. The grain material was stored in 1.5 litre jars containing holes in the bottom and the cover. With cotton pads the holes were slightly closed. The grains of the different moisture levels were stored in different climate chambers at 25 °C. From the delivered grains and the grains after the storage time of 6, 12 and 24 month we took subsamples for analysing the mould counts. This was done according VDLUFA (2012) via plate counting on agar plates. For this report we used the different moisture levels (18 and 22 % DM, 3 rep. each) as a data set with one moisture and 6 replicates.

RESULTS AND DISCUSSION

All grain materials showed an increase in mould counts. But the counts were strongly affected by the different treatments (Tab. 1-3). Possibly caused by the rougher testa of the barley we found with 5.95×10^4 CFU/g higher mould counts in the raw material of that specie (Tab. 2). For wheat we found with 7.50×10^3 CFU/g a clear lower mould load. Contrarily, the wet maize kernels showed a load of 1.62×10^5 CFU/g.

The 12- or 24-month observation period showed more visible differences between the treatments. The untreated control samples of all grains experienced high mould populations, with numbers soaring past one million CFU/g – a level that poses significant challenges for grain safety and quality. In stark contrast, grains treated with the preservative 1a700, particularly at the recommended application rate of 9 litres per ton (calculated based on the initial grain moisture content), demonstrated a substantial suppression of mould growth. This effect was consistent across both wheat and barley and observed at all three monitored time points during storage.

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Tab. 1: Effect of different 1a700 application amounts on mould counts (CFU/g) over time in wet wheat grain

	Storage length (month)			
		6	12	24
	Initial mould count	**Moisture (%)**		
	7.50×10^3 CFU/g	18 / 21	18 / 22	17 / 19
Treatment	**Dosage (l/t)**	**CFU/g**		
control	0	$1.09 \times 10^{7\,a}$	$2.67 \times 10^{7\,a}$	$5.17 \times 10^{7\,a}$
1a700	4.5	$2.8 \times 10^{2\,b}$	$1.53 \times 10^{6\,b}$	$1.47 \times 10^{6\,b}$
1a700	9	$3.2 \times 10^{2\,b}$	$9.01 \times 10^{2\,c}$	$1.91 \times 10^{3\,c}$

*different letters show significant differences within a column ($p < 0.05$)

Tab. 2: Effect of different 1a700 application amounts on mould counts (CFU/g) over time in wet barley grain

	Storage length (month)			
		6	12	24
	Initial mould count	**Moisture (%)**		
	5.95×10^4 CFU/g	17 / 21	18 / 23	17 / 20
Treatment	**Dosage (l/t)**	**CFU/g**		
control	0	$4.97 \times 10^{6\,a}$	$2.71 \times 10^{8\,a}$	$6.25 \times 10^{7\,a}$
1a700	4.5	$3.73 \times 10^{4\,b}$	$1.09 \times 10^{5\,b}$	$2.48 \times 10^{5\,b}$
1a700	9	$5.84 \times 10^{2\,c}$	$1.40 \times 10^{3\,c}$	$3.50 \times 10^{3\,c}$

*different letters show significant differences within a column ($p < 0.05$)

Tab. 3: Effect of different 1a700 application amounts on mould counts (CFU/g) over time in wet corn grain

	Storage length (month)		
		6	12
	Initial mould count	**Moisture (%)**	
	1.62×10^5 CFU/g	31	19
Treatment	**Dosage (l/t)**	**CFU/g**	
control	0	$1.0 \times 10^{8\,a}$	$1.5 \times 10^{8\,a}$
1a700	12	$2.4 \times 10^{2\,b}$	$1.3 \times 10^{5\,b}$
1a700	15	$4.0 \times 10^{2\,b}$	$1.45 \times 10^{4\,c}$

*different letters show significant differences within a column ($p < 0.05$)

Corn grain also responded positively to preservative treatments, with the extent of mould reduction closely tied to the applied dosage (Tab. 3). This dose-response relationship was evident at both the 6- and 12-month storage intervals, underscoring the importance of proper dosing for effective mould control in higher-risk grains like maize. For maize the application of the highest preservative dose resulted in the most pronounced and statistically significant decline in mould counts after 12 months of storage (Table 3). This finding reinforces the critical role of adequate preservative dosage in managing mould risks in grains prone to high initial contamination.

CONCLUSION

Grain with a moisture level which is too high for a long-time storage gets rapidly and very moulded. This effect is in relation to the storage time as well. Preserving the wet grains via the additive 1a700 is decreasing the moulding significantly with increasing application rates and at all analysed storage periods. In all tested grains the highest dosage of 1a700 resulted in the highest reduction of moulds and was always significant against the control.

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