

Abstract Dry degerming of corn is a low-cost and environment-friendly process in comparison to wet process and produces a increasing output of degermed corn grits (DCG) in recent years in China. This work aimed to evaluate whether DCG was suitable for beer brewing. The results showed that most components in DCG were similar to those of rice, expect fatty acid content, which was positively correlated to its particle size. The fatty acids in DCG were identified as unsaturated fatty acids and their content significantly increased when storage time extended. The fatty acids content should be strictly controlled when DCG is used as brewing adjunct. Fermentation parameters using DCG were also similar to those of rice. Whereas, there was a strong corn aroma during gelatinization and liquefaction of DCG, medium corn aroma during mashing and weak corn aroma in beer production. Several flavor compounds were identified using GC-MS-O method and one compound, might belong to thioether, was identified as corn-flavor compound in the beer product.



Fig 1 Is degermed corn grits suitable for beer brewing?

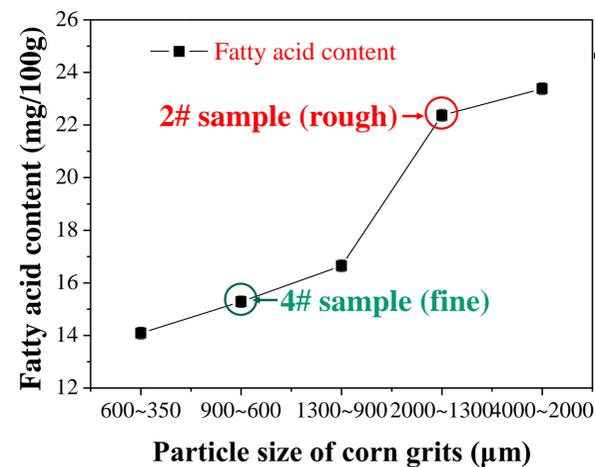


Fig 2 The relationship between fatty acid content and particle size

Table 1 The component of brewing material/adjunct

Index, %	Malt	Rice	Corn grits	
			2#	4#
Moisture	6.24	14.66	13.53	12.66
Ash	1.87	0.38	0.39	0.32
Protein	8.93	7.68	7.32	7.43
Fatty	1.66	0.48	0.85	0.50
Extract	74.57	95.83	87.99	90.70
Fatty acid (mg/100 g)	8.37	7.74	22.37	15.28

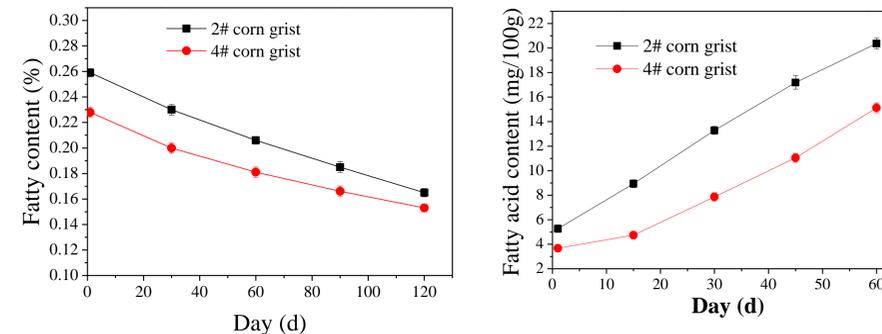


Fig 3 The change in fatty content and fatty acid content in DCG (2# and 4#) during storage period

Table 2 Fermentation parameters and flavor compounds of four type beer

Index	100%-malt beer	30%-rice beer	30%-2#-corn-grits beer	30%-4#-corn-grits beer
Extract of original wort (°P)	12.09	11.61	12.05	11.78
Real degree of attenuation (%)	61.67	59.53	59.75	62.08
Alcohol concentration (% vol)	4.84	4.48	4.68	4.74
Chroma (EBC)	9.81	6.89	6.36	6.01
pH	4.65	4.40	4.28	4.33
Total nitrogen (mg N·L ⁻¹)	879.50	592.50	523.30	484.50
Viscosity (mP·S)	1.51	1.46	1.51	1.43
VDK (mg·L ⁻¹)	0.085	0.076	0.089	0.064
TBA value	0.53	0.46	0.50	0.45
Total acid (g/L)	1.71	1.30	1.40	1.29
Ethyl acetate	19.94	17.03	26.71	17.67
n-propanol	11.00	11.01	17.77	11.11
Isobutanol	15.50	14.80	29.80	15.91
Iso-amyl acetate	2.99	3.41	4.54	3.42
Isoamyl alcohol	92.36	84.26	145.85	84.66
Total higher alcohol	118.87	110.08	193.41	111.68
Total ester	22.93	20.43	31.25	21.09
Alcohol : Ester	5.18	5.39	6.19	5.30

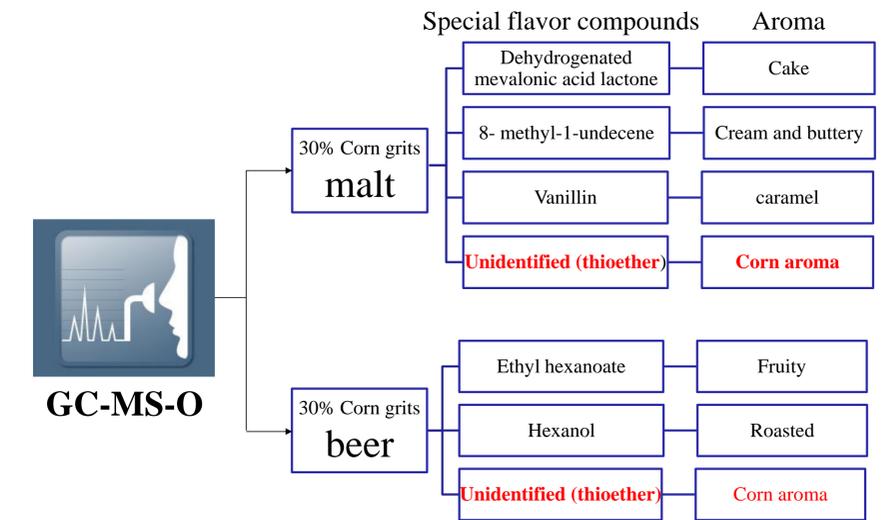


Fig 4 The identification of special-flavor compounds in malt and beer product using DCG as adjunct

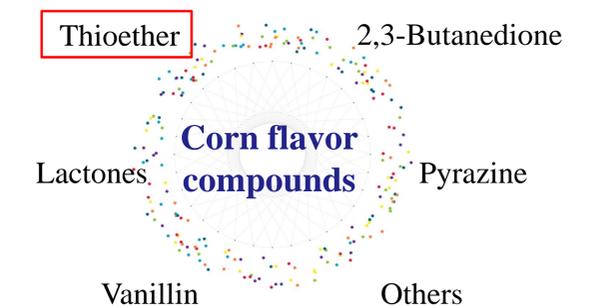


Fig 6 The composition in corn flavor compounds and thioether might be residual in beer product

Reference

- [1] Bamforth. CW Brewing and brewing research: past, present and future. Journal of the Science of Food & Agriculture, 2000, 80(9): 1371-1378.
 [2] Li HM, Li HJ, Liu XH, et al. Analysis of volatile flavor compounds in top fermented wheat beer by headspace sampling-gas chromatography. International Journal of Agricultural & Biological Engineering, 2012