

Effect of hop harvest date on the thiol contents in hop cones

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See what SCIENCE can brew for you





Agenda

- ✓ **Introduction**
- ✓ **Materials and Methods**
- ✓ **Results**
- ✓ **Summary and Perspective**



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About SAPPORO BREWRIES LTD.

- ✓ In 1876, established in Sapporo, Hokkaido
- ✓ 6 breweries in Japan
 - Hokkaido
 - Sendai
 - Chiba
 - Nasu
 - Shizuoka
 - Kyushu-Hita



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✓ Our Varieties

- SORACHI ACE**
- Furano No. 18**
- Furano Special**
- Furano Beauty**
- Furano Magical**

...

SAPPORO is the only company which breeds both barley and hops all over the world.



Effect of harvest date

Variation of characteristics depends on harvest date

Mellowed fruit

Banana
Mangos etc.



Wine

Spätlese (Late harvest grape)

How about the effect of harvest date in hop cones?

yield



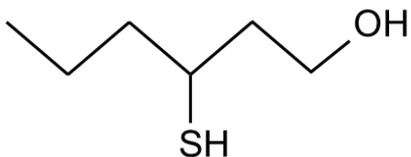
Essential oils



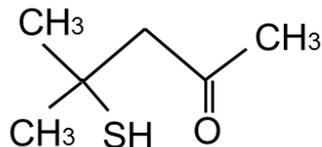


Volatile thiols

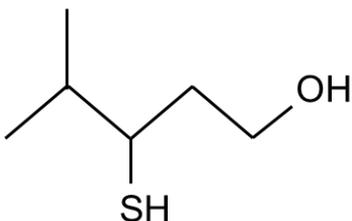
3-sulfanylhexan-1-ol □ 3SH □



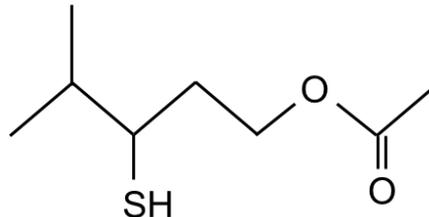
4-methyl-4-sulfanylpentan-2-one (4MSP)



3-sulfanyl-4-methylpentan-1-ol (3S4MP □



3-sulfanyl-4-methylpentyl acetate □ 3S4MPA □



Representative varieties including thiols



Nelson Sauvvin



Citra®



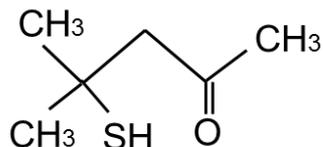
Mosaic®





Volatile thiols

4MSP (4-methyl-4-sulfanylpentan-2-one)

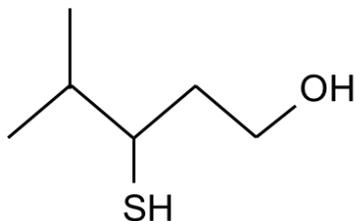


Odor : Black currant-like

Threshold : 1.5 ppt



3S4MP (3-sulfanyl-4-methylpentan-1-ol)



Odor : Grapefruit-like

Threshold : 70 ppt



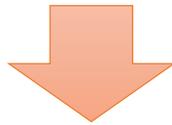
4MSP and 3S4MP have major influences on the flavor of beer.

We focused on these two volatile thiols.



Aim of this study

The relationship between the harvest date and the contents of thiols has never been researched.



✓ **To clarify the relationship between the harvest date and the thiol contents**





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Materials and Methods

Raw materials

Cascade

Furano Beauty

Furano Magical®

} bred by SAPPORO BREWERIES LTD.

Both hops give unique varietal aroma to finished beer

Harvest date

'45 days' after flowering (Normal)

'65 days' after flowering

'75 days' after flowering

'85 days' after flowering





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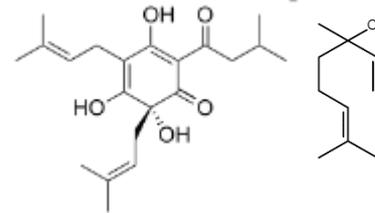


Results

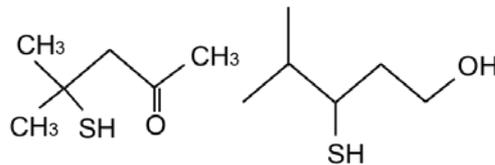
Result 1 Sensory evaluation using hop boiled water extraction method (Koie *et al.*, J.ASBC 2016)



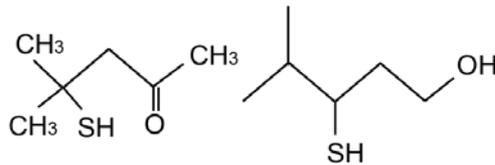
Result 2 Analysis of α -acids and essential oils in hop cones



Result 3 Analysis of thiols in hop cones



Result 4 Analysis of thiols in trial beer



Result 5 Sensory evaluation of trial beer



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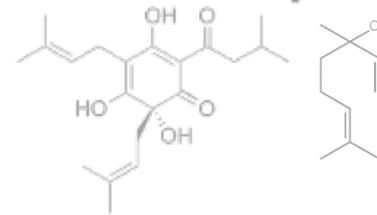


Results

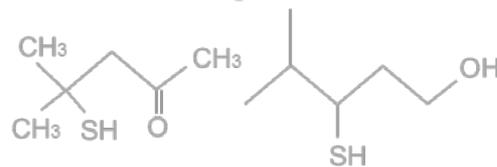
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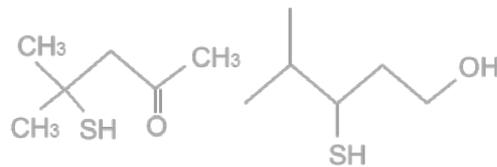
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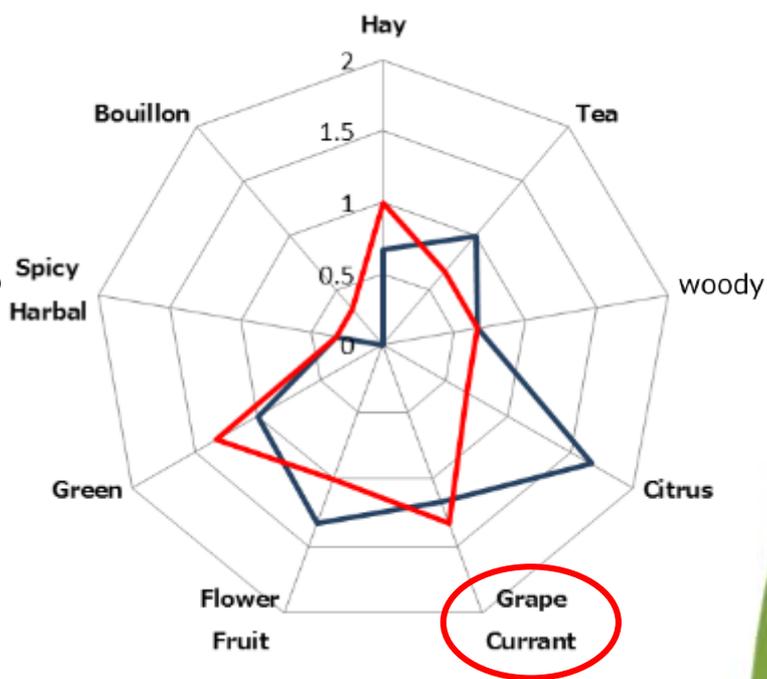
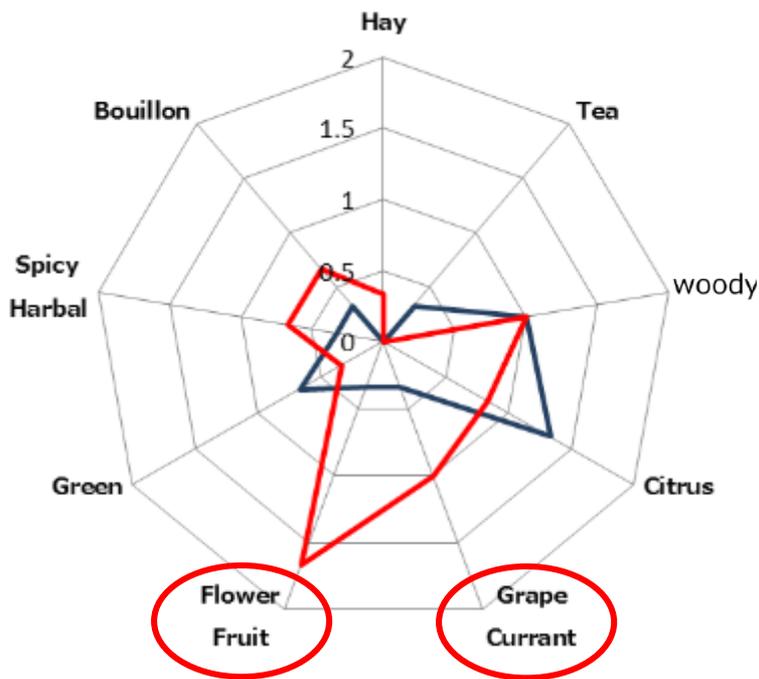


Result 1

Sensory evaluation using hop boiled water extraction method

Furano Beauty

Furano Magical



— 45 days — 65 days

Furano Beauty

The scores of fruit and flower are increased by late harvest.

Furano Magical

The balance of aroma are changed by late harvest.



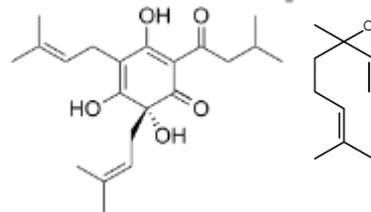


Results

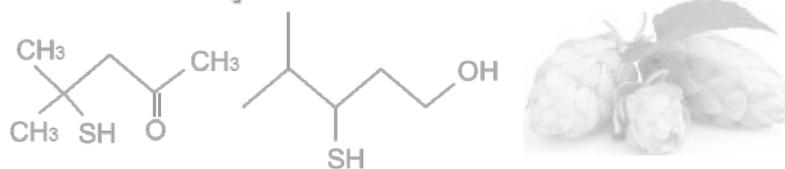
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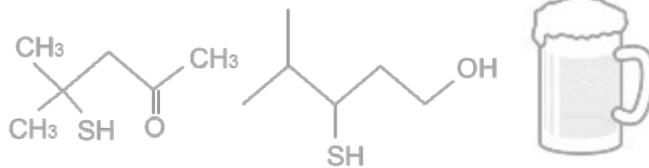
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Analysis of α -acids and essential oils

Essential oils (ppm)

	Cascade			Furano Beauty	
	45 days	65 days	75 days	45 days	65 days
Myrcene	5,157	6,062	10,158	8,917	13,338
Linalool	48	65	88	70	110
Geraniol	14	14	31	66	84

α -acids (%)

	Furano Beauty		Furano Magical	
	45 days	65 days	45 days	65 days
α -acids	10.7	10.6	5.0	5.6

Essential oils

With the delaying harvest date, the content of essential oils are increased.

α -acids

Depending on the date of harvest, the content of alpha acids are not almost changed or slightly increased.

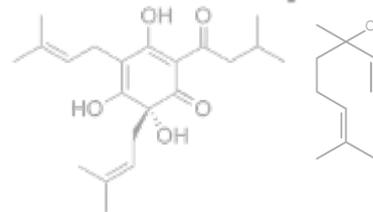


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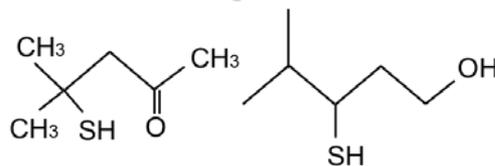
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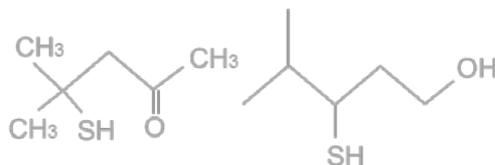
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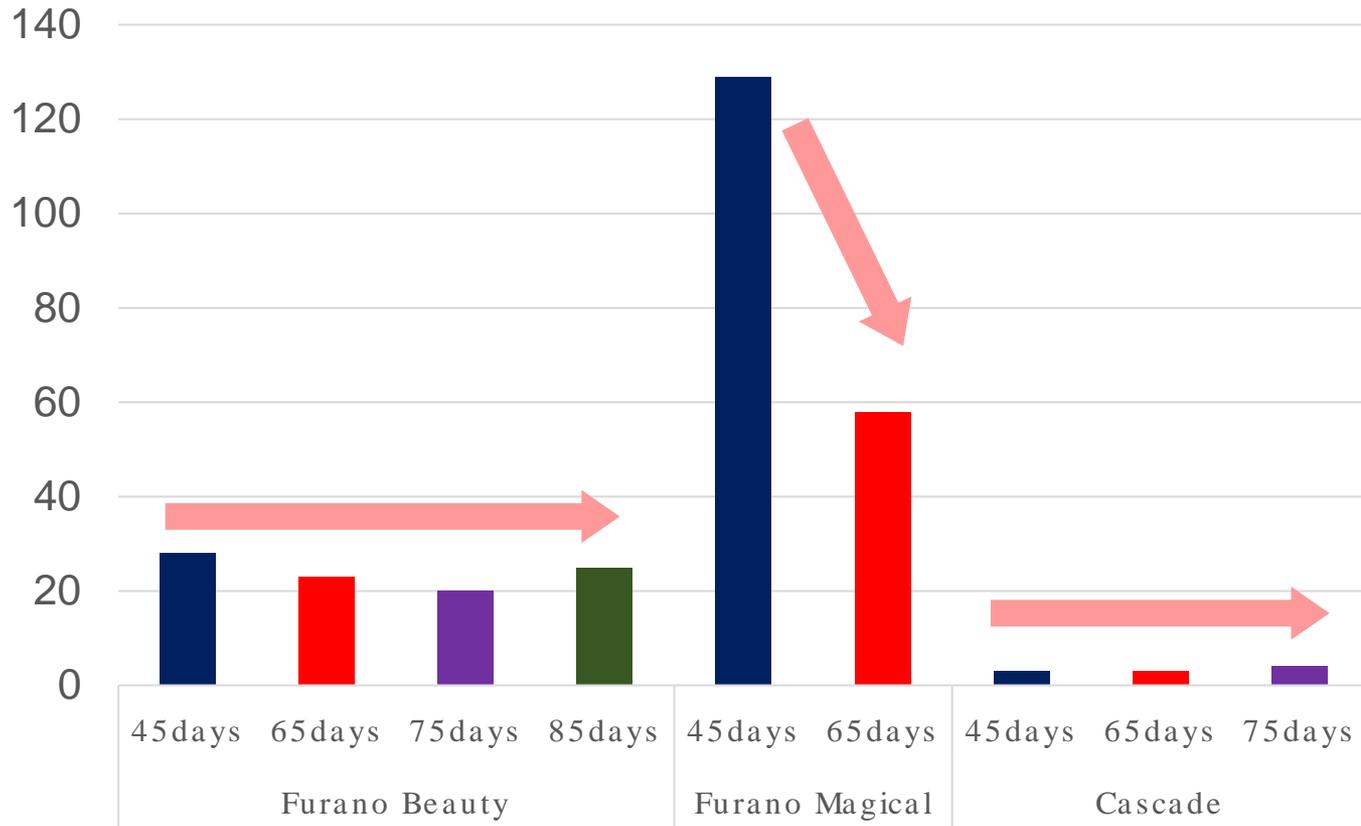


Result 3

Analysis of thiols in hop cones

□(ppb)□

4MSP



Furano Beauty, Cascade

The contents of 4MSP are not changed.

Furano Magical

The content of 4MSP is decreased by late harvest

Result 3

Analysis of thiols in hop cones

□(ppb)□

3S4MP



The contents of 3S4MP are increased by several times **in all varieties.**

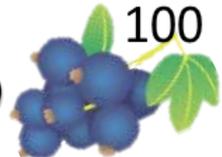
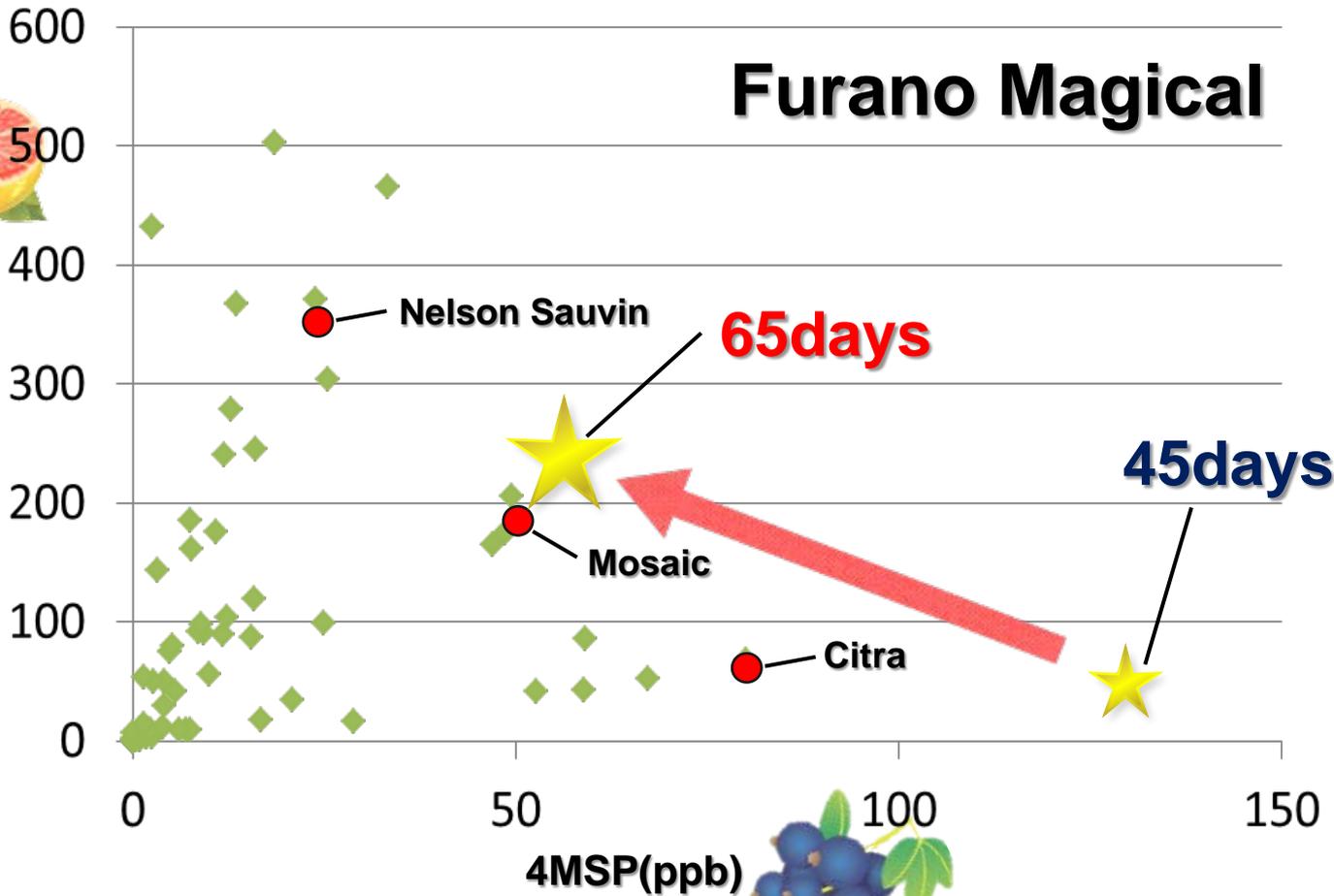
Result 3

Analysis of thiols in hop cones



3S4MP(ppb)

Furano Magical



With delaying harvest date,

the balance of these thiols are significantly changed

the thiol's balance of Furano Magical '65days' shows similar to Mosaic®

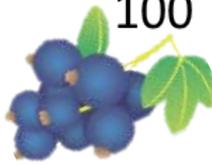
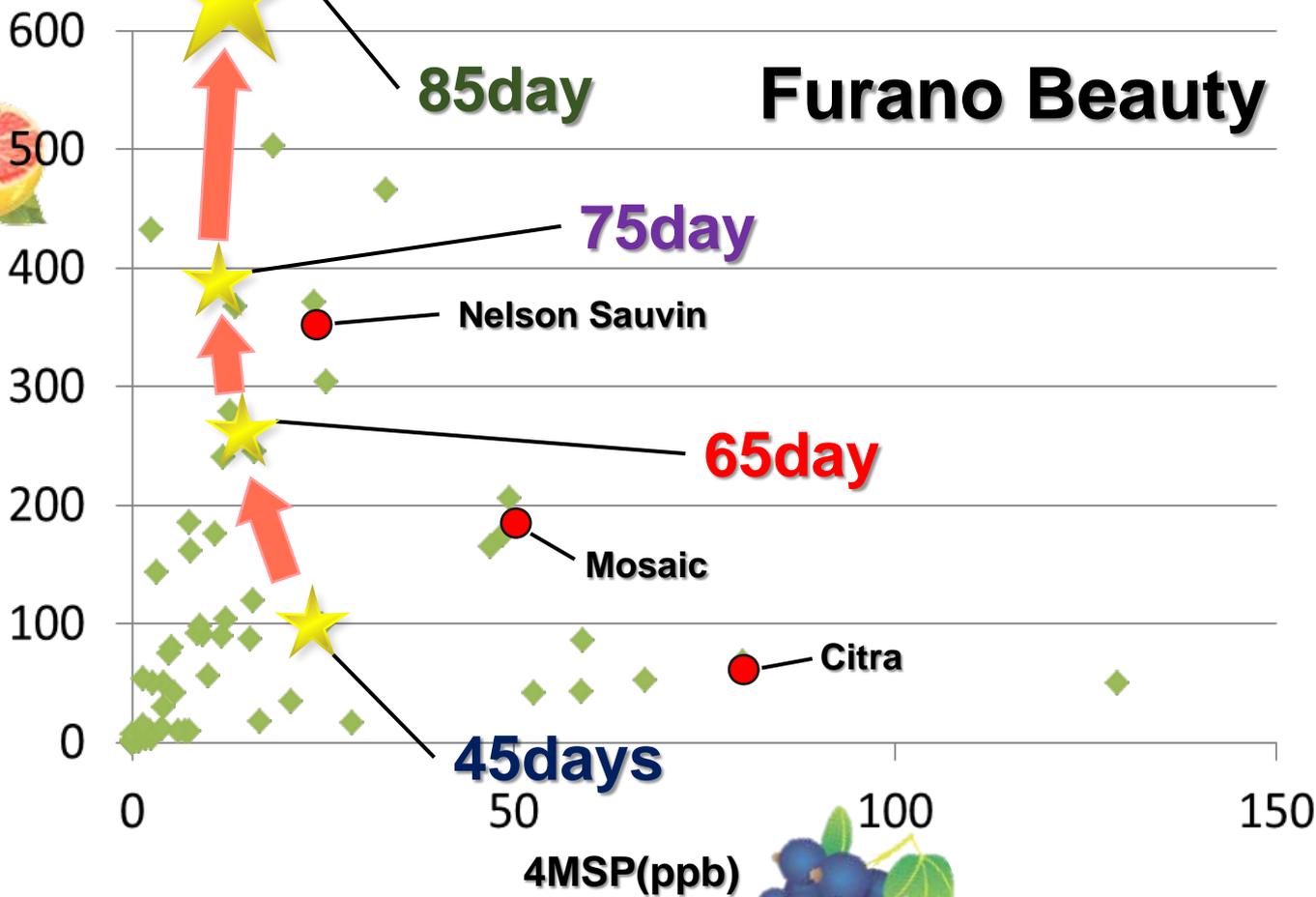


Result 3

Analysis of thiols in hop cones



3S4MP(ppb)



With delaying harvest date,

3S4MP is increased by several times, while 4MSP is maintained.

Furano Beauty '75days' and '85 days' shows higher contents of 3S4MP than that of Nelson Sauvvin



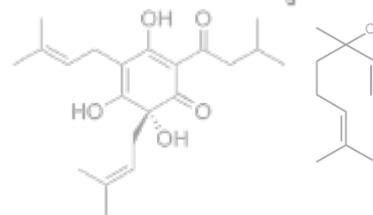


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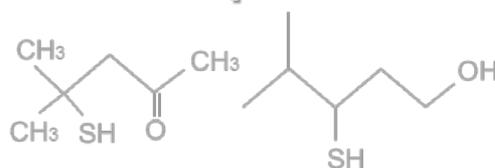
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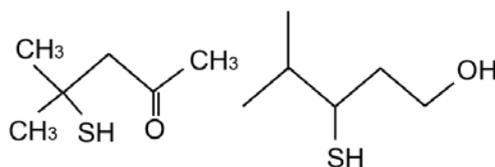
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Result 4 Analysis of thiols in trial beer



Result 5 Sensory evaluation of trial beer



Result 4

Analysis of thiols in trial beer

	4MSP (ppt)	3S4MP (ppt)
Furano Beauty 45 days	10	37
Furano Beauty 65 days	8	174



Over threshold

	4MSP	3S4MP
Furano Magical 45days	40	17
Furano Magical 65days	42	148



Over threshold

4MSP : Not changed

3S4MP : Increased by several times

It is possible to increase 3S4MP selectively by delaying harvest date

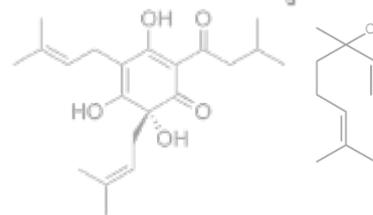


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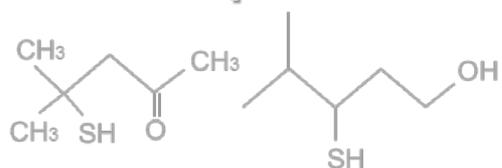
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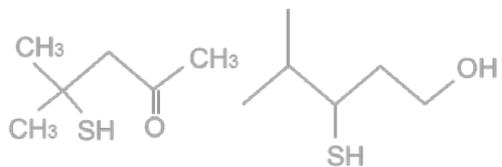
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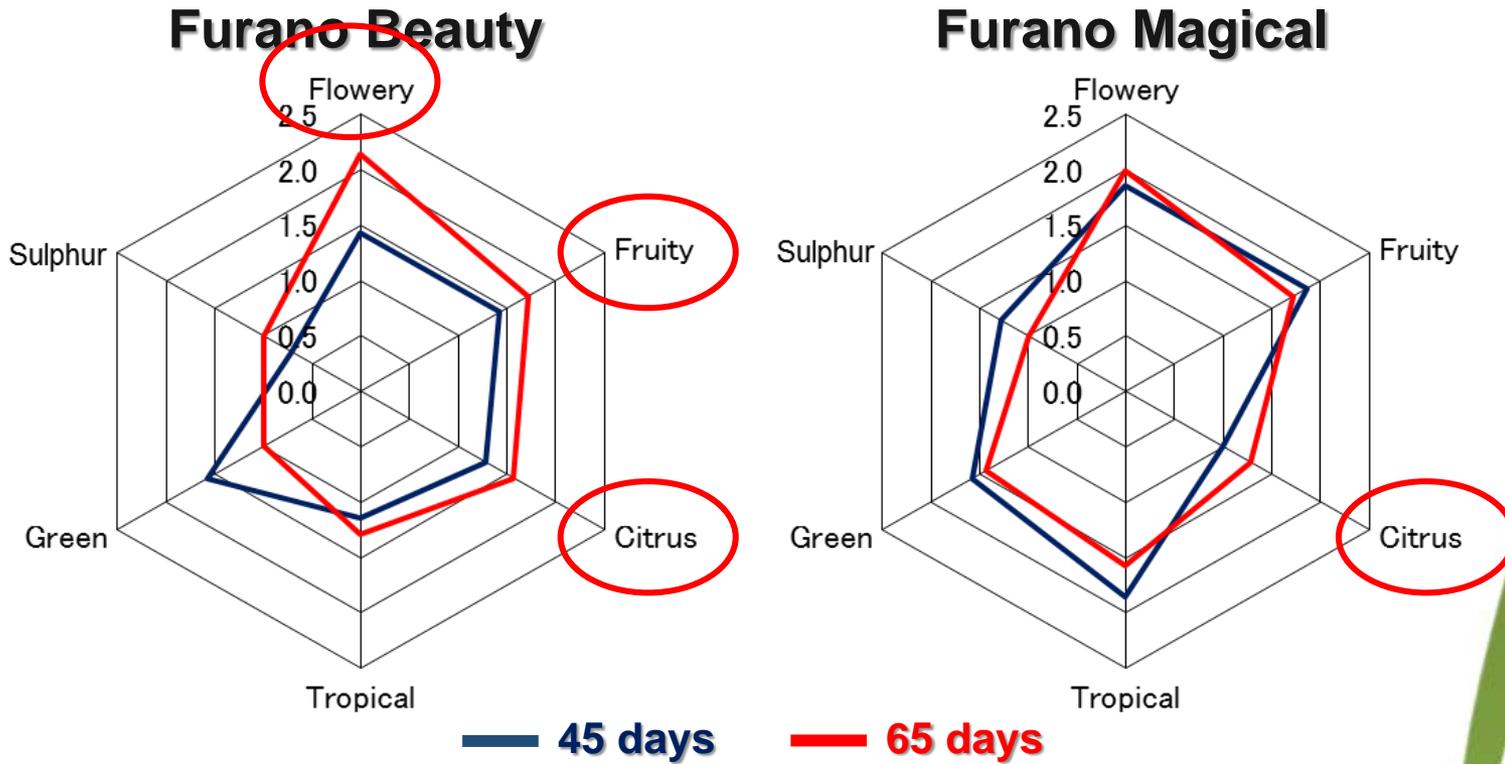


Result 5 Sensory evaluation of trial beer



Result 5

Sensory evaluation of trial beer



Furano Beauty

The scores of fruity, flowery and citrus are increased by late harvest.

Furano Magical

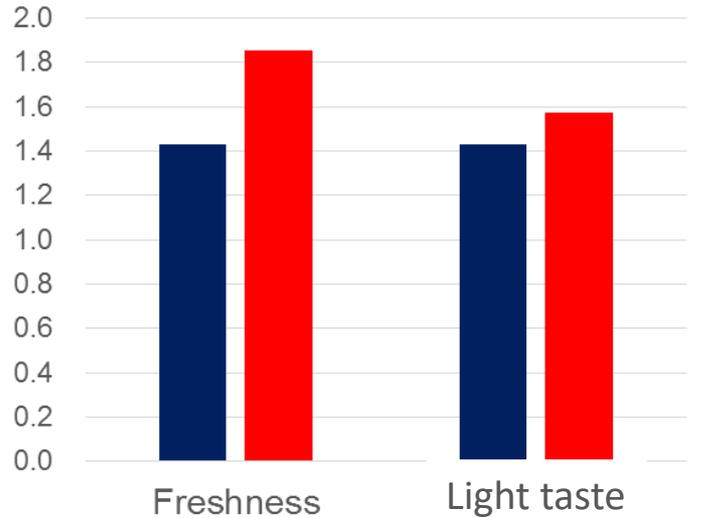
The balance of aroma is changed by late harvest.



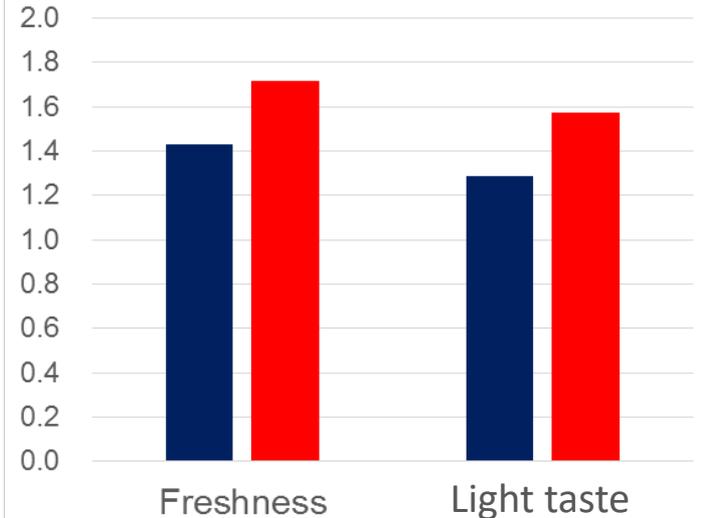
Result 5

Sensory evaluation of trial beer

Furano Beauty



Furano Magical



— 45 days — 65 days

In both varieties, the scores of 'Freshness' and 'Light taste' is increased



The increase of 3S4MP might contribute to increase these scores



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Summary and Perspective

Summary

With delaying harvest date,

the balance of these thiols are significantly changed

the content of 3S4MP in hop cones are increased by several times

the scores of 'Freshness' and 'Light taste' increase in trial beer

It is possible to increase 3S4MP selectively in trial beer



The flavor of beer can be appropriately controlled by 'hop harvest date'

Perspective

- Investigate of the effect of late harvest on yield
- Establish the "Spätlese" for flavor hops





Acknowledgement

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Koji Takazumi,
Narushi Suda,
Kensuke Ogushi**





**Thank you
for your attention**



2017 ASBC Meeting

