Grain Research Laboratory Technical Bulletin

Title	Effects of mineral oil application on the quality of malting barley, general purpose barley and oats
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Summary

This study was conducted to determine whether the application of mineral oil on malting barley, general purpose barley and oats has any negative effects on the quality of these grains. Grain samples were treated with mineral oil applied at the recommended level by weight (0.02% w/w) and at 10 times higher than the recommended level (0.2% w/w). Treated and untreated grain samples were tested for various parameters commonly used in quality evaluation. Results indicated that mineral oil applied at levels from 0.02 to 0.2% w/w had no significant impact on specific quality attributes.

Goals and objectives

Application of food grade mineral oil can effectively suppress the dust during grain loading. The following were the objectives of this study:

1. To determine the effects of mineral oil application at the recommended level (0.02% w/w) and at 10 times higher than the recommended level (0.2% w/w) on the quality characteristics of malting barley, malting process, and quality of malt.
2. To determine the effects of mineral oil application at the recommended level (0.02% w/w) and at 10 times higher than the recommended level (0.2% w/w) on the selected quality parameters of general purpose barley and oats.

Materials and methods

Mineral oil ([CAS 8042-47-5] MilliporeSigma Canada Co. Oakville, ON) was applied to grain samples using an airbrush applicator to obtain final oil concentrations of 0.02 and 0.2% (w/w). The oil was applied to three 1-kg samples of each of the following:

- two malting barley varieties (AAC Connect and CDC Copeland)
- two feed barley varieties (CDC Austenson and Oreana)
- three oat samples (grain company rail car subsamples; mixture of varieties)

A multipurpose airbrushing system kit (see Appendix: Figure 1), equipped with a 1/5 horsepower air compressor and a dual-action airbrush (2 ml gravity feed fluid cup and 0.2 mm nozzle diameter), was used in this study. To ensure even application of the mineral oil throughout the sample, the grain was spread out in a single layer in a rectangular container.

Treated and untreated samples were tested for various quality parameters based on grain type. Test weight, 1000 kernel weight, moisture, protein, plumpness and germination energy for barley samples were measured according to American Society of Brewing Chemists (ASBC) Methods of Analysis. Malting barley samples were malted in a Phoenix Automated Micromalting System and the quality of the subsequent malt was measured according to the ASBC Methods of Analysis. Selected oat quality parameters were measured according to the methods outlined in the Operating Procedures of the Prairie Recommending Committee for Oat and Barley and the Official Grain Grading Guide of the Canadian Grain Commission.

Statistical analysis was conducted in SAS Enterprise Guide Version 7.15. For each sample, Analysis of Variance—General Linear Model (PROC GLM) was conducted using treatment as the fixed effect. For samples exhibiting a significant treatment effect, the Tukey's all pairwise multiple comparison test was applied to determine significant differences among the treatments.

Results

Malting barley

Germination is the most important quality requirement for malting barley. Barley with acceptable quality should have at least 95% germination energy (that is, 95 germinated kernels out of 100 kernels testedafter 72 hours. The application of oil did not reduce the germination energy of the two cultivars tested. Germinative index is an indication of the vigour with which germination starts. The results indicated that the application of oil did not slow down the germination process (Table 1).

The application of mineral oil at 0.02 and 0.2% w/w concentration did not affect any of the physical characteristics of barley, such as the test weight, 1000 kernel weight or plumpness, nor did it affect the concentration of proteins in the grain. The application of mineral oil at 0.02% w/w did not affect the malting process and did not have any effects on the malt and wort quality characteristics (Table 1).

The application of oil at 0.2% w/w slightly reduced the water absorption of barley during steeping and resulted in lower friability of malt from CDC Copeland compared to the untreated control (0% w/w), but generally had no effect on the malt and wort characteristics. The results indicate that the application of mineral oil at 0.02 and 0.2% w/w to barley samples had no significant effect on any of the measured quality parameters of barley (Table 1).

General purpose barley

The results indicate that the application of oil at 0.02 and 0.2% w/w had no effect on the test weight, 1000 kernel weight, and protein concentration of the two general purpose barley cultivars investigated in this study (Table 2).

Oats

The results indicate that the application of mineral oil at 0.02 and 0.2% w/w had no effect on the test weight, 1000 kernel weight, plumpness, and the amount of thin kernels in any of the three oat samples investigated in this study (Table 3).

Conclusion

The application of mineral oil at the recommended level of 0.02% w/w has no significant effect on any of the assessed quality parameters of malting barley, general purpose barley, and oats.

References

1. American Society of Brewing Chemists. American Society of Brewing Chemists Methods of Analysis, 14th ed.
2. Prairie Grain Development Committee. Prairie Recommending Committee for Oat and Barley-Operating procedures.
3. Canadian Grain Commission. Official Grain Grading Guide of the Canadian Grain Commission. Chapter 7-Oats.

Appendix

Figure 1 Multipurpose airbrushing system kit used to apply mineral oil

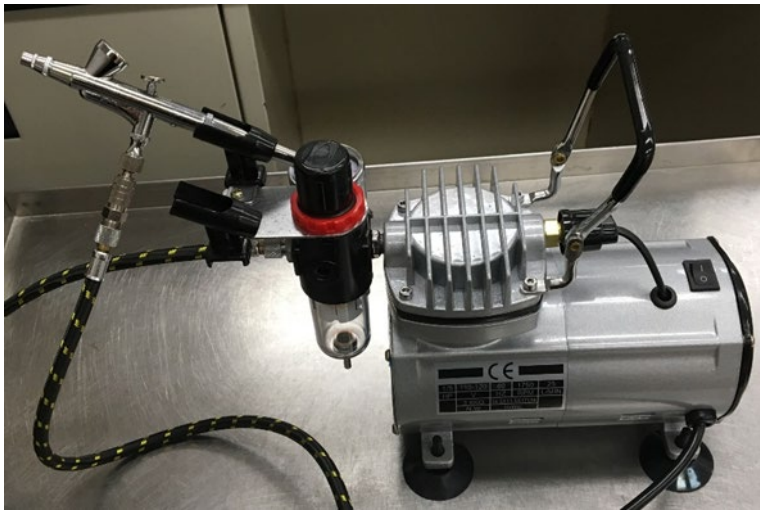

Table 1 Effect of mineral oil application (0.02 and 0.2% w/w) on the quality parameters of malting barley[±]

	AAC Connect			CDC Copeland		
Mineral oil application (% w/w)	**0**	0.02	0.20	**0**	0.02	0.20
Barley						
Germination energy, 4 ml (%)	**99±1[a]**	99±1[a]	99±1[a]	**99±1[a]**	99±1[a]	100±0[a]
Germination energy, 8 ml (%)	**98±1[a]**	95±2[a]	96±2[a]	**99±1[a]**	98±2[a]	95±4[a]
Germination index	**7.1±0.7[a]**	7.6±0.3[a]	7.6±0.3[a]	**7.0±0.2[a]**	7.0±0.3[a]	7.5±0.3[a]
Test weight (kg/hL[c])	**68.6±0.2[a]**	68.3±0.1[b]	68.7±0.0[a]	**68.0±0.1[a]**	68.0±0.2[a]	68.0±0.1[a]
1000 kernel weight (g)	**50.2±0.5[ab]**	50.0±0.4[a]	51.0±0.3[b]	**47.5±0.2[a]**	47.4±0.4[a]	47.5±0.2[a]
Plump (%)	**97.6±0.1[a]**	97.6±0.1[a]	97.6±0.3[a]	**92.9±0.4[a]**	93.4±0.1[a]	93.3±0.1[a]
Intermediates (%)	**2.1±0.1[a]**	2.2±0.1[a]	2.0±0.2[a]	**5.9±0.2[a]**	5.6±0.2[a]	5.4±0.5[a]
Moisture (%)	**10.5±0.0[a]**	10.7±0.1[b]	10.6±0.0[b]	**11.6±0.0[a]**	11.6±0.0[a]	11.5±0.1[a]
Protein (%, db[d])	**13.5±0.1[a]**	13.5±0.2[a]	13.5±0.2[a]	**11.2±0.1[a]**	11.1±0.2[a]	11.2±0.1[a]
Malting Process						
Steep out moisture (%)	**46.1±0.4[a]**	46.4±0.2[a]	45.2±0.0[b]	**45.3±0.5[ab]**	45.6±0.2[b]	44.6±0.4[a]
Malt yield (%)	**95.3±1.3[a]**	94.0±0.7[a]	95.2±0.8[a]	**97.3±0.2[a]**	96.8±0.4[a]	97.2±0.2[a]
Roots (%)	**4.0±0.7[a]**	4.4±0.3[a]	4.4±0.4[a]	**3.3±0.3[a]**	3.2±0.2[a]	3.3±0.3[a]
Malt						
Moisture (%)	**4.9±0.1[a]**	4.7±0.1[a]	5.4±0.1[b]	**5.0±0.2[a]**	5.2±0.1[a]	5.3±0.2[a]
Friability (%)	**66.9±1.9[a]**	67.4±3.1[a]	69.8±2.5[a]	**79.1±2.1[a]**	76.4±0.8[a]	72.1±1.9[b]
Protein (%, db[d])	**14.0±0.0[a]**	14.0±0.1[a]	13.9±0.2[a]	**11.2±0.1[a]**	11.2±0.1[a]	11.2±0.2[a]
Diastatic power (º, db[d])	**185±5[a]**	183±4[a]	210±3[b]	**149±8[a]**	158±1[a]	157±4[a]
α-amylase (DU[e], db[d])	**93.0±2.7[a]**	89.0±1.5[a]	93.9±1.6[a]	**67.8±2.4[a]**	70.2±0.5[a]	71.2±3.6[a]
Wort						
Fine extract (%, db[d])	**80.8±0.1[a]**	80.4±0.02[a]	80.9±0.1[a]	**81.7±0.2[a]**	81.5±0.3[a]	81.4±0.2[a]
Soluble protein (%, db[d])	**5.48±0.11[ab]**	5.64±0.11[b]	5.26±0.07[a]	**4.59±0.05[ab]**	4.61±0.03[b]	4.42±0.11[a]
Kolbach index (%)	**39.2±0.8[ab]**	40.2±1.1[b]	37.9±0.3[a]	**41.1±0.8[a]**	41.2±0.7[a]	39.5±1.4[a]
FAN (mg/L[f])	**231±10[a]**	234±8[a]	220±5[a]	**198±3[a]**	205±4[b]	198±2[a]
Colour (º)	**1.94±0.10[a]**	2.07±0.12[a]	1.65±0.05[b]	**1.51±0.03[a]**	1.57±0.03[a]	1.55±0.01[a]
ß-glucans (mg/L[f])	**171±44[a]**	119±4[a]	153±15[a]	**104±7[a]**	99±5[a]	112±5[a]
Viscosity (cP[g])	**1.45±0.03[a]**	1.42±0.01[a]	1.44±0.01[a]	**1.45±0.01[a]**	1.44±0.01[a]	1.45±0.01[a]

[±]Results are reported as the mean and standard deviation of 3 replicates

*For each cultivar, the mean values in the same row followed by a different letter are significantly different ($p<0.05$) as determined by PROC-GLM and the Tukey's all pairwise multiple comparison test.

[c] kilograms per hectolitre

[d] dry basis

[e] dextrinising units

[f] milligrams per litre

[g] centipoise

Table 2 Effect of mineral oil application (0.02 and 0.2% w/w) on selected quality parameters of general purpose barley ±

	CDC Austenson			Oreana		
Mineral oil application (% w/w)	**0**	0.02	0.20	**0**	0.02	0.20
Test weight (kg/hL[b])	**73.4±0.5** a	73.3±0.1 a	73.3±0.1 a	**71.8±0.2** a	71.7±0.0 a	71.9±0.2 a
1000 kernel weight (g)	**47.9±0.3** a	47.7±0.3 a	47.7±0.2 a	**51.8±0.2** a	52.3±0.3 a	51.6±0.4 a
Moisture (%)	**10.2±0.1** a	10.3±0.1 a	10.3±0.1 a	**11.2±0.1** a	11.2±0.1 a	11.1±0.5 a
Protein (%, db[c])	**13.0±0.1** a	12.9±0.2 a	13.1±0.1 a	**13.3±0.0** a	13.2±0.1 a	13.4±0.2 a

±Results are reported as the mean and standard deviation of 3 replicates

* For each cultivar, the mean values in the same row followed by a different letter are significantly different ($p<0.05$) as determined by PROC-GLM and the Tukey's all pairwise multiple comparison test.

[b] kilograms per hectolitre

[c] dry basis

Table 3 Effect of mineral oil application (0.02 and 0.2% w/w) on oat quality parameters±

	Sample 1			Sample 2			Sample 3		
Mineral oil application (% w/w)	**0**	0.02	0.20	**0**	0.02	0.20	**0**	0.02	0.20
Test weight (kg/hL[c])	**59.0±0.2**[a]	58.6±0.3[a]	58.8±0.2[a]	**58.7±0.1**[a]	58.7±0.2[a]	58.6±0.1[a]	**58.8±0.3**[a]	58.5±0.1[a]	58.5±0.3[a]
1000 kernel weight (g)	**40.9±0.8**[a]	40.9±1.0[a]	40.5±0.8[a]	**40.7±0.2**[a]	41.1±0.2[a]	41.0±0.4[a]	**40.0±0.4**[a]	40.5±0.3[a]	40.7±0.1[a]
Plumpness (%)	**94.5±0.3**[a]	94.5±0.2[a]	94.4±0.3[a]	**94.3±0.1**[a]	94.6±0.2[ab]	94.8±0.2[b]	**93.9±0.4**[a]	94.3±0.0[a]	94.4±0.3[a]
Thins (%)	**1.3±0.1**[a]	1.2±0.1[a]	1.3±0.1[a]	**1.2±0.0**[a]	1.2±0.0[a]	1.1±0.0[a]	**1.4±0.2**[a]	1.2±0.1[a]	1.0±0.2[a]

±Results are reported as the mean and standard deviation of 3 replicates

* For each sample, the mean values in the same row followed by a different letter are significantly different ($p<0.05$) as determined by PROC-GLM and the Tukey's all pairwise multiple comparison test.

[c] kilograms per hectolitre