



CLARITY

PROANTHOCYANIDIN FREE MALT

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Introduction

Non biological haze in beer is composed largely of complexes of proteins and polyphenols. The most reactive polyphenols are the proanthocyanidins and, in beer, 70-80% are derived from the barley, the rest from hops.

In 1972 Carlsberg Research in Copenhagen initiated a plant breeding programme to modify barleys so that proanthocyanidin producing genes were eliminated. In 1983 Crisp Malting established a licensing agreement with Carlsberg to promote the proanthocyanidin free barley project in the UK. Patent protection is in force for the brewing of beers from proanthocyanidin free barley varieties.

CLARITY is the current proanthocyanidin free variety from Crisp Malting Group. The barley has been proved to be agronomically sound and in brewing trials at Brewing Research International (BRi) CLARITY malt has lived up to expectations. Extensive trials in a wide range of breweries - small, regional and national - have been successfully completed and commercial use of CLARITY is now an accepted part of brewing practice. Beers made with 100% CLARITY malt have taken prizes in UK national beer competitions.

Breeding

Proanthocyanidin free barleys are the product of breeding programmes which induce mutations specifically to eliminate the proanthocyanidin gene from barley chromosomes. Some concern has been expressed about the nature of such mutations but sixty years of investigations into the subject of cereal genetics support the conclusion that induced mutations are of the same nature as spontaneous mutations.

Proanthocyanidin free barley varieties are bred in the same classical manner as all other malting barley varieties, employing the routine selection, crossing, re-selection and multiplication techniques used to bring any new variety from pollination to the market place.

Genetic transformation, the "transplanting" of specific genes from one plant species into another, has **NOT** been used in the development of proanthocyanidin free barleys.

Farming

For several years now Crisp Malting Group has contract grown CLARITY in Norfolk so that stocks of seed and barley for malting can be built up. The farmers who have been growing this proanthocyanidin free barley for Crisp Malting Group are happy to continue as, on more than one occasion, CLARITY has been the pick of the spring barley crop.

Brewing Trials at Brewing Research International (BRi)

In 1994 Crisp Malting Group commissioned a BRi Confidential Member Project in the form of a lager brewing trial on 1993 crop CLARITY. The objective was to seek out any hitherto undiscovered features which might detract from the brewing quality of the variety or the storage capabilities of the beers. No adverse characteristics were found, with results confirming the findings of earlier work that CLARITY malt is sound brewing material, processing without difficulty in the brewhouse to produce haze free beer with inherently long shelf life.

Beer Analysis

This table of typical results from the trial brews shows how polyphenol levels can be reduced.

| | Yeast crop | Colour °EBC | Bitterness BU | Polyphenols mg/l |
|---------|------------|-------------|---------------|------------------|
| Control | normal | 12 | 19 | 190 |
| CLARITY | normal | 12 | 18 | 78 * |

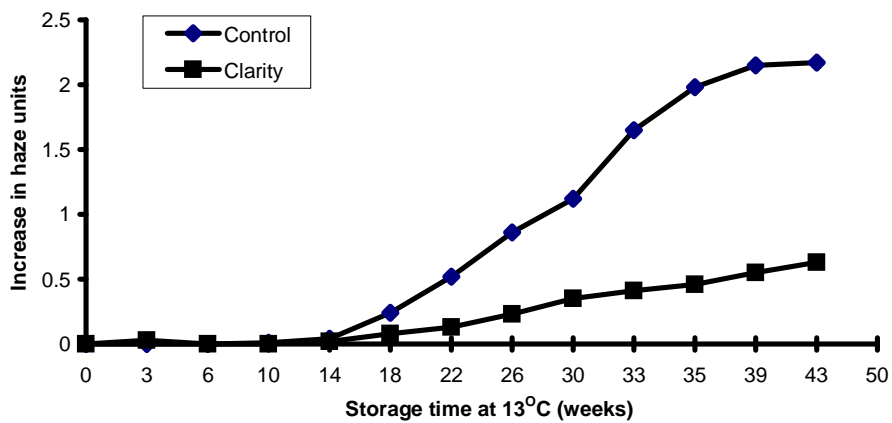
* contribution from Saaz hop pellets used for late hop aroma, not from CLARITY malt.

Cautionary note: if hops are used which have a proanthocyanidin to alpha acid ratio of >0.4 some of the gains from using proanthocyanidin free malt are eliminated.

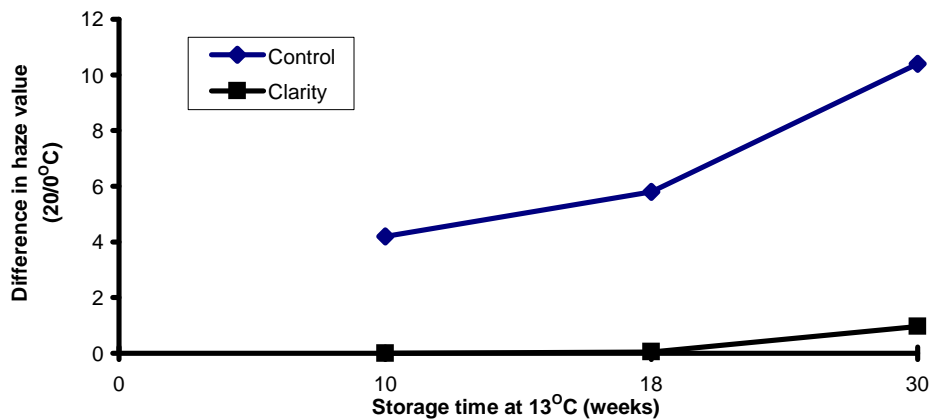
Shelf Life

Storage trials at BRi examined both haze development and chill haze potential during long term storage at normal cellar temperature. The superiority of CLARITY's natural haze stability and very low chill haze potential was soon in evidence, as can be seen from the graphs, and the experience has since been repeated many times over on the commercial scale.

Change in haze with storage time at 13°C



Change in chill haze with storage time at 13°C

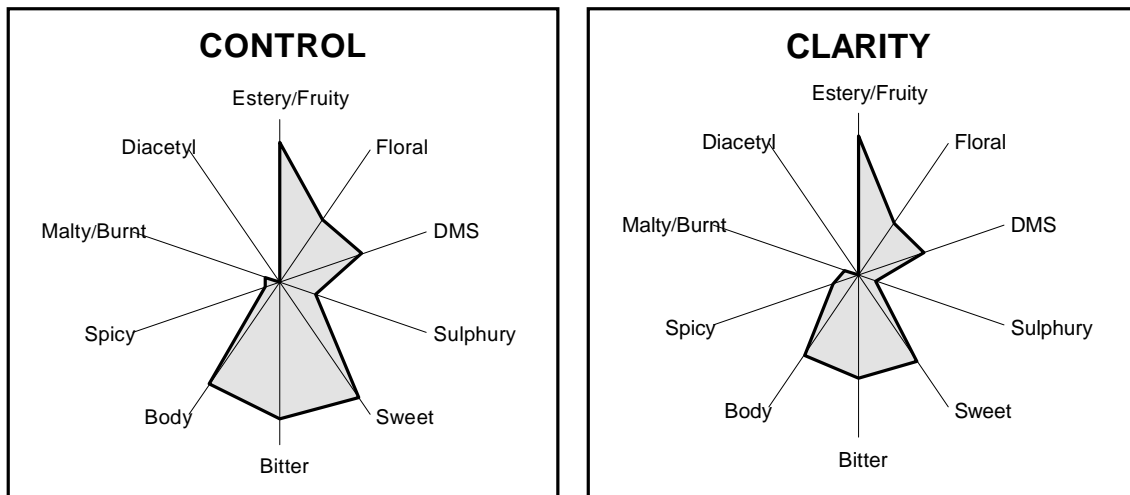


Flavour Stability

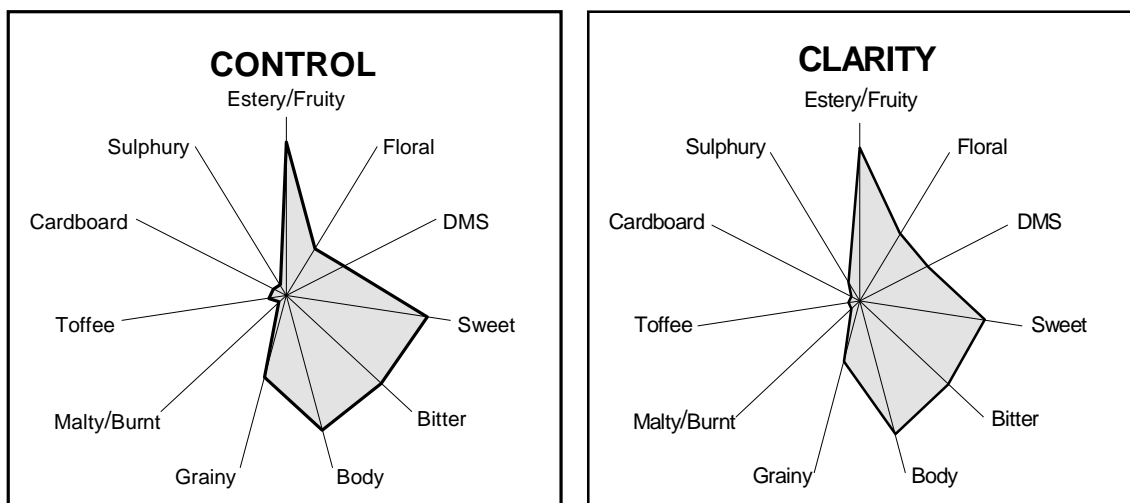
Flavour stability is often a cause for concern with a new variety. Flavour assessments on beers from the BRi storage trials indicated excellent comparability between control and CLARITY beer both initially and after 6 months storage.

FLAVOUR PROFILES

FRESH BEER



AFTER 6 MONTHS STORAGE



Grist Replacement

To take full advantage of the stability characteristics of proanthocyanidin free malt its use as a total grist replacement is recommended. However, use as a partial grist replacement also brings benefits which are in direct proportion to the amount of proanthocyanidin free malt incorporated.

The data below typify the reductions in bright beer polyphenol levels which have been consistently achieved in one brewery's lager.

| | 100% Standard Malt | 50% Standard Malt 50% CLARITY |
|-------------------|--------------------|----------------------------------|
| Total Polyphenols | 200 – 250 ppm | 120 - 140 ppm |

Cold Conditioning

Work in Carlsberg's pilot brewery at Copenhagen has shown that conditioning at temperatures below 0°C is not essential with proanthocyanidin free malt. Conditioning trials at +4°C and -1°C produced equally good haze stability results with proanthocyanidin free malt whereas, with an Alexis control, substantially poorer results were obtained under both conditioning regimes. Comparative forcing test total haze figures, read after cooling to 0°C, were as shown in the table:

| | ALEXIS | | PROANT-FREE | |
|----------------------------|--------|------|-------------|------|
| | +4°C | -1°C | +4°C | -1°C |
| Conditioning temperature | +4°C | -1°C | +4°C | -1°C |
| Initial Haze | 0.4 | 0.4 | 0.7 | 0.7 |
| Total Haze 5 days at 60°C | >12 | 7.9 | 1.2 | 1.2 |
| Total Haze 60 days at 20°C | 3.5 | 1.6 | 0.8 | 0.9 |

Further Development

Continuing the Crisp Malting Group development programme, a new line of proanthocyanidin free barley with better agronomic properties than Clarity was subjected to brewing trials at BRi during 1996/1997. Malt from the new line was compared in trials with proanthocyanidin free Clarity and Chariot as controls.

The haze free shelf life of the new variety was excellent, as expected from the experience of Clarity and, just as importantly, so was the flavour stability, which was better than that of the Chariot control. The new variety is ready to take over from Clarity when the time is right, but is likely to be overtaken by even better varieties currently in the pipeline.

This statement formed part of the BRi report:

PILOT MALTING AND BREWING TRIALS ON A NEW LOW ANTHOCYANOGEN BARLEY

Pilot malting and brewing trials were recently carried out at BRF International on behalf of Crisp Maltings to compare the flavour and haze stability of beers produced from a new low anthocyanogen barley. Comparison was made to beers brewed from the variety Chariot.*

The usual touchstone for judging a new low anthocyanogen barley's success is improved haze stability with no negative effect on key flavour attributes. The data generated in trials using the ISO9002 accredited BRFI pilot malting and brewing plant clearly show substantial improvement in the new low anthocyanogen barley compared to Chariot.

The brewing protocol was specially designed to highlight differences in flavour balance due to the malt by using a 100% malt grist. The malt analysis for Chariot and the new low anthocyanogen variety was similar. This was also true for wort analysis, fermentation profile and final beer analysis.

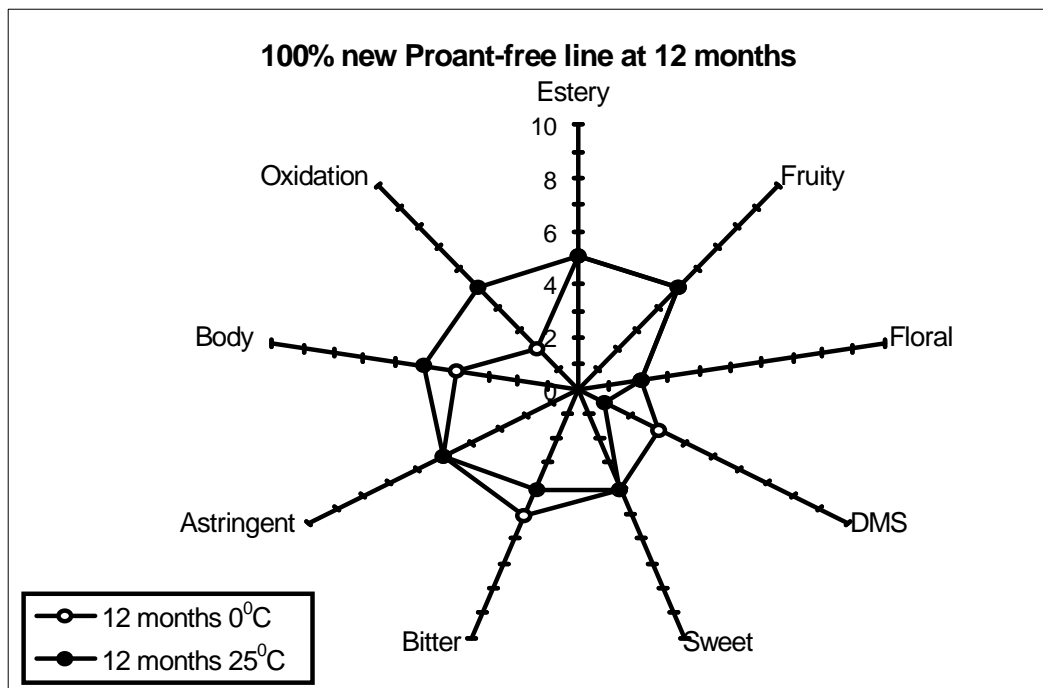
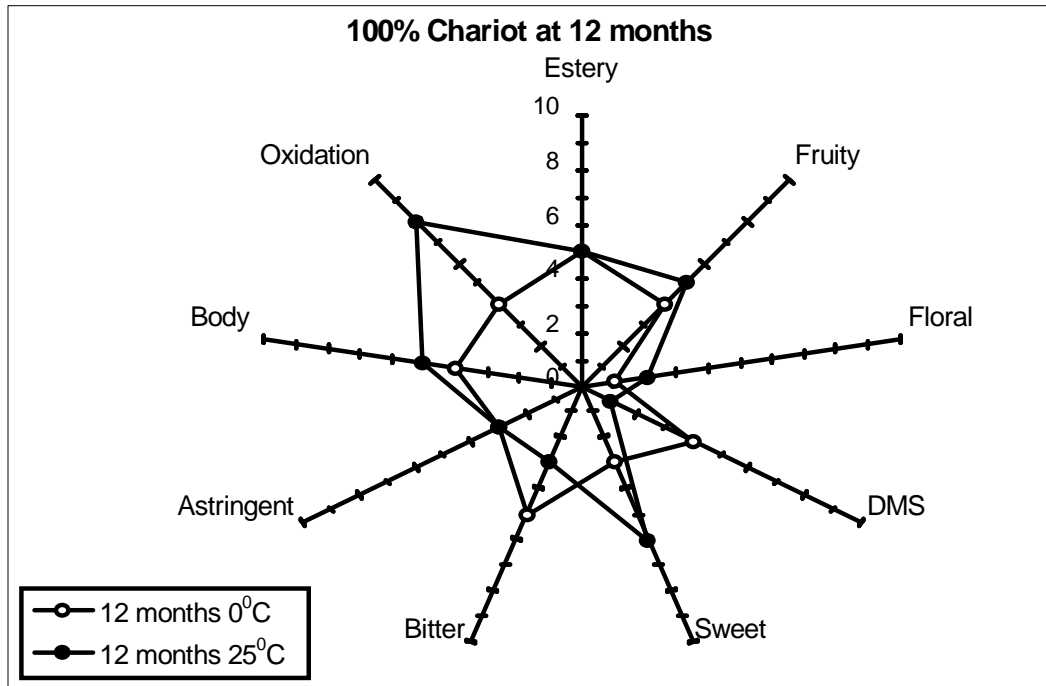
The development of haze over the 12 month period was dramatically reduced in the new variety: *the 100% Chariot brew had a haze value of 9.0, the new low anthocyanogen brew a value of 0.98.*

*Initial tasting of the beers confirmed that there was no difference in the flavour profile. Differences only became apparent as the beers were stored at 0°C and 25°C for up to 12 months. The higher temperature was designed to accelerate the development of oxidised flavours. **Oxidised flavours developed in both***

beers as normal, but to a substantially lower level in the new low anthocyanogen variety. There were no negative flavour attributes in the beer brewed from the new variety.

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Flavour profiles using nine key flavour indicators are shown below as radar (spider) diagrams.



*BRF International has since been renamed Brewing Research International (BRi)

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Benefits of Proanthocyanidin Free Malt

Benefits which have been recognised by brewers using proanthocyanidin free malt include:

- Normal processing through the brewhouse. In some breweries, cleaner throughput and reduced trub volumes have allowed reductions in the use of copper (kettle) finings.
- Improved efficiency of filtration.
- Reduction in potential beer losses.
- Removal of the need for processing aids to improve beer stability, saving on stabilisation costs.
- Cold conditioning at +3 or +4°C instead of -1°C. Savings can be made by reducing refrigeration costs or, alternatively, by reducing the time taken for intense cold conditioning, allowing increased throughput at times of high demand.
- The advantage of being able to state on labels that stabilisers have not been used for chill proofing.
- For packaged beer, the imparting of haze free long term shelf life, for periods in excess of 1 year, without the use of specialised processing aids.
- For cask beer, the virtual elimination of fluffy bottoms as the yeast/trub sediment settles into a very firm cake, giving more beer per barrel. A similar effect is seen in bottle conditioned beers.
- Proportional improvements when proanthocyanidin free malt is used as a partial grist replacement.

The Future

As with conventional winter and spring varieties, breeding work is continuing to produce better yielding lines with enhanced brewing performance. As processing aids begin to fall out of favour and brewers start to turn towards more wholesome solutions to some of their problems, the natural alternative of a

proanthocyanidin free barley with the potential for built in beer stability is now available to all brewers.

SMS/5.8.99