An Updated Review of Various Current Australian Malt Varieties and their Impact on Linoleic Acid Levels in Worts Produced Under Various Brewing Conditions

Aldo Lentini, Mark Goldsmith & Chris Jay
Carlton and United Breweries,
4-6 Southampton Crescent, Abbotsford, Victoria, Australia 3067

INTRODUCTION:

- The quality of wort produced within a brewery can be influenced by a variety of mashing conditions, in terms of both processes and raw materials.
- Previous studies within CUB have shown that certain Brewhouse mashing process conditions used to control the level of fermentable extract indirectly affected the level of fatty acids extracted from the malt (in particular Linoleic Acid -C18:2). The level of Linoleic Acid in wort was shown to be influenced by mash temperature and appeared to be influenced by malt variety. The presence of Linoleic Acid has also been shown to have an negative impact on the formation of Volatile esters during fermentation.
- This current study investigates the impact of new Malt varieties, Region of their growth and various mashing conditions (PG, mash temperature and time, Malt to Adjunct ratios) on Linoleic Acid release in the wort prior to fermentation.

METHOD:

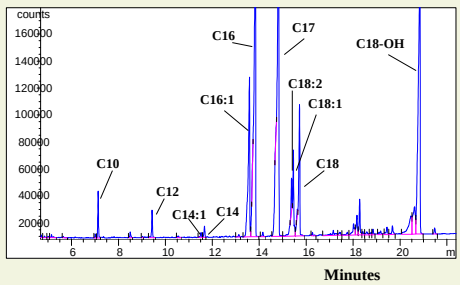
BREWING

- Malts from different regions from Australia (Old and New Varieties)
- Mini Mashes: 1L Scale (consistent Malt to Liquor ratio – 3.2:1)
- Wort Original Gravity, Mash Temperatures and Time, Different Malt to Adjunct ratios, as stated (using Gardiner malt).
- Lautering and Sparging at 76°C
- Wort boiled for 60 min.

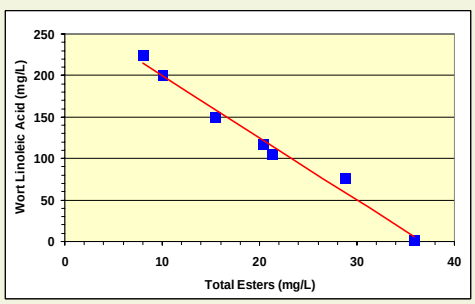
LIPID ANALYSIS

- Digest wort with KOH (25% w/w), 80°C for 3 hours
- Extraction with Hexane:Chloroform (3:1)
- Derivatised with BSTFA
- GC Analysis: BP1 column, 120°C to 300°C (5°C/min)
- FID detection (quantification based on predetermined standards)

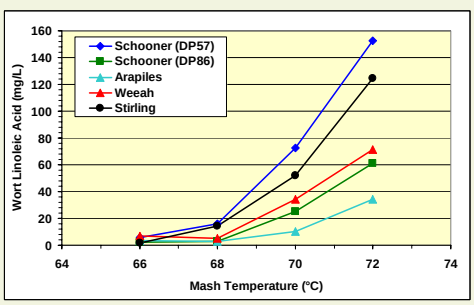
GC Chromatography of Wort



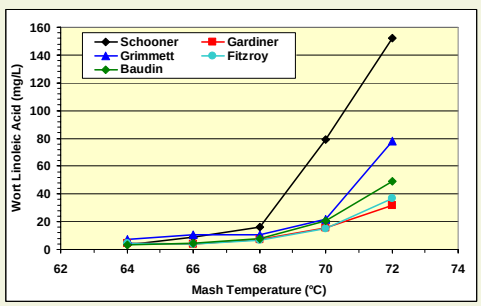
Impact of C18:2 on Total Esters



Old Malt Varieties



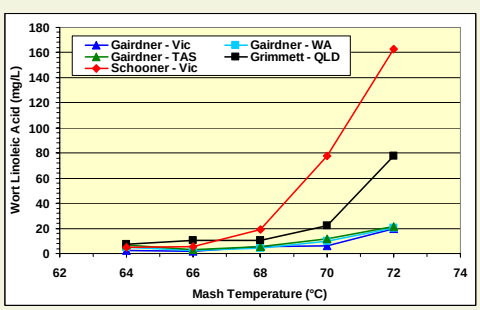
Current Malt Varieties



Impact of Linoleic Acid (C18:2) on Beer Volatile Total Esters

- There is an Inverse Relationship between Wort Linoleic Acid levels in the wort and the amount of Total Esters produced during Fermentation
- Linoleic Acid is absorbed from the wort into the yeast cell during fermentation
- Linoleic Acid is know to repress the yeast's biochemical pathway in the production of Volatile esters during fermentation
- Linoleic Acid is also known as a precursor for the formation of Beer Staling compounds.

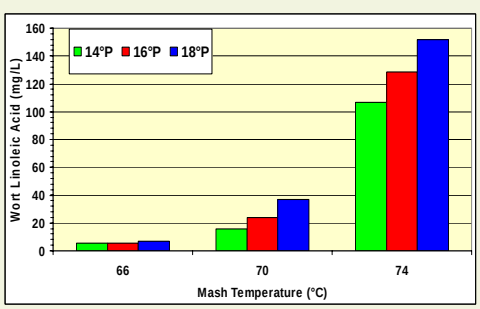
Malts From Different Regions



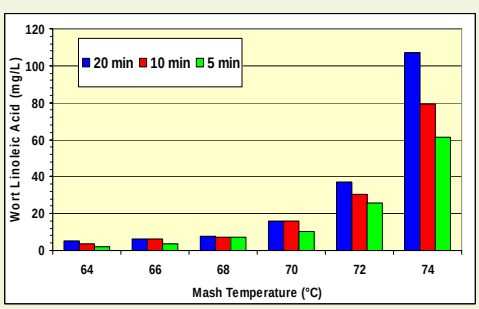
Malt Varieties and Linoleic Acid

- Older malt varieties gave higher amounts of Linoleic Acid (C18:2) as mash temperature increased (especially after 68°C stand time). The level of C18:2 produced in Schooner does appear to be DP dependent.
- New malt varieties (Gardiner, Baudin, Fitzroy) appear to produce less Linoleic Acid at higher mash temperatures (Increases occur after 70°C, but still significantly lower C18:2 Levels at 72°C when compared to older malt varieties – e.g. Schooner)
- The Region where the malt is grown does not appear to significantly influence C18:2 levels in the wort. The C18:2 profiles for Gardiner malt from Victoria, WA and Tasmania appear to be very similar over a wide range of mash temperatures.

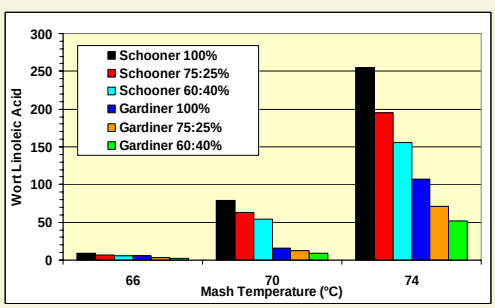
Effect of Wort PG on C18:2



Impact of Mash Time on C18:2



Influence of Adjuncts on C18:2



SUMMARY:

- There appears to be a malt varietal dependency in relation to the amount of Linoleic Acid (C18:2) present in the wort.
- The newer Malt Varieties appear to contribute a lower level of Linoleic Acid in the wort even at higher mash temperatures.
- The level of Linoleic Acid extracted into the wort with the newer malt varieties start to accumulate at higher mash temperatures (>70-72°C) compared to older malt varieties (e.g. Schooner) where the level of Linoleic Acid significantly increases when lower mash temperatures (68°C) are used.
- Brewing process conditions (eg. Mash time, wort Present Gravity and the percentage of malt to adjunct present in the wort) all influence the amount of Linoleic Acid present in the wort.
- Achieving the desired Fermentable extract component of a wort, whist ensuring a low level of Linoleic Acid, will be influenced by many factors: there include - malt variety, the mash temperature and time, the worts present gravity and the ratio of malt to adjunct used in brewing.
- Achieving this balance will ensure a wort will have the desired level of fermentables and non-fermentables, as well as ensuring that the amount of volatile esters produced during fermentation will be at an optimal level.

Brewing Process Influences on C18:2

- Increases to wort PG resulted in proportional increases to C18:2 with higher mash temperatures.
- Increasing the mash time results in a greater amount of C18:2 present in the wort. This is more evident as the temperature rises above 70°C. There is a both a time and temperature dependency in the level of C18:2 extracted.
- As the malt to Adjunct ratio changes to a greater dependency on Adjunct material (100% malt to 60:40% Malt:Adjunct) the amount of C18:2 decreases proportionally across a range of mash temperatures (64°C to 74°C). This is as expected for as the level of malt present in the wort decreases, the level of C18:2 extracted should also decrease.

Acknowledgements

The authors like to thank;

- The staff of CUB's National Laboratory for their assistance in the preparation of the Gas Chromatograph instrument.
- Barrett Burston Maltings for the supply of some of the newer malt varieties.
- The Management of Carlton and United Breweries for permission to be allowed to present the results from this study to the 31st IBD (Asia Pacific Section) Convention.