Master Brewers Association of the Americas
Dedicated to the technology of brewing.

A novel malting method for improvement in bitter quality of beer

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Outline

1. Background

2. Malting trial
2-1. Laboratory scale
- Effect of steeping condition
- Effect of germination condition
2-2. Commercial scale

3. Brewing trial on pilot scale

4. Conclusions

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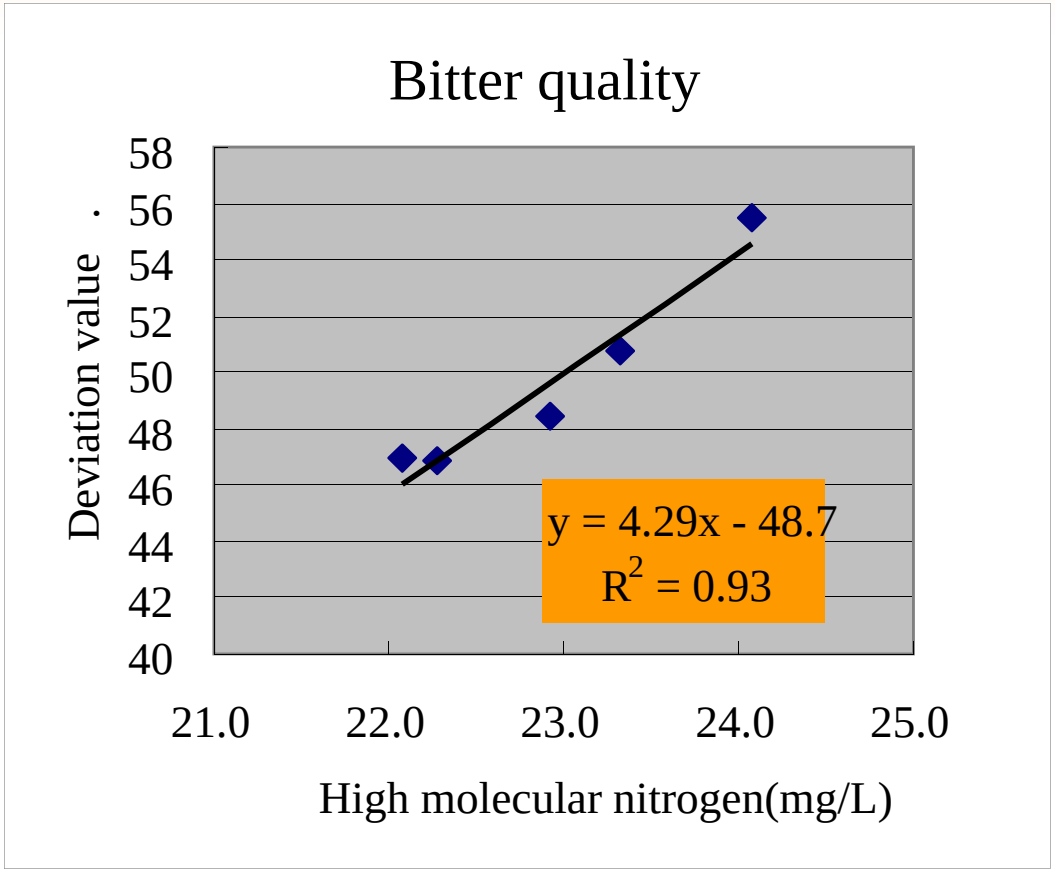
Relationship between bitter quality of beer and high molecular nitrogen

WBC in 2012

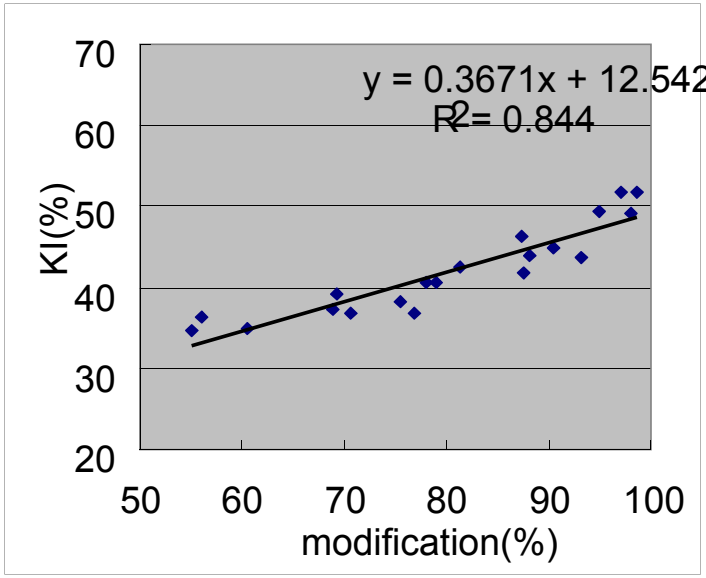


N=6 well trained panelists

Bitter quality of beer and high molecular nitrogen were positively correlated with each other.

Relationship between malt quality and brewing

Modification and Kolbach Index (KI) are positively correlated with each other.



※Result of lab scale
- using same barley

✓ Promote the degradation of cell wall
- Improve brewhouse yield
- Improve beer filterability

Trade-off

✓ Inhibit the degradation of protein
- Improve foam quality of beer
- May improve bitter quality of beer

Objective

- ✓ Investigation of malting conditions to change the relationship between Modification and KI
- ✓ Evaluation of the effect of the malt produced by this trial on beer quality

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Laboratory scale malting trial

Barley:
Spring two-row

Malting size:
1kg micromalting

Analysis:
Analytica-EBC and MEBAK

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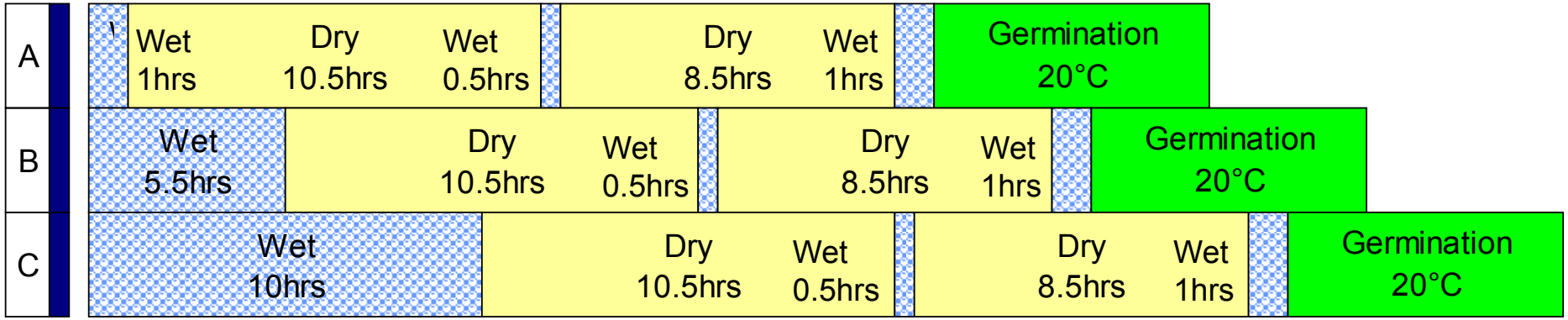
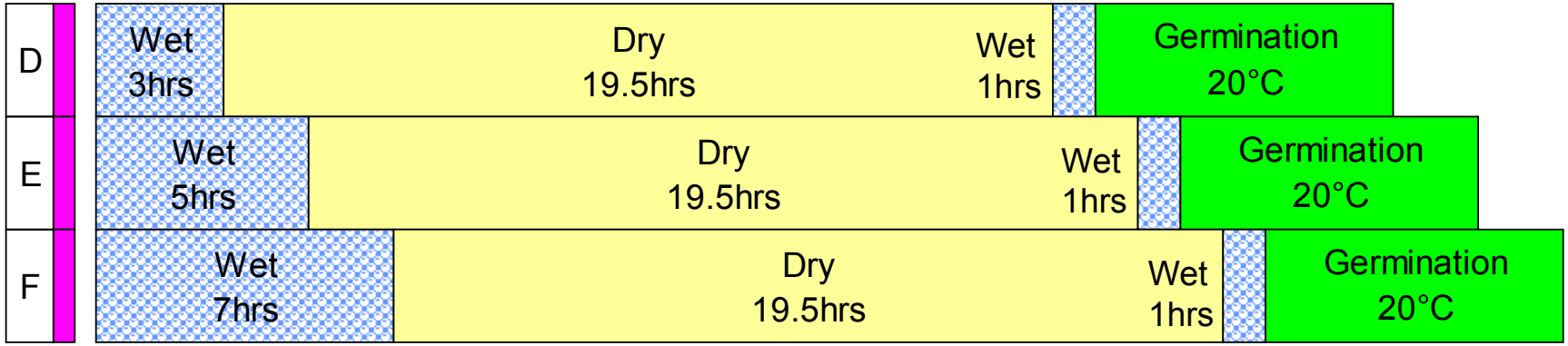
Steeping conditions

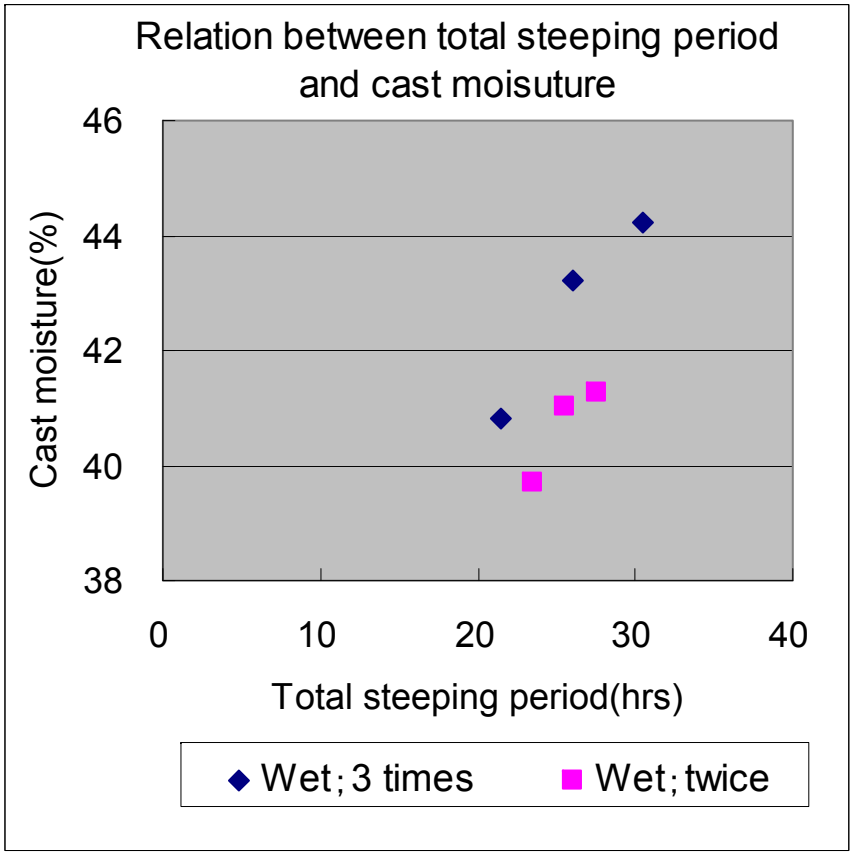
Wet ; 3 times

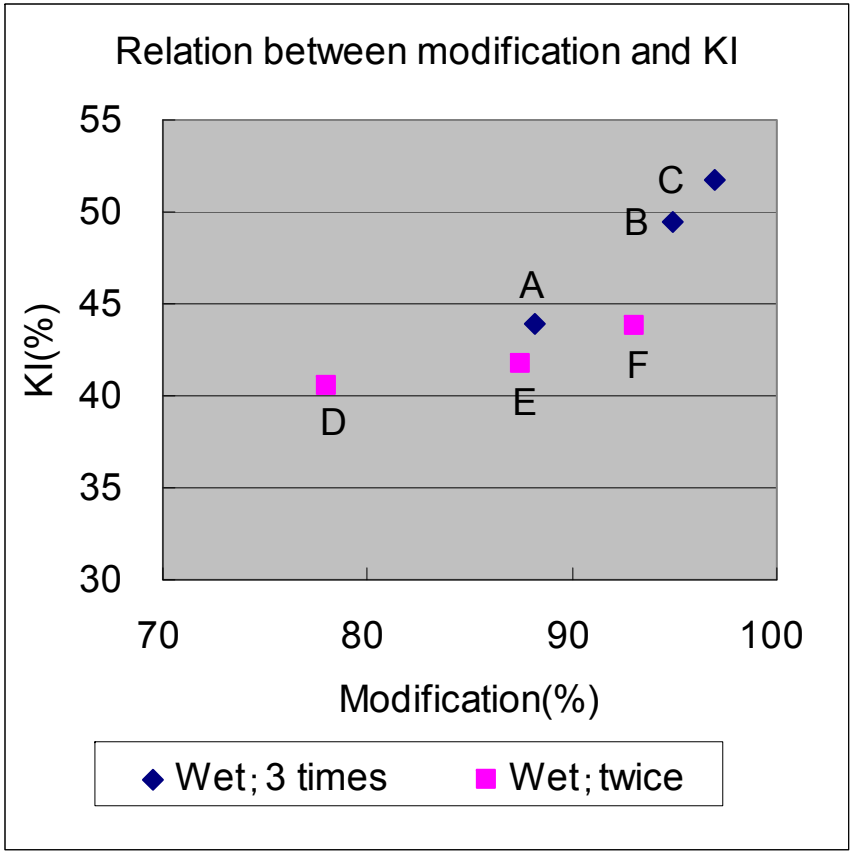


Wet ; twice



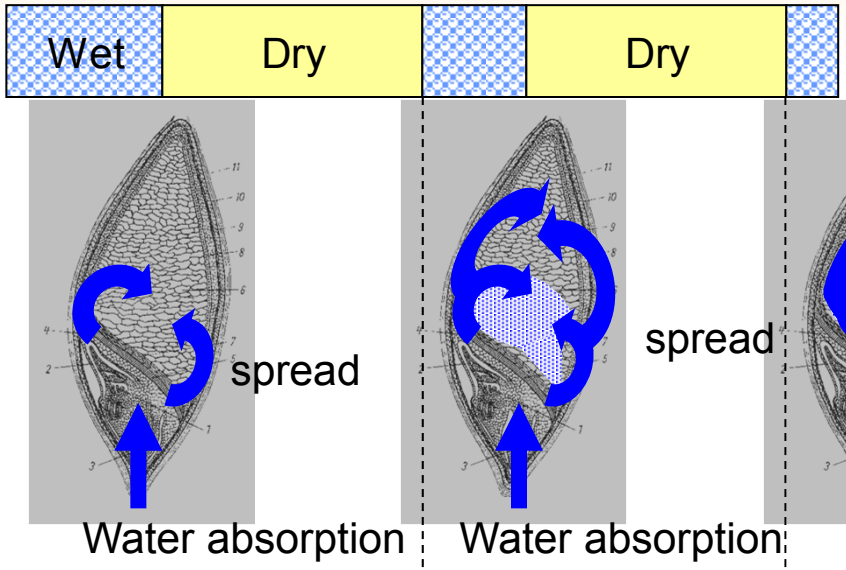
Result
Effect of steeping times on cast moisture and KI





More steeping times increase the water uptake into the kernel.
Steeping times affect the relationship between Modification and KI.

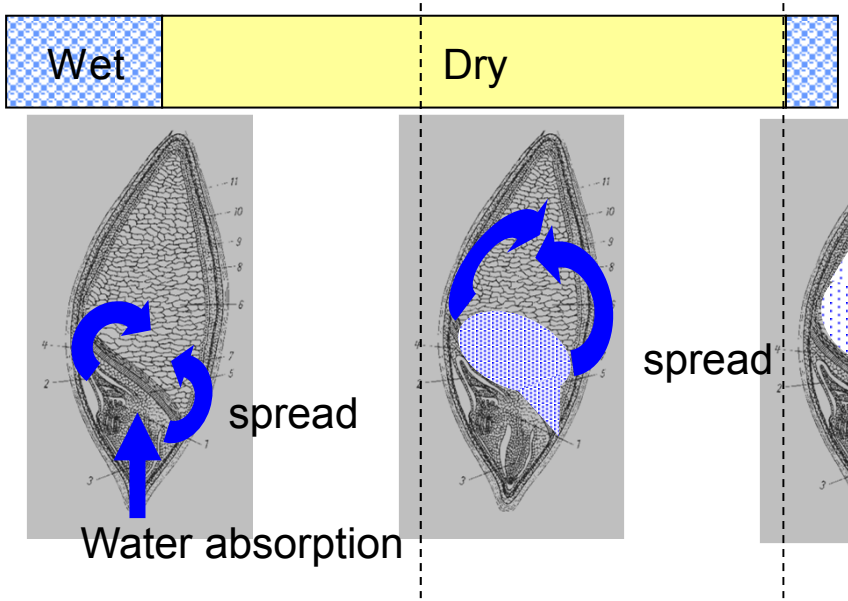
Estimation of mechanism
Water distribution in kernel and malt modification



High cast moisture

Uneven water distribution

Then, protein is rich in outer side



Low cast moisture

⇒Inhibit the degradation all over

Homogeneous water distribution

- ✓ Cell wall
  ⇒Promote the degradation
- ✓ Outer side protein
  ⇒Inhibit the degradation

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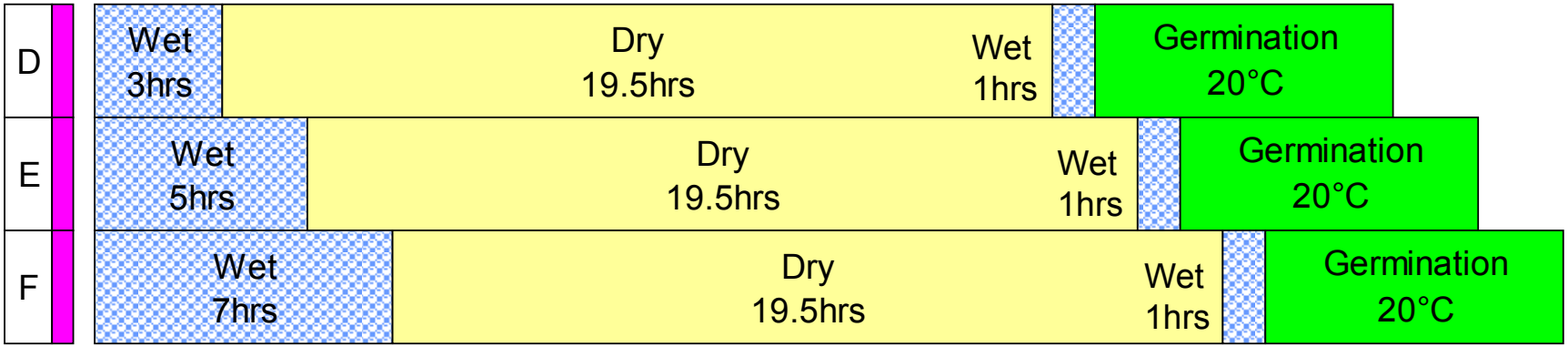
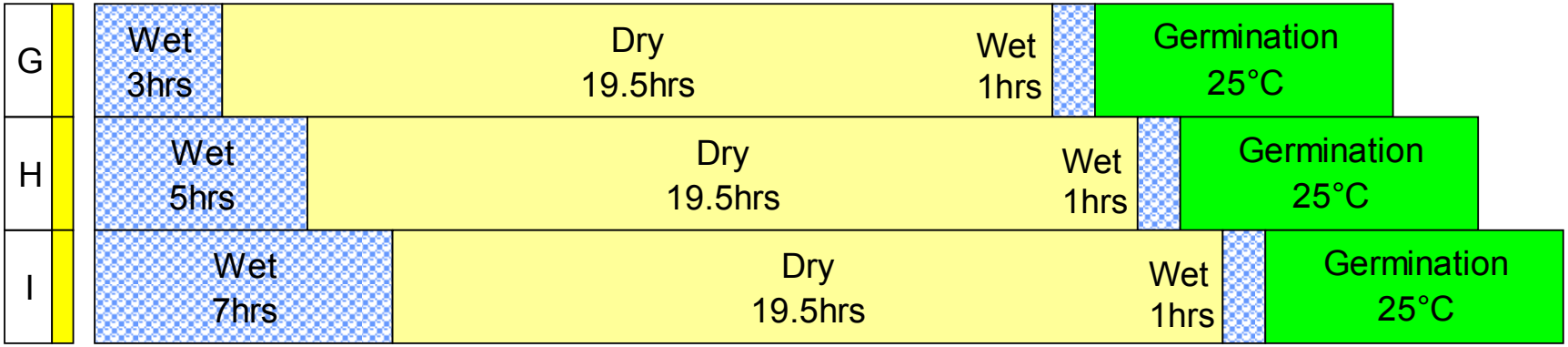
Germination conditions

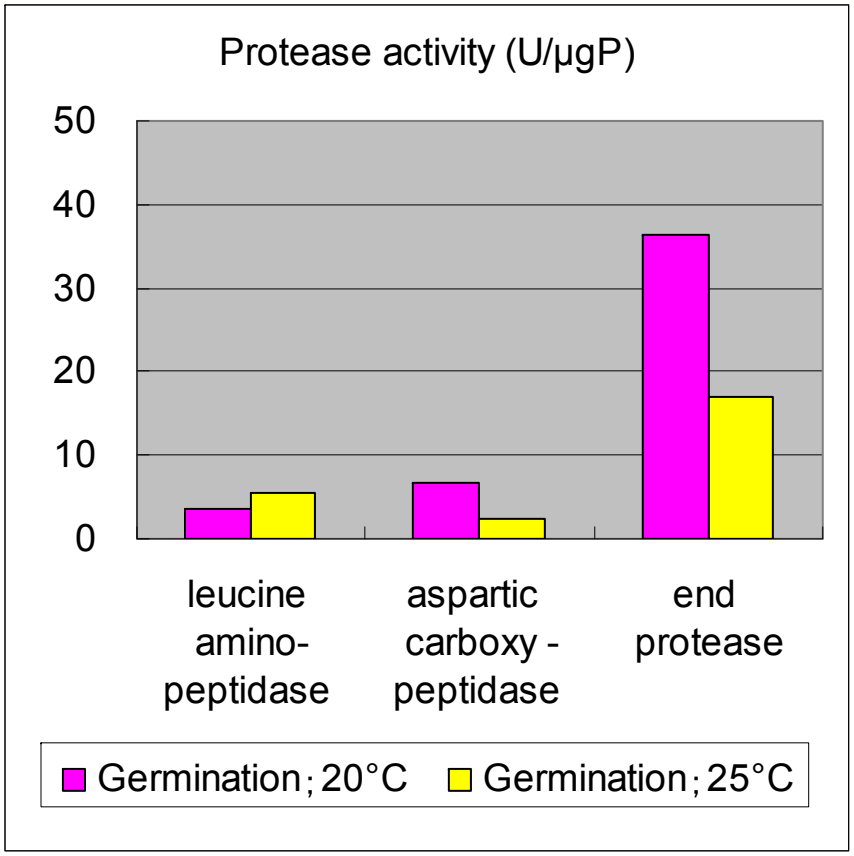
Germination；20° C

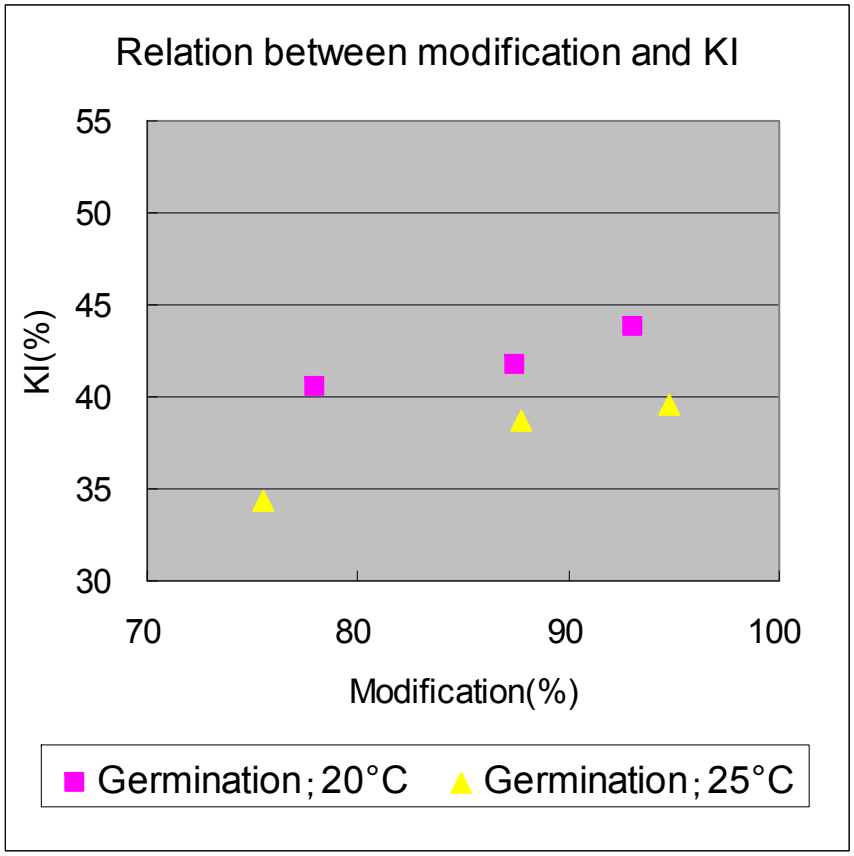


Germination；25° C



Result
Changing protease activity and KI by germination temp.





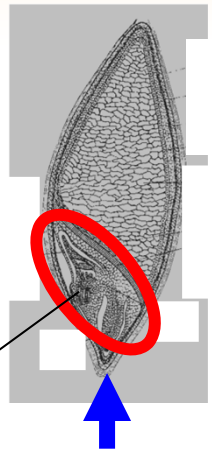
Germination temperature
- -especially affected end protease activity.
- -was the effect to suppress only protein degradation.

Estimation of mechanism
Suppression of enzymatic activity of GA by temperature

induction of various enzyme

inhibit

form gibberellin



water absorption

GA_{12}

GA_9

GA3ox

(active) GA_4

GA2ox

(inactive) GA_{34}

Gene guided GA

SPATULA
（bHLT transcription factor）

Gene guided GA（activated by raising temp.）

Formation path of gibberellin as for thale cress (from 'chemistry of seeds and biotechnology')

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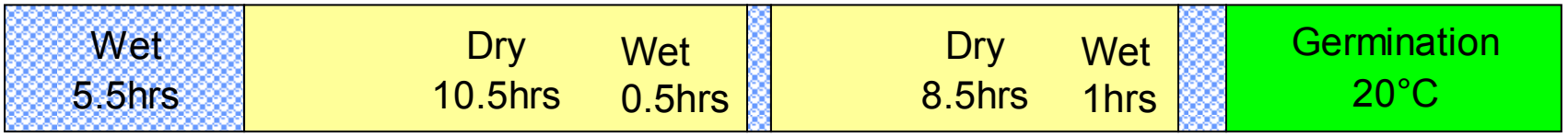
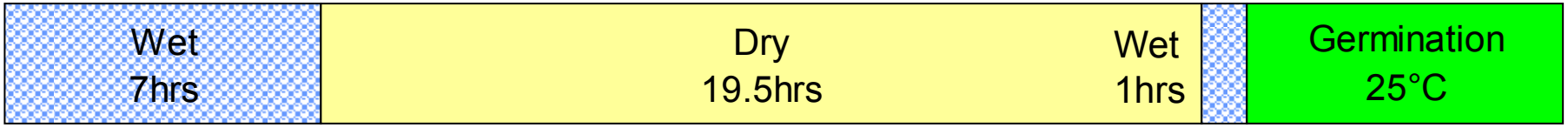
Trial in commercial malting

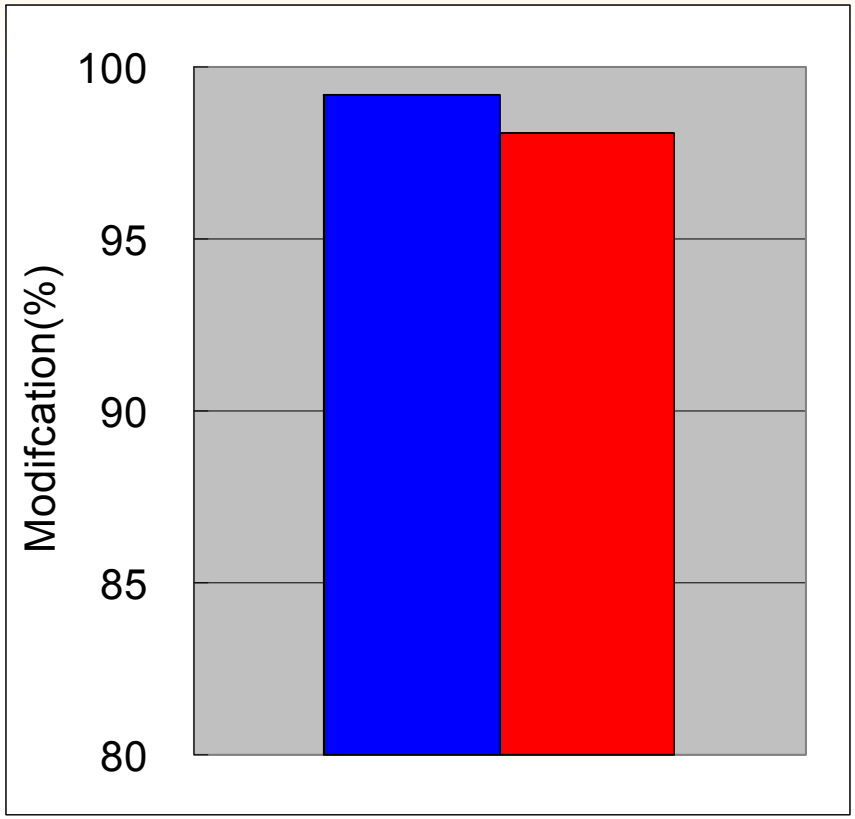
＜Trial1＞
Wet；3 times
Germination；20° C

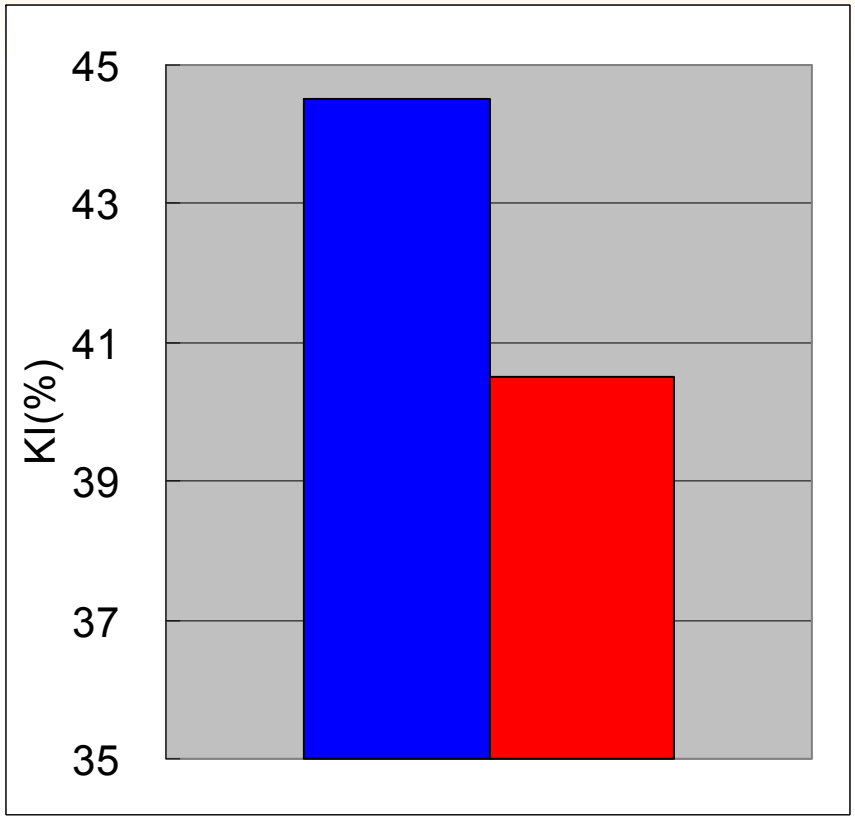


＜Trial2＞
Wet；twice
Germination；25° C



Malt quality





Wet；3 times、Germination；20° C
Wet；twice、Germination；25° C

Lower KI was achieved also in commercial plant.

Summary of malting trial

The flexibility of malt modification was enhanced by the novel malting method.

- Steeping times changed the relationship between Modification and KI.
- Germination temperature controlled KI selectively.

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Malting and brewing conditions

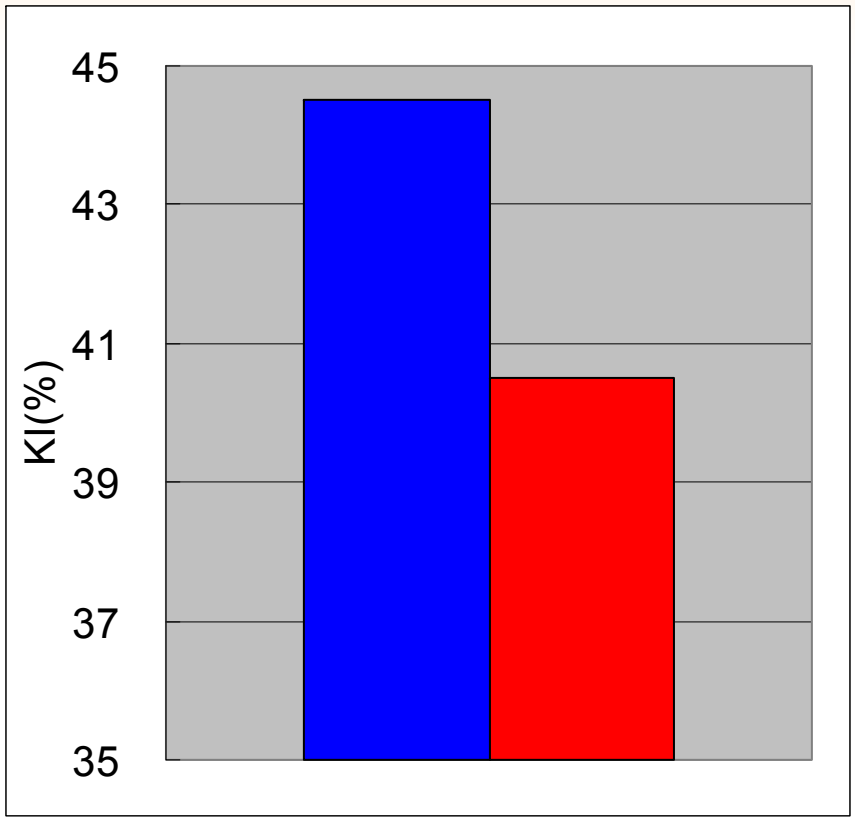
Malting

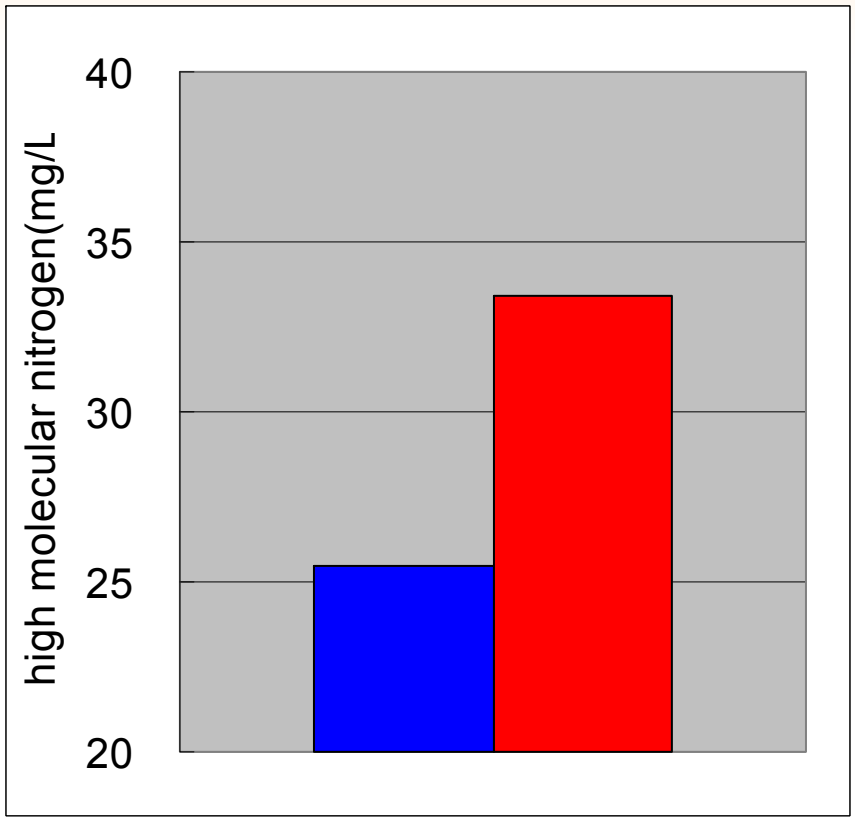
✓ Scale	Commercial malting
✓ wet, germination	trial1 ; 3 times, 20° C
	trial2 ; twice, 25° C
✓ Modification, KI	trial1 ; 99%, 98%
	trial2 ; 45%, 41%

Brewing

✓ Malt ratio	100%
✓ Mashing	Mash concentration 1:4
	Decoction mashing
✓ Scale	Pilot brewing(100L)
✓ Fermentation	Yeast - Lager yeast
	Fermentation temp. 13 ° C

Malt quality used in pilot brewing

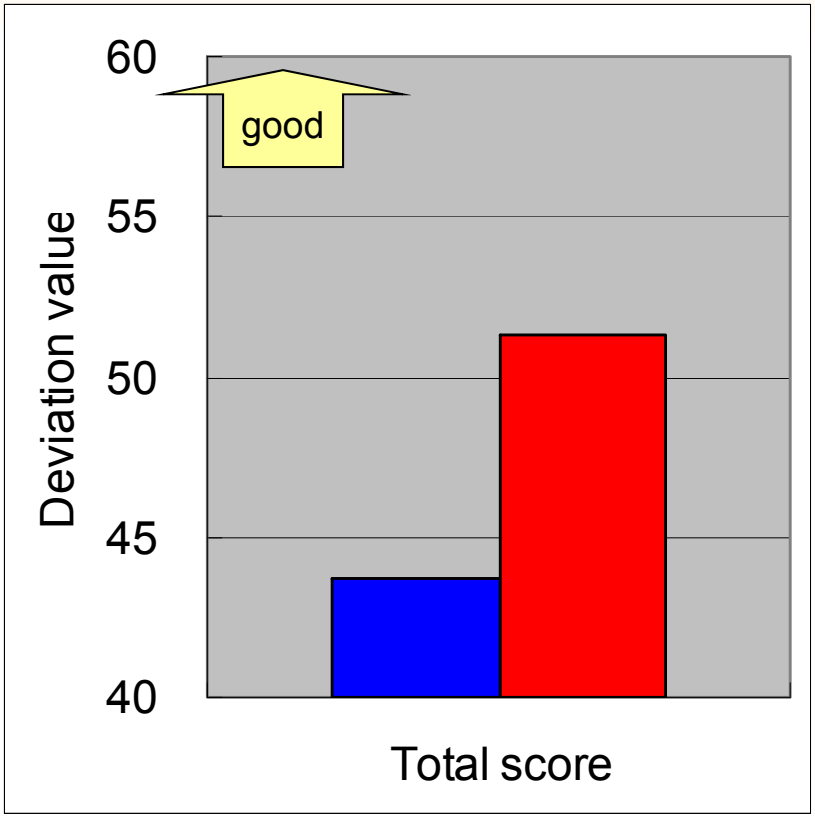




Wet；3 times、Germination；20° C
Wet；twice、Germination；25° C

High molecular nitrogen of malts was increased by inhibiting protein degradation.

Sensory evaluation



Wet；3 times、Germination；20° C
Wet；twice、Germination；25° C

Bitter quality and total score of trial 2,
using the malt containing more high molecular nitrogen,
were better than trial 1.

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Conclusions

- ✓ The flexibility of malt modification was enhanced by the novel malting method.
- ✓ Bitter quality of beer was improved using malts produced by this malting method, which yielded high Modification and low KI.

Thank you for your kind attention