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Improved utilization of alpha acids and varied aroma characters by pre-incubation of hops

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ABSTRACT

Pre-incubation of aroma hops dosed at the end of wort boiling improves the utilization of alpha acids. Therefore, the usage of hops is reduced in 12% to 36%. The character of hop aroma can be varied by the incubation.

INTRODUCTION

TRADEOFF AROMA AND BITTERNESS :
The more the aroma hops are dosed at the end of wort boiling, the less alpha acid is utilized (Fig. 1). It is because of insufficient isomerization.
We can utilize either aroma or bitterness of hops sufficiently at the same time. This is an typical case of tradeoff in conventional brewing.

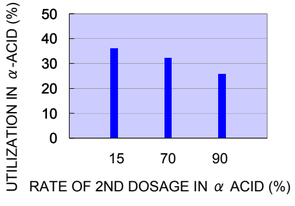

Fig.1 UTILIZATION OF ALPHA ACID

PIE® :
In WBC 2008 and ASBC 2011, I have reported our original equipment named Pre-Isomeriser & Evaporator (PIE®). It is a small kettle for boiling hops with hot water, separately from wort (Fig. 2). It was used for removing undesirable flavor in bitter hops dosing at the start of wort boiling, when we reduced the total evaporation ratio of wort boiling for energy saving (EP 2 189 518).

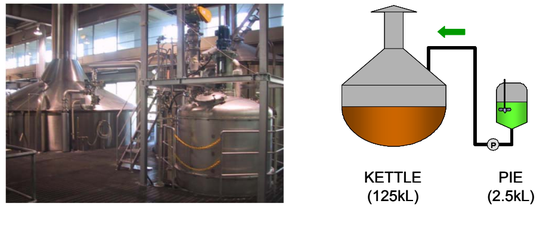

Fig. 2 OUTLOOK AND FLOW OF PIE®

In this study, I report another application of PIE® to aroma hops dosed at the end of wort boiling. It can improve utilization of alpha acids and vary the character of the hop aroma.

MATERIAL AND METHOD

BREWING :
- 5kL/Brew
- Malt, Starch, Adjuncts
- Hops : Saaz, Perle, Saphir, Hallertauer Tradition, Summit, Nugget, Nugget-ex
  - 1st dosage at start of wort boiling
  - 2nd dosage at end of wort boiling
    - Before 2nd dosage, aroma hops were incubated in PIE, with 70 liters of hot water at 90℃ to 99℃ in the non-boiling state for 30 to 60 minutes (Fig. 3).
- Wort boiling : 60-70 min
- Whirlpool : 20-30 min

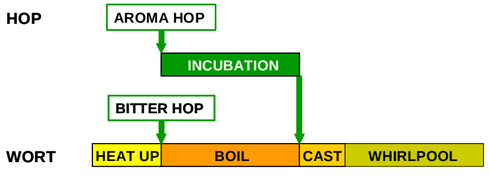

Fig. 3 TIME CHART OF WORT BOILING AND HOP INCUBATION

ANALYSIS OF HOP AROMA :
- SBSE (Twister desorption unit : Gerstel)
- GC-MS（GC:HP6890, MSD:HP5973）
- Column : DB-WAX (Agilent122-7062)

ANALYSIS OF ALPHA ACID :
- HPLC (Shimadzu)
- Column : (Shim-pack CLC-ODS/H)

RESULT AND DISCUSSION

UTILIZATION OF ALPHA ACID
Isomerization of alpha acids was improved by pre-incubation (Fig.4, 5).

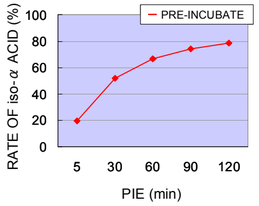

Fig.4 ISOMERIZATION OF ALPHA ACID IN PIE®

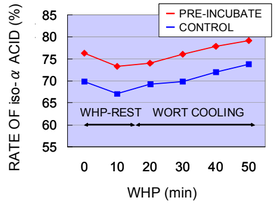

Fig.5 ISOMERIZATION OF ALPHA ACID IN WHP

When more rate of alpha acid was dosed in the 2nd dosage, the utilization of alpha acid improved more effectively in comparison with the controls (Fig.6). In these trials, hop usage was reduced in 12% to 36%.

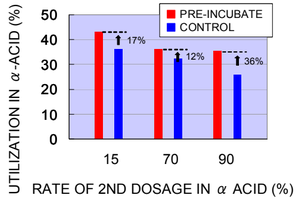

Fig.6 IMPROVED UTILIZATION OF ALPHA ACID

CHARACTERS OF HOP BITTERNESS
There was no influence from the pre-incubation, in the composition of alpha acid isomers, s-fraction, polyphenols and sensory evaluation of final products.

CHARACTER OF HOP AROMA
In the trial 1, the composition of hop terpene was not much affected by the incubation. And, in a sensory evaluation, the aroma character was similar (Fig. 7). In the trial 2, myrcene was reduced by the pre-incubation more than linalool, geranial and citronellal. It is supposed to be related with the difference in hydrophilicity between alcohols (e.g. linalool) and hydrocarbons (e.g. myrcene). And in a sensory evaluation, the aroma profile changed (Fig. 8). The aroma of final products with pre-incubated hops was preferred to the control with normal hops. The trial 2 is different from the trial 1 in the condition of the pre-incubation. The behavior of hop aroma substances is supposed to be influenced by incubation time, temperature, agitation, and concentration of hops in PIE®. The investigation is going on.

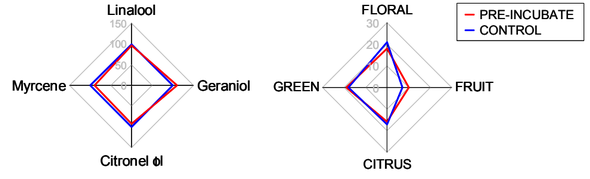

Fig.7 TRIAL 1 (Aroma character no-changed)

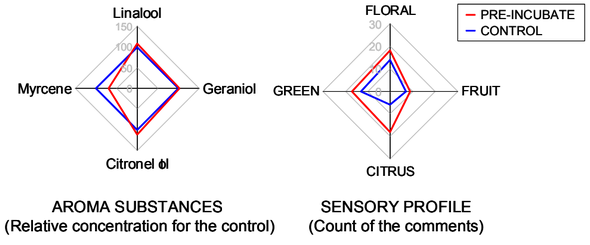

Fig.8 TRIAL 2 (Aroma character changed)

CONCLUSION

- Pre-incubation of hops with hot water in non-boiling state ;
  - Utilize both aroma and bitterness of hops at the same time
  - Reduced usage of hop in 12% to 36%
  - Useful to modify character of hop aroma

REFERENCE

1. Hisato Imashuku ; O-52, Annual Meeting 2011, American Society of Brewing Chemists
2. European patent No.2189 518