Odorant phenolic markers in chocolate malts.

Fate of them through beer aging

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INTRODUCTION

Issued from enzymatic or thermic decarboxylation of phenolic acids, volatile phenols are responsible of typical spicy notes in a large range of beverages. Among these, brown special beers exhalng strong coffee aromas generally contain dark specialty malts, produced at higher kilning temperatures than typical pilsen malts and through specific equipment like roasting drum or torrefactor. A panel of malts (4.3 to 1500 EBC) were analysed and the resulting phenol-specific extracts investigated by gas chromatography - olfactometry (GC-O), aroma extract dilution analyses (AEDA) and by gas chromatography-mass spectrometry (GC-MS). The aim of the present work was first to identify specific phenolic markers of the use of torrefied malts in special beers. These compounds have been further quantified in a large series of specialty malts as well as through beer aging.

METHODS

Five fresh belgian special beers - one blond (BL1), one amber (AM1) and three brown (BR 1 to 3) - have been analyzed. A phenol-specific extraction was applied, as described by Callenmien et al., (2006). The extracts were investigated by gas chromatography-olfactometry (GC-O), aroma extract dilution analyses (AEDA) and by gas chromatography-mass spectrometry (GC-MS). Five malts were also investigated, after EBC congress mash.

RESULTS

The investigation of a panel of belgian special beers revealed interesting aromatic particularities in term of phenolic content. The use of dark torrefied malts in BR1, BR2 and BR3, exhibiting a nice coffee aroma, lead to higher concentrations of guaiacol and 4-methylphenol compared to BL1 and AM1 only brewed with pilse and cara malts (Figure 1).

As shown in Figure 2, thermic decarboxylation of p-coumaric acid and ferulic acid during malting, roasting, wort boiling, rest in the whirlpool and pasteurization can contribute to the phenolic flavor of special beers. Furthermore, phenylactic decarboxylase activity of top fermented yeasts (Pad1 phenotype) and contaminating microorganisms like Enterobacteriaceae, lactic and acetic bacteria and Brettanomyces/Dekkera spp. can be responsible of an additional enzymatic decarboxylation during fermentation.

Understanding of these pathways and quantification of guaiacol and 4-methylphenol in dark brown beers (see figure 1) allowed us to investigate other possible phenolic markers of dark malts. Three profiles emerged from this work. The first one (figure 3a) shows the evolution of syringaldehyde, 4-methylphenol and acetovanillone which are characterized by an increase of concentration when roasting treatment is stronger and longer. Temperature becomes really a a limiting parameter for the generation of 4-guaiacil. For vanillin, saicycldaldehyde, 4-ethylguaiacol, 4-ethylphenol, apocynol and phenol, the concentrations increase with temperature of roasting but the compounds appeared degraded after a too long treatment ( 900 and 1500 EBC malts ) ( figure 2b).

CONCLUSIONS

Use of dark specialty malts brings specific phenolic compounds exhalng nice roasted flavors in beer. 4-Methylguaiacol, 4-methylphenol and guaiacol revealed to be good markers of strong heating treatment through torrefaction. Aging of brown special beers could amplify the nice coffee aroma perception through acid hydrolysis of guaiacol glycosides.

As shown in Figure 4, an unexpected hidden potential of guaiacol was here evidenced in fresh beer. It revealed to be progressively acid hydrolysed through beer ageing.