

ASBC Annual Meeting

June 4–7 ■ Fort Myers, Florida

See what SCIENCE can brew for you

New technologies for development of citrus-based ready-to-drink (RTD) alcoholic beverages that maintain freshness

Asahi Breweries, Ltd.

Development Laboratories for Alcoholic Beverages

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Seiichi Higuchi, Itsuo Nishitani and Yoshinori Ito

Asahi
その感動を¹わかちあう。

Contents

1. Introduction
2. New value “freshness”
3. Flavor components
4. Antioxidants
5. Summary

Contents

1. Introduction

2. New value “freshness”

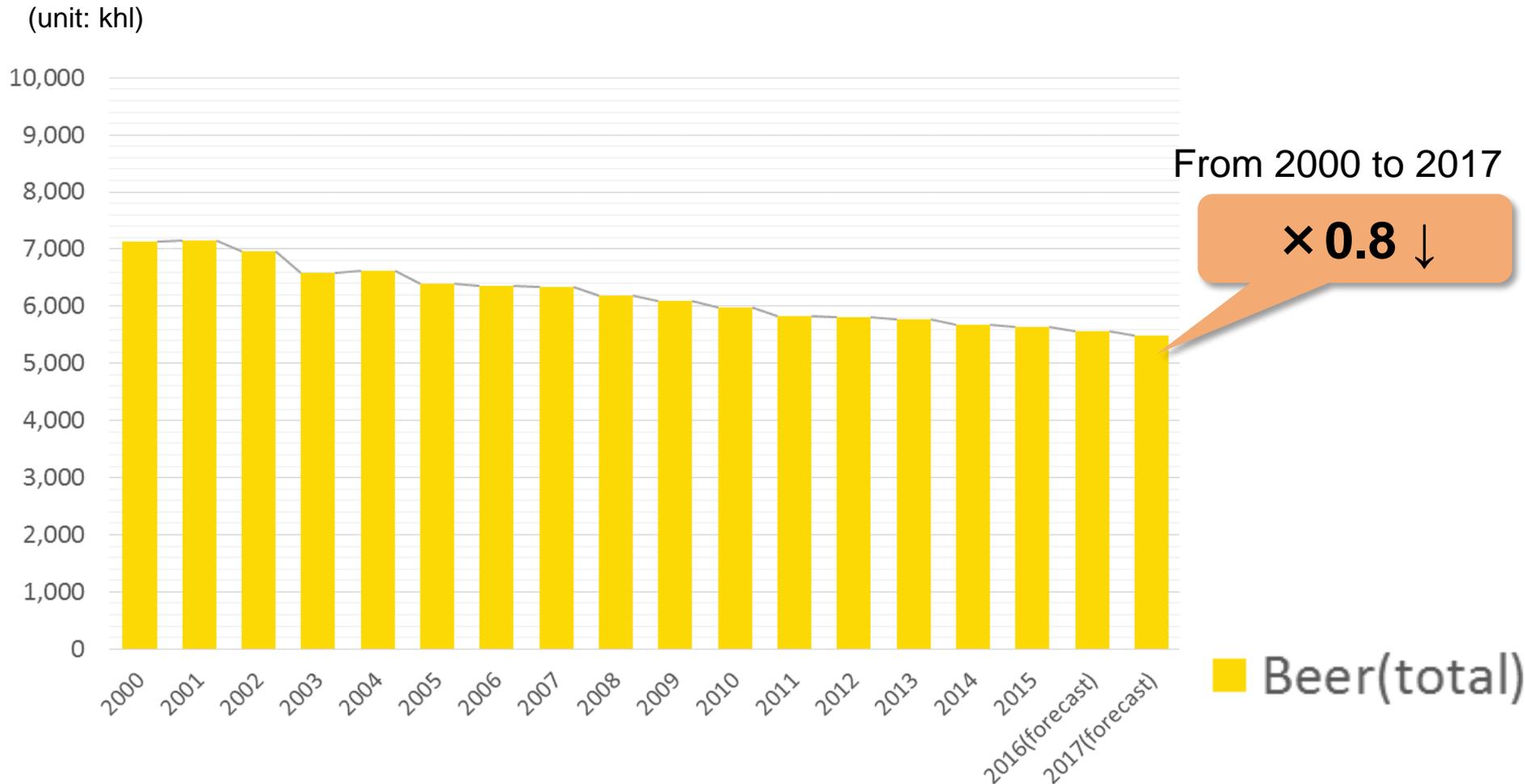
3. Flavor components

4. Antioxidants

5. Summary

Japanese beer market

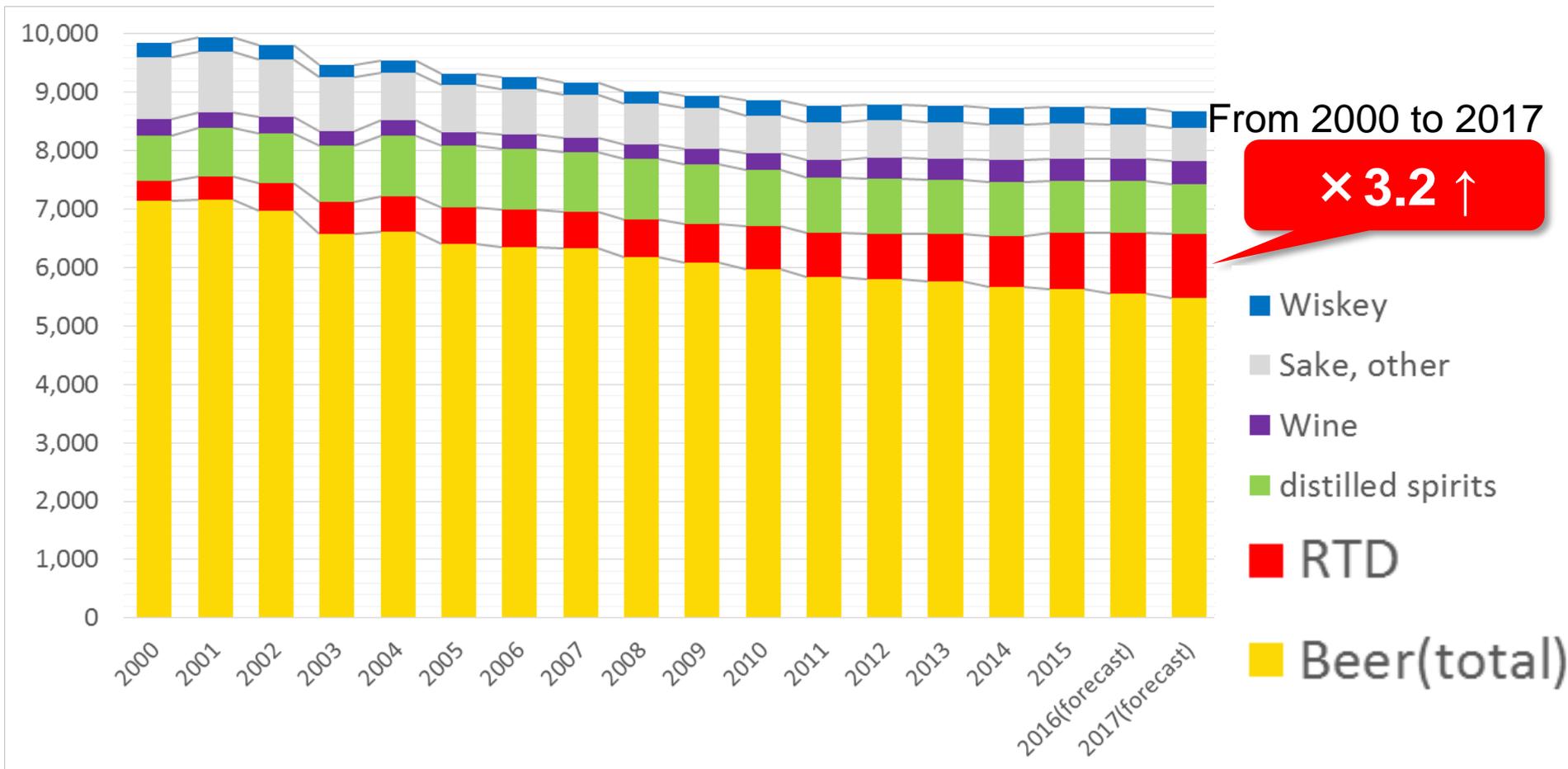
The quantity of beer consumption is decreasing



Japanese alcohol market

RTD is increasing every year

(unit: khl)



Source: National Tax Agency "taxable shipping volumes" (partly estimated by Asahi breweries)

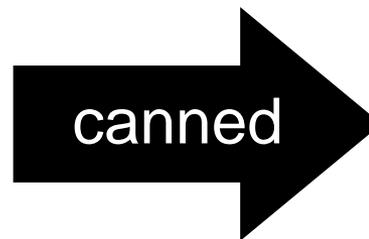
What is RTD?

- RTD stands for “**Ready To Drink**“ beverages with low alcohol (alcopop)
- RTD was inspired by freshly squeezed lemon cocktails



Vodka + lemon juice + carbonation

bar



1984 □

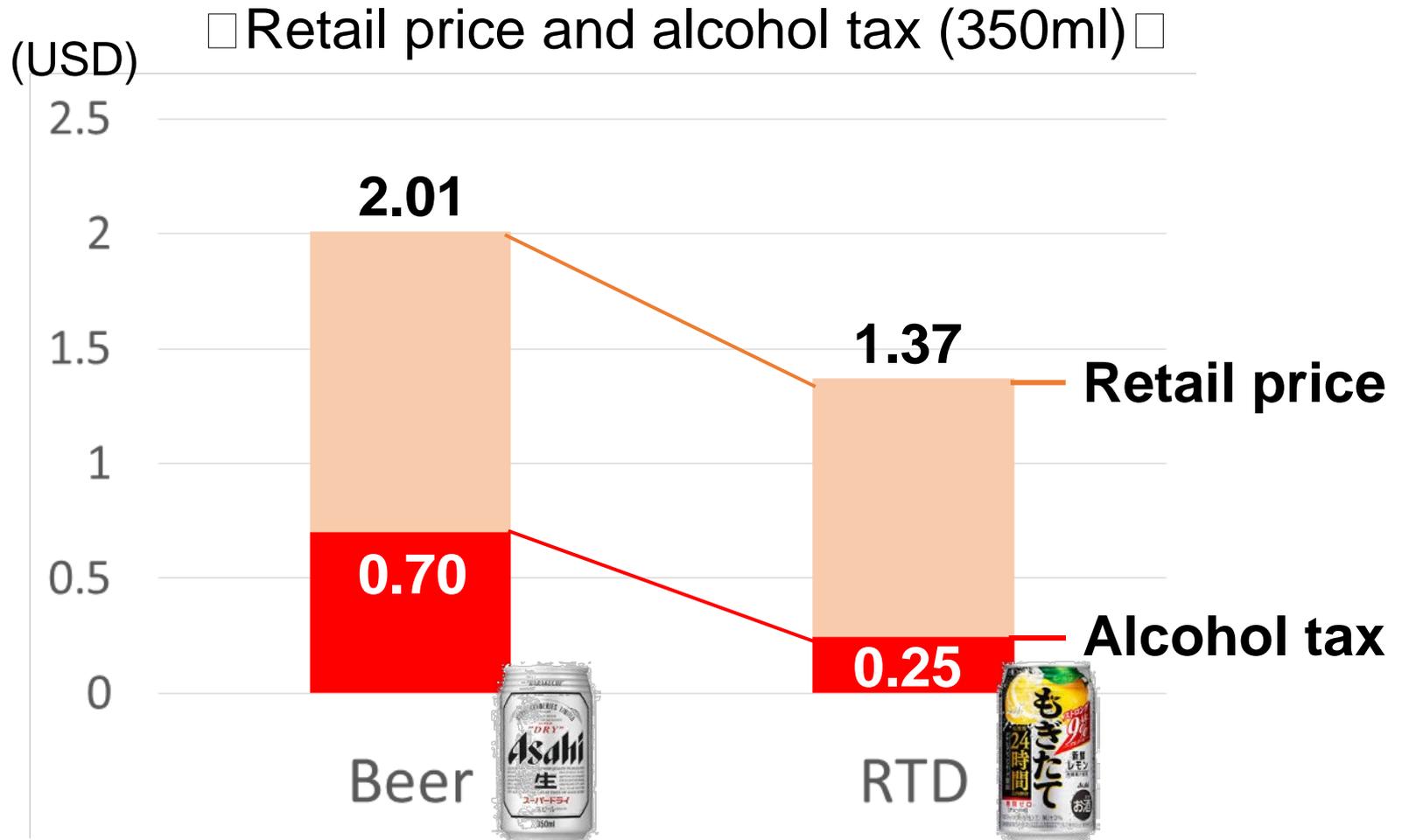
RTD



home

Why is RTD growing? ① “Price”

Tax and retail price of RTD are less than beer



- Retail price at convenience stores (including 8% consumption tax)
- 109.5 JPY/USD

Why is RTD growing? ②“Variety”

RTDs can meet a wide range of customer needs

Flavor

citrus



Soft fruits



plain



Alcohol

9%



6%



3%



Function

Non Sugar



Low calories



Why is RTD growing? ②“Variety”

RTDs can meet a wide range of customer needs

Flavor

Alcohol

Function

citrus



9%



Non Sugar

pairs with any meals

Soft



calories

plain



3%



Why is RTD growing? ②“Variety”

RTDs can meet a wide range of customer needs

Flavor

citrus



Soft fruits



plain



Alcohol

9%



6%



3%



Function

Non Sugar

like juice



Why is RTD growing? ②“Variety”

RTDs can meet a wide range of customer needs

Flavor

citrus



Alcohol

9%



Function

Non Sugar



200 new RTD products
every year
(60 new beer products)

plain



3%



low calories



Why is RTD growing?

Many consumers have changed from beer to RTDs

Beer



RTD



High

price

Low

affordable

Few

flavors

Various

5-6%

alcohol

3-9%

Unhealthy

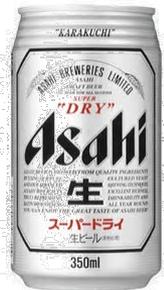
image

Healthy

various

Our brewery in Ibaraki

Beer and RTDs have many points in common in production and sales process



Beer



Softdrink



RTD

1991

2017

Strategy of Asahi breweries

Become the “No.1 alcohol beverage company in Japan”
⇒ Develop brands as No.1 in all alcohol beverage categories

Beer



Distilled spirits



Imported Wine



Non-Alcohol



Whisky



RTD



RTD market in Japan

- RTD (Ready to Drink) market is growing while beer is decreasing
- The reasons why RTD is growing are
 - ① Tax and retail price of RTD are cheaper than beer
 - ② Various RTDs can meet a wide range of customer needs



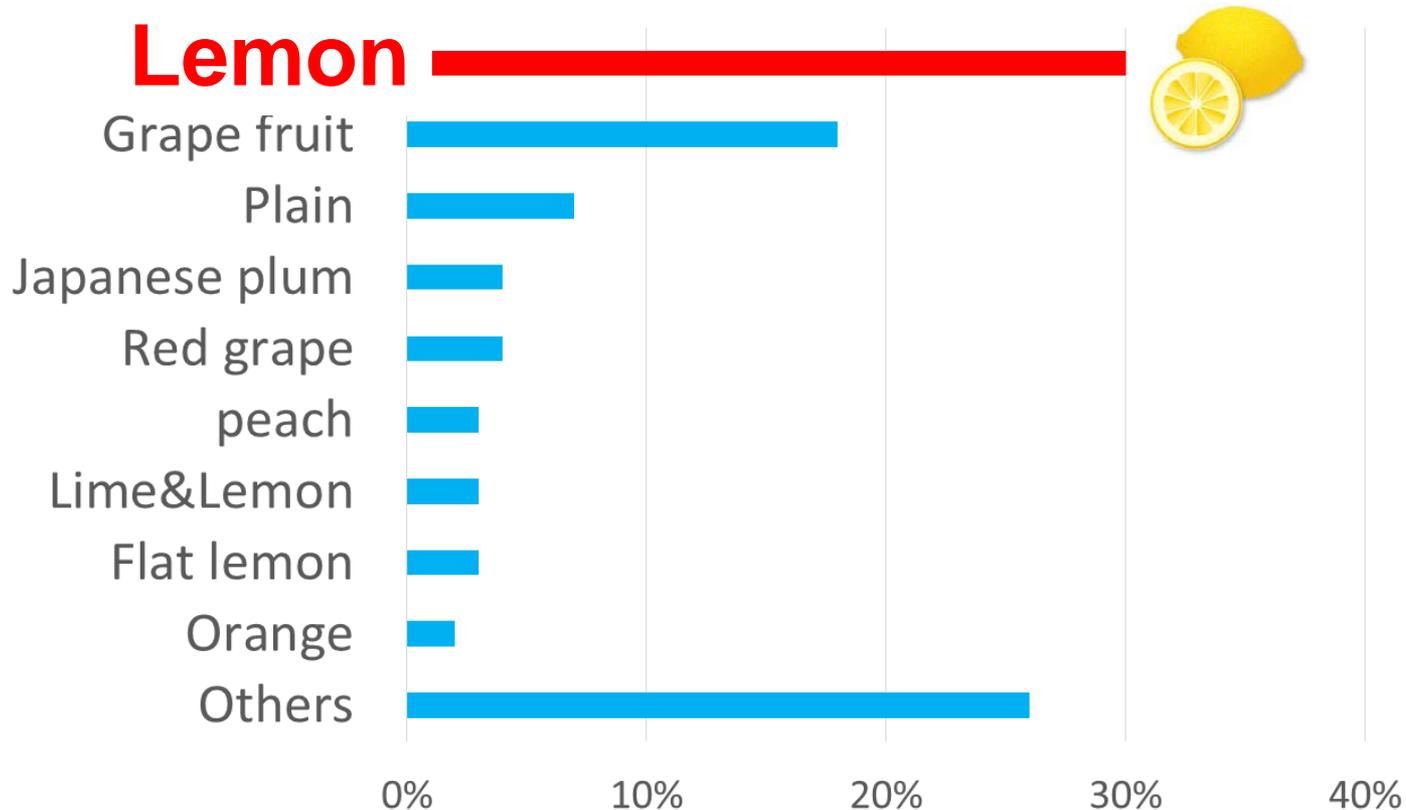
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The most important flavor of RTDs

Citrus-based RTDs are popular in Japan,
and lemon taste RTDs are 30% of sales
⇒ We focused on lemon taste RTDs

□ Flavor shares of RTDs in 2016 □



We pursued RTD's needs for consumers

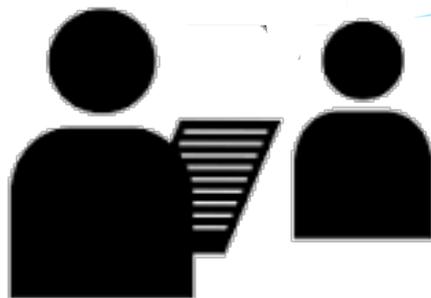
According to market research,
ideal RTDs for consumers have a fresh feeling

Q. What is ideal RTDs for you?

A. Match with any food!

A. Light & refreshing !

A. Freshly squeezed !



Squeezed lemon alcohol beverage



We pursued RTD's needs for consumers

We propose "fresher feeling of fruit juice" in RTDs

Ideal RTDs

Squeezed
lemon
beverage

Natural

Fresh

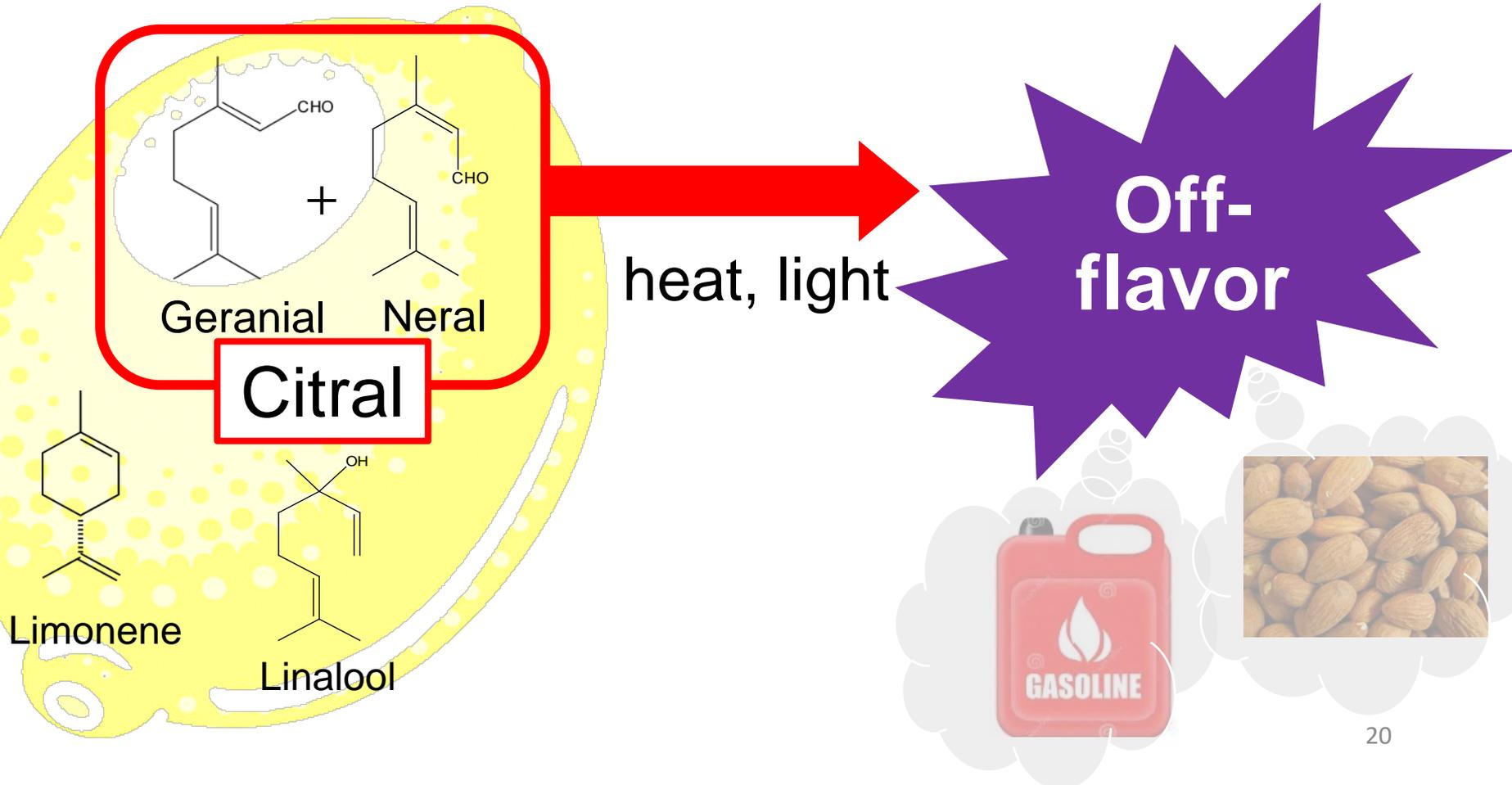
Rich

New value
『Freshness』

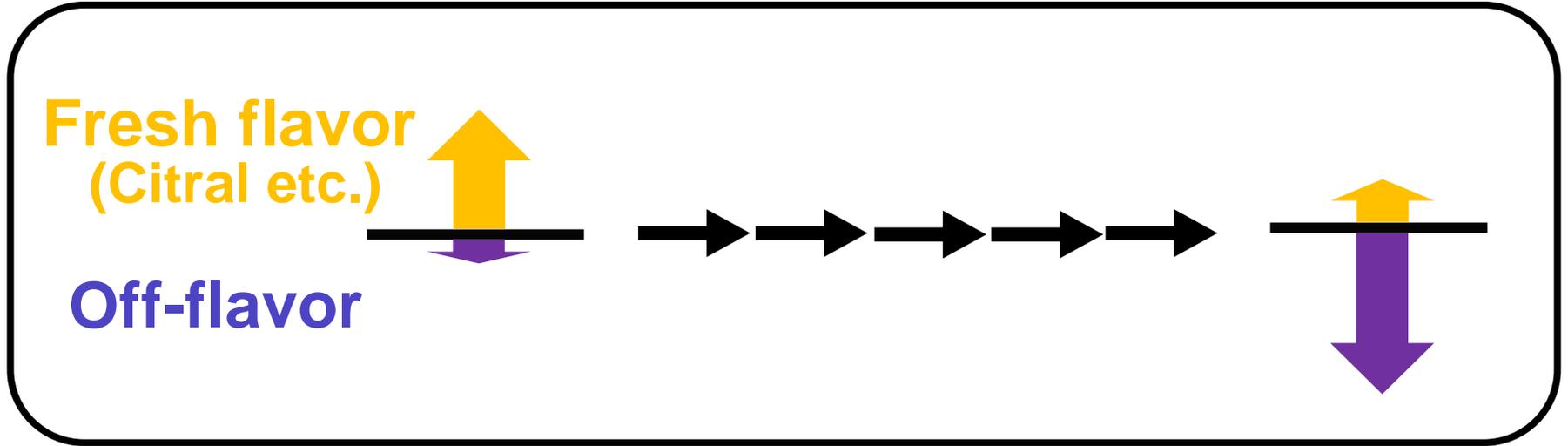


Key flavor component “citral”

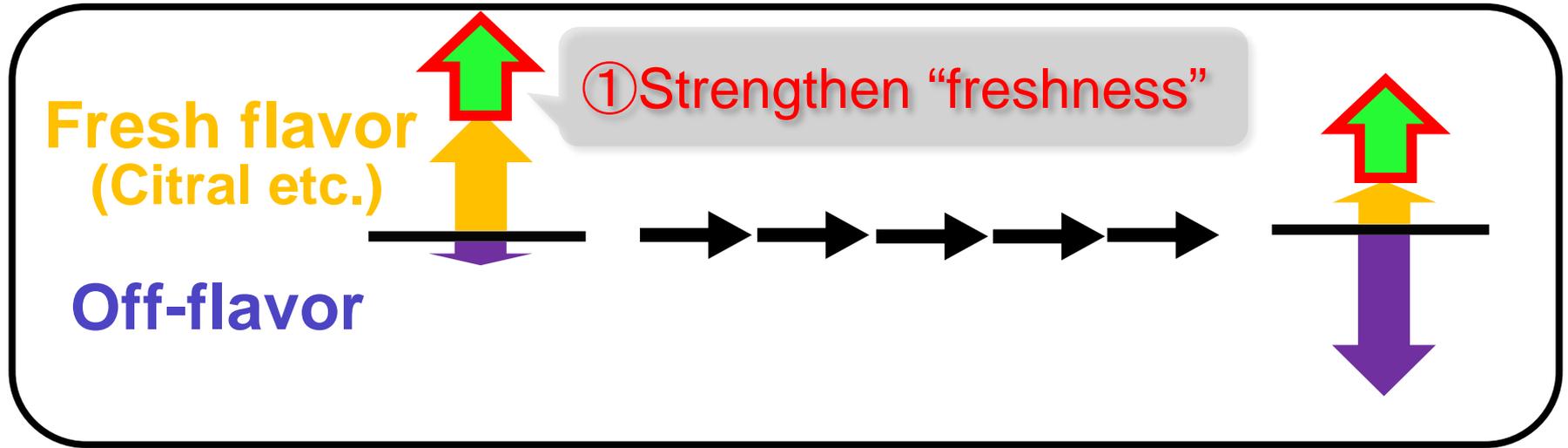
- Citral is important flavor component, contribute to freshness
- Citral is unstable in beverages and converts into off-flavors



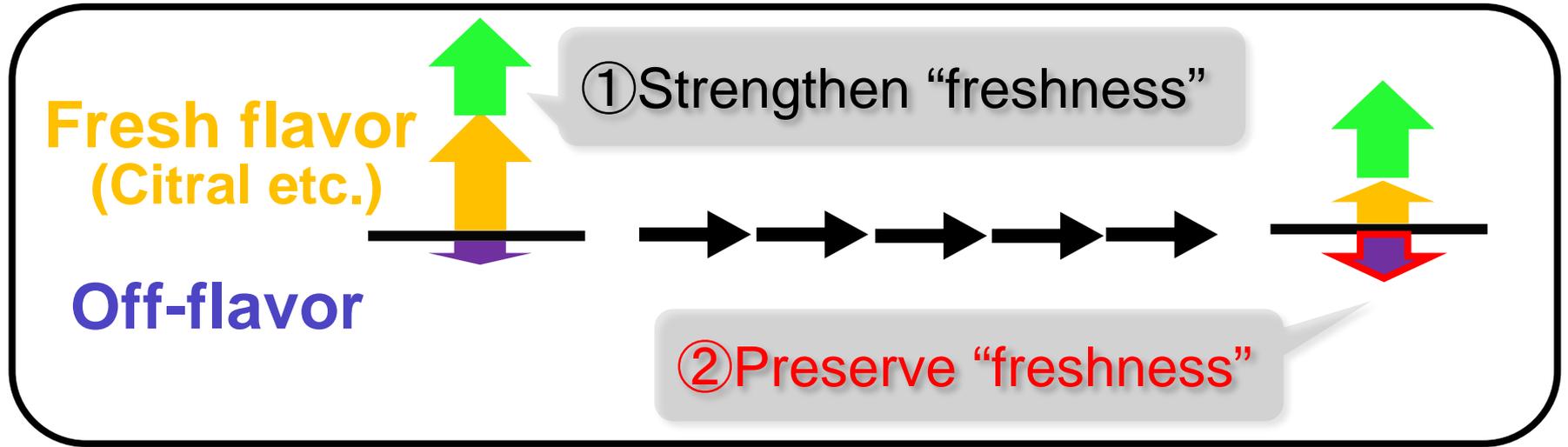
Problem



Strategy ①



Strategy ②



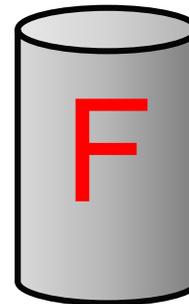
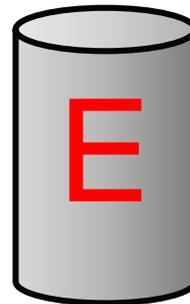
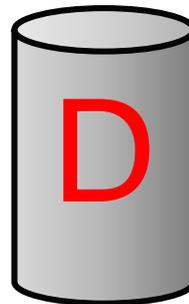
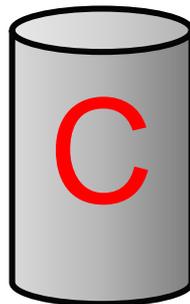
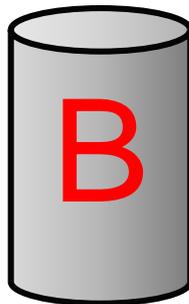
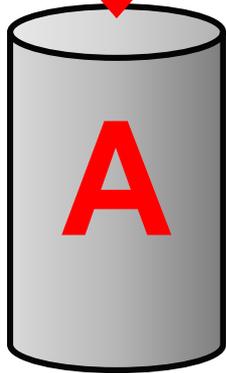
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Material

Lemon-based RTDs (prototypes, commercial products)

The freshest
Prototype



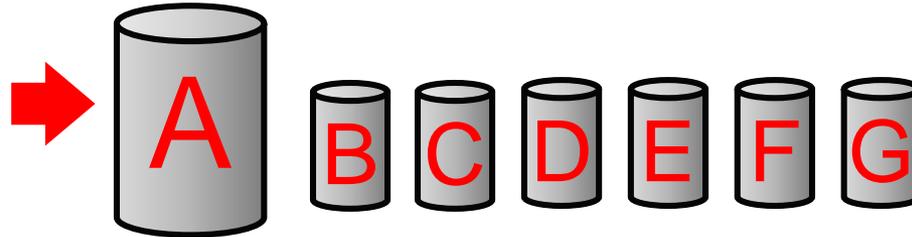
- lemon juice contents : high, low
- characteristics of flavor : fruity, juicy, ...
- taste : sweet, sour...



Search key flavor components
contribute to freshness in sample A

Method

The freshest
Prototype



Sensory
analysis

CATA (Check-all-that-apply) sensory evaluation

(Adams, Williams, Lancaster (2007))

Check **all attributes** that describe this sample:

Citral

Green

Vitamin C

Peel

Fatty

Gasoline

Floral

Fruity

Brunt

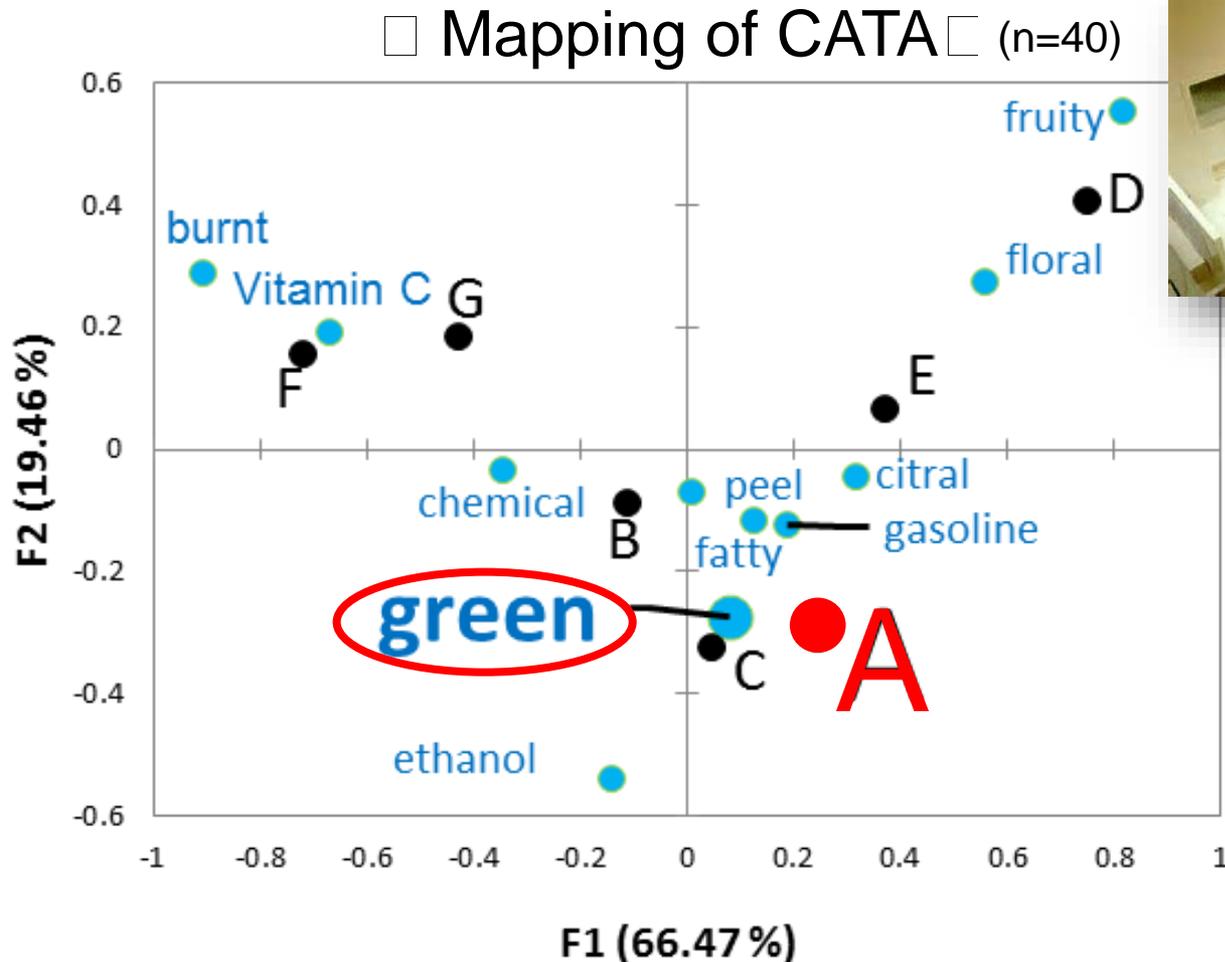
Flavor
analysis

Non-target GC-MS

with multivariate analysis software ²⁶

Result ① sensory analysis

Sample A (the freshest RTD) is characterized by “green”

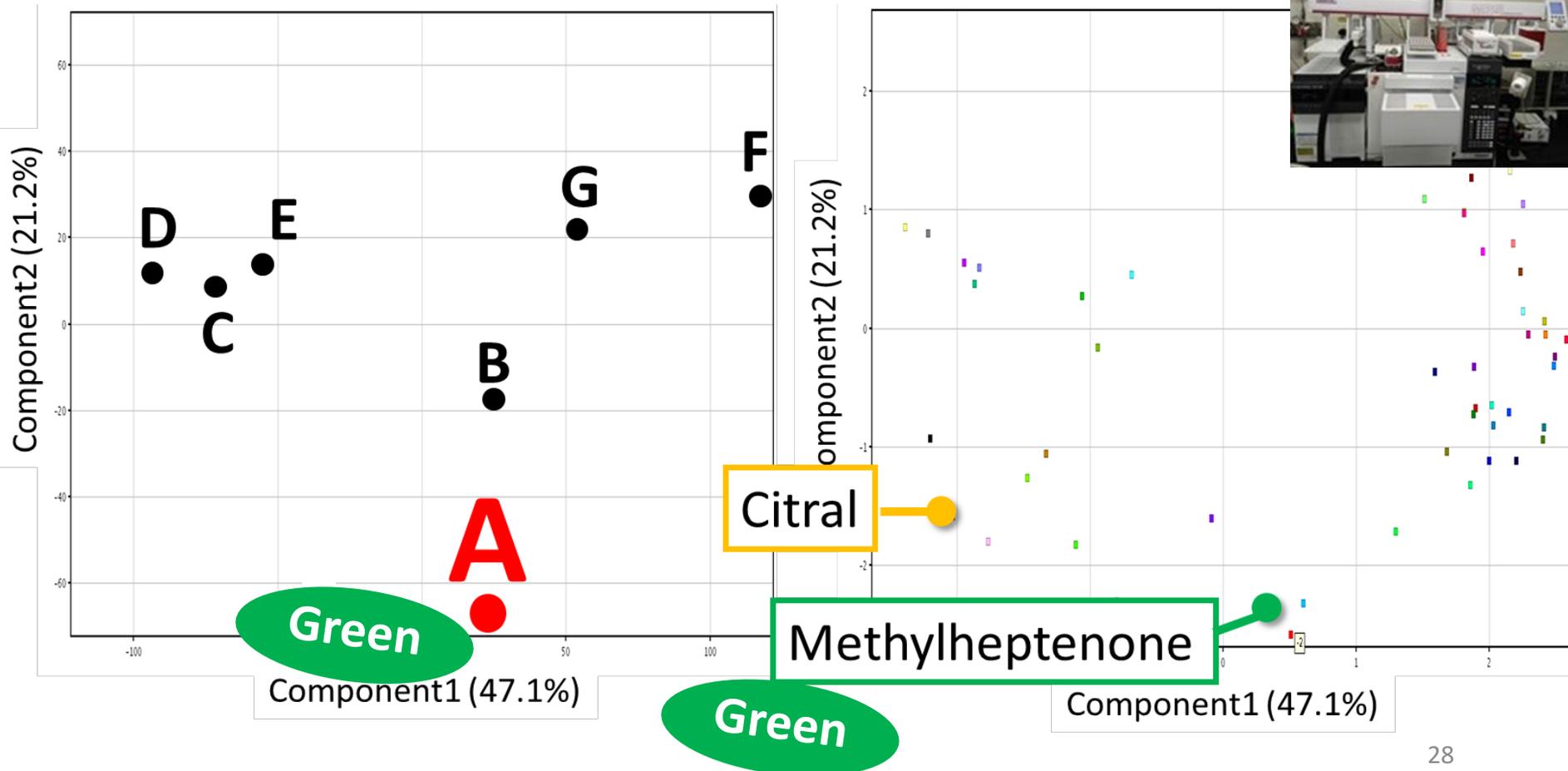


● sensory words ● samples

Result ② flavor component analysis

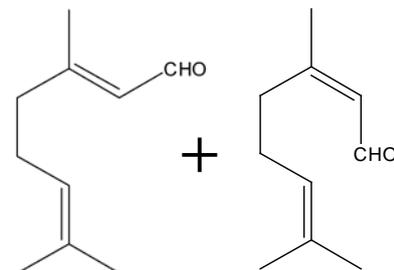
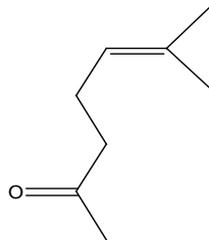
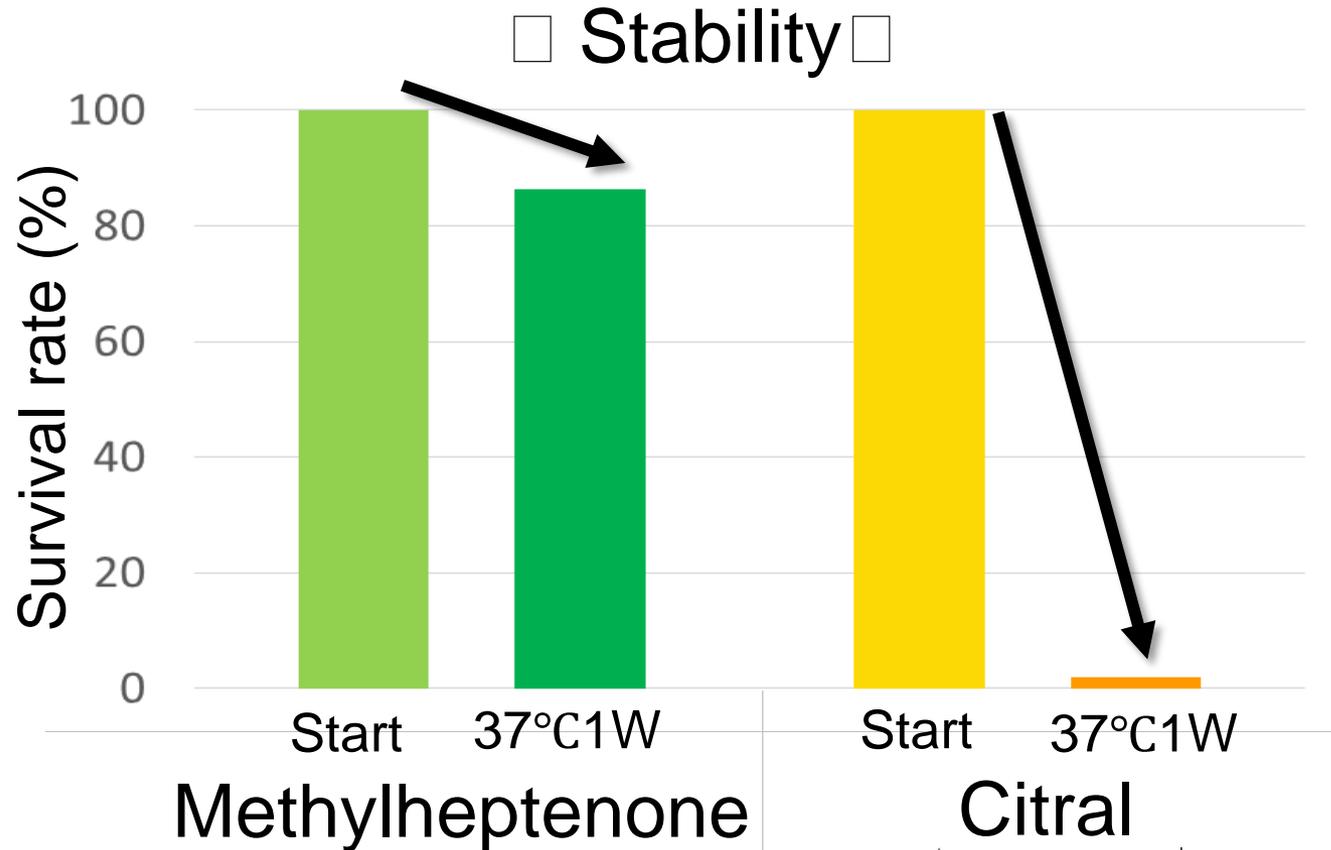
Methylheptenone is highly contribute to characteristics of sample A (the freshest RTD)

□ SBSE (Stir Bar Sorptive Extraction) □



Result ③ Stability of methylheptenone

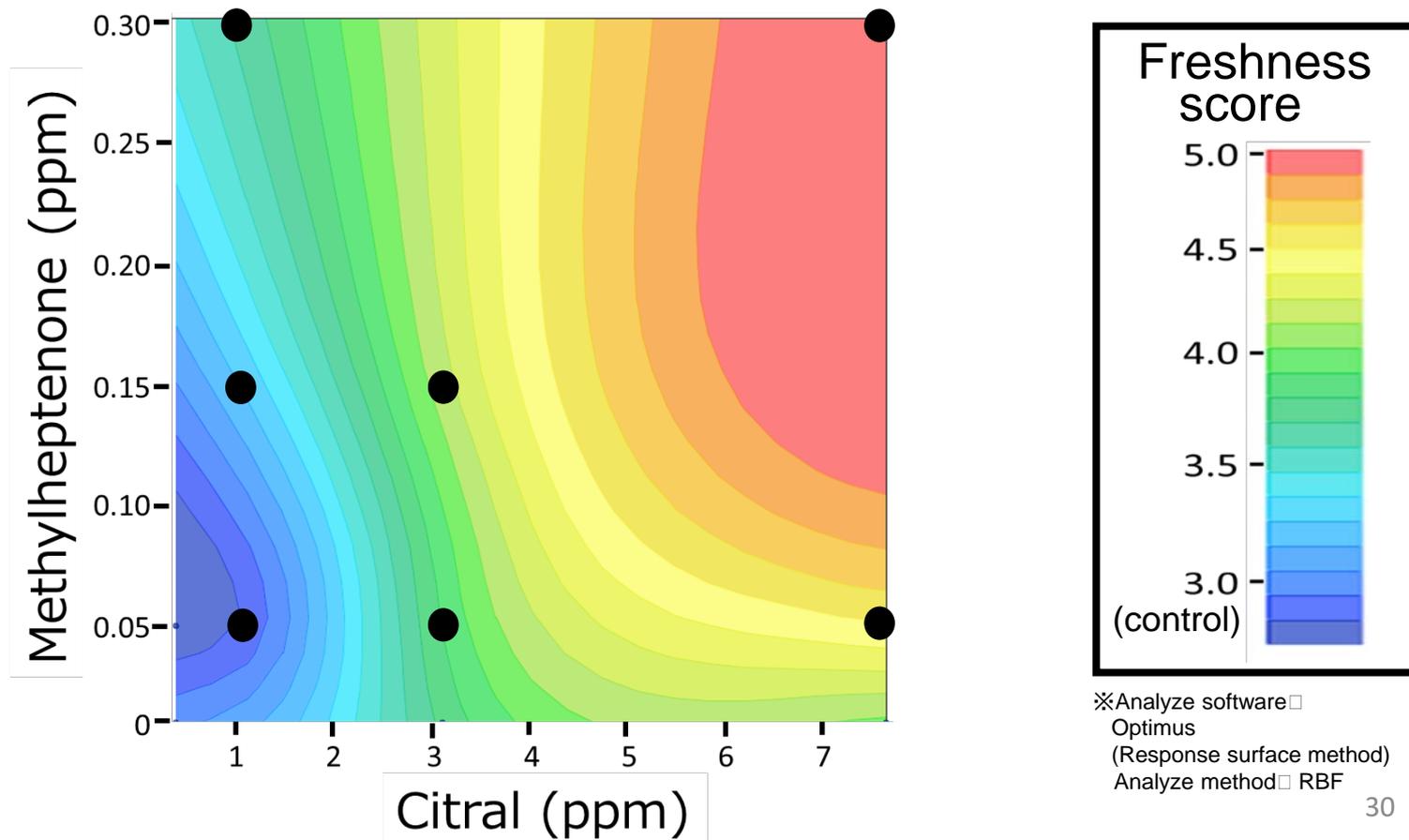
Methylheptenone is very stable



Result ④ freshness-improving effect of methylheptenone

Methylheptenone is considered to improve and maintain a feeling of freshness, combined with citral

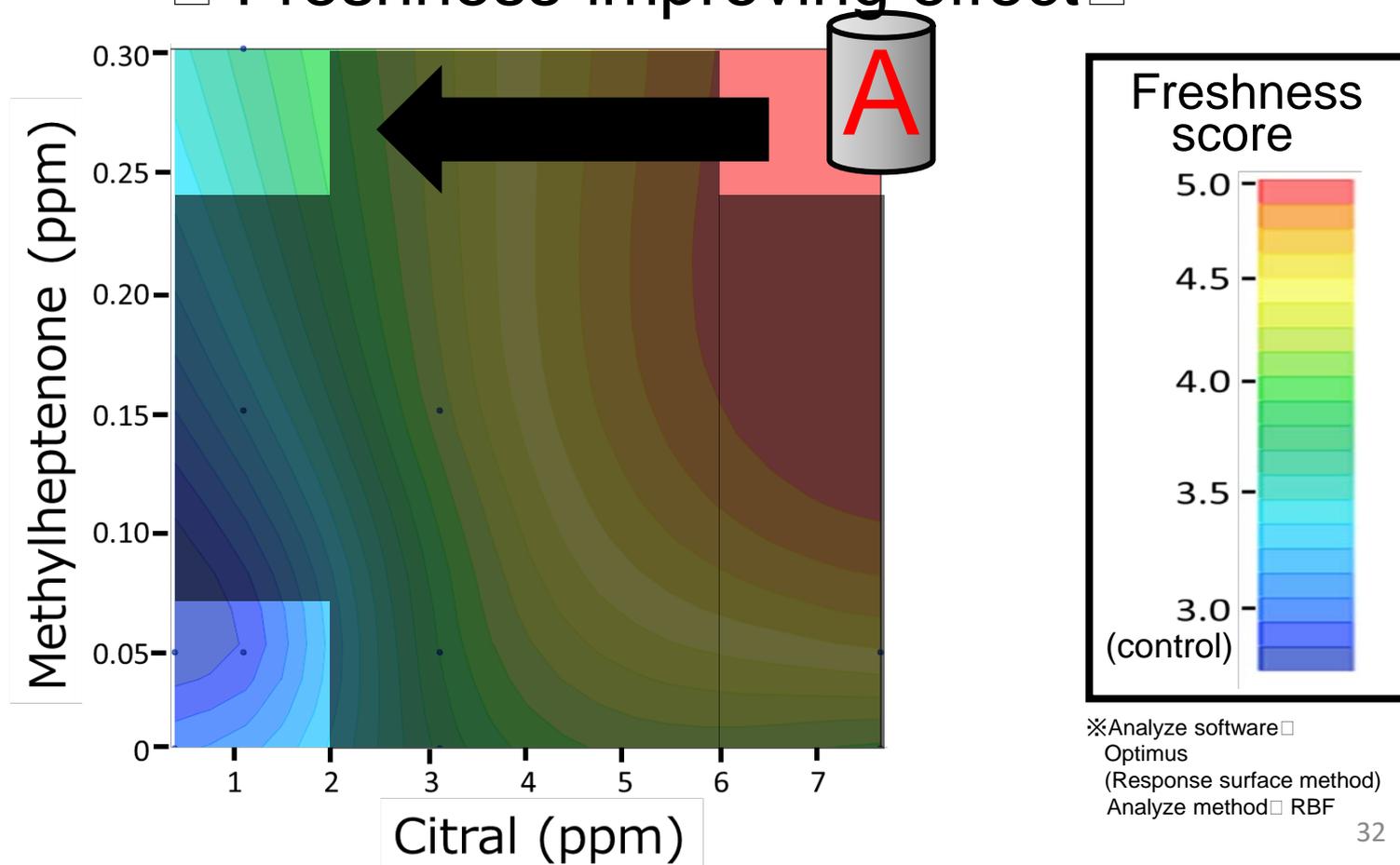
□ Freshness-improving effect □



Result ④ freshness-improving effect of methylheptenone

Methylheptenone is considered to improve and maintain a feeling of freshness, combined with citral

□ Freshness-improving effect □

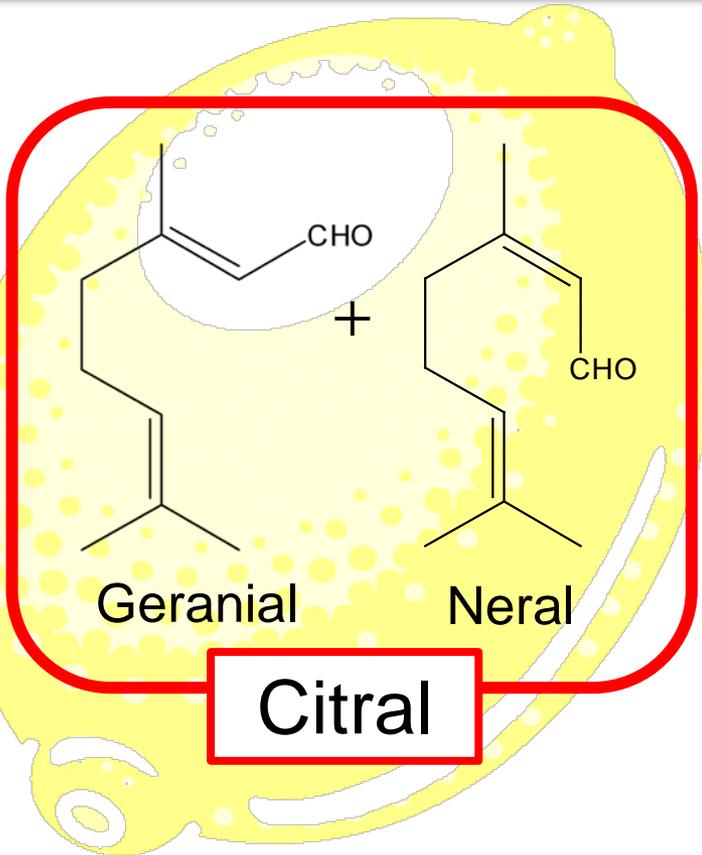


Contents

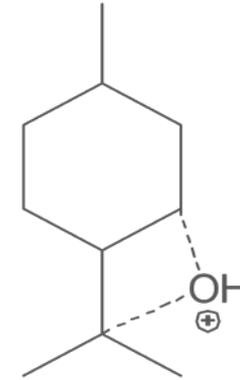
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Key flavor component "citral"

Citral is instable in beverages and converts into off-flavors



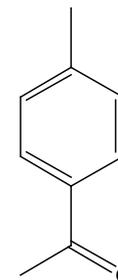
Cyclization
in acid condition
(pH of RTD: 3.0~3.5)



Oxidation etc.



p-Cymene
(gasoline-like)



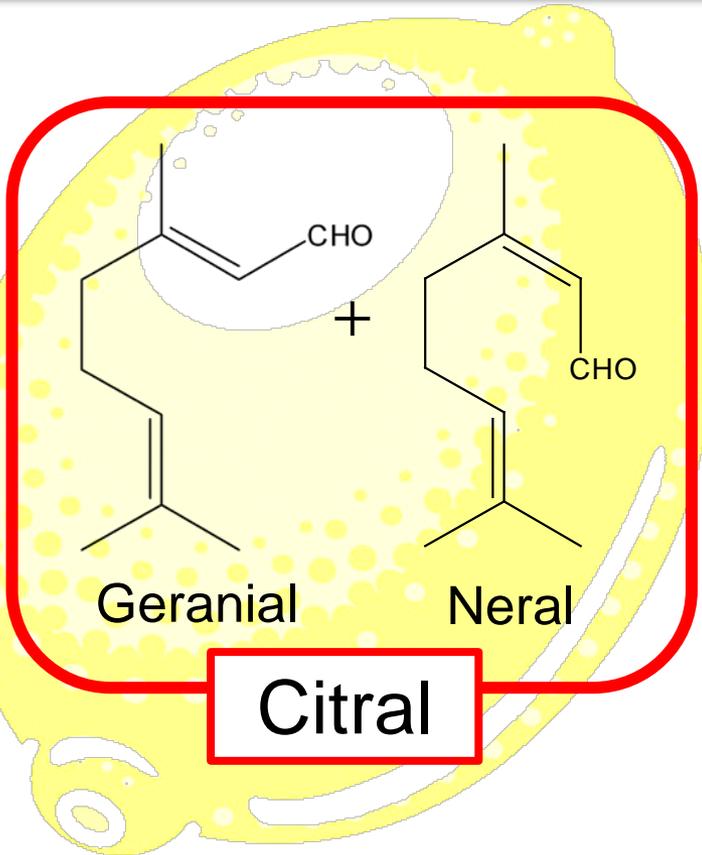
p-Methylacetophenone
(bitter-almond-like)



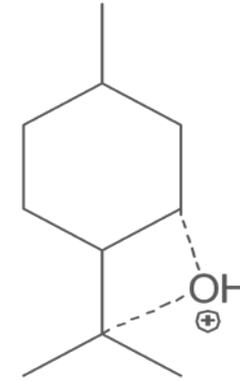
p-Cresol
(phenolic)

Key flavor component "citral"

Citral is instable in beverages and converts into off-flavors



Cyclization
in acid condition
(pH of RTD: 3.0~3.5)



Antioxidants

Oxidation etc.



p-Cymene
(gasoline-like)

p-Methylacetophenone
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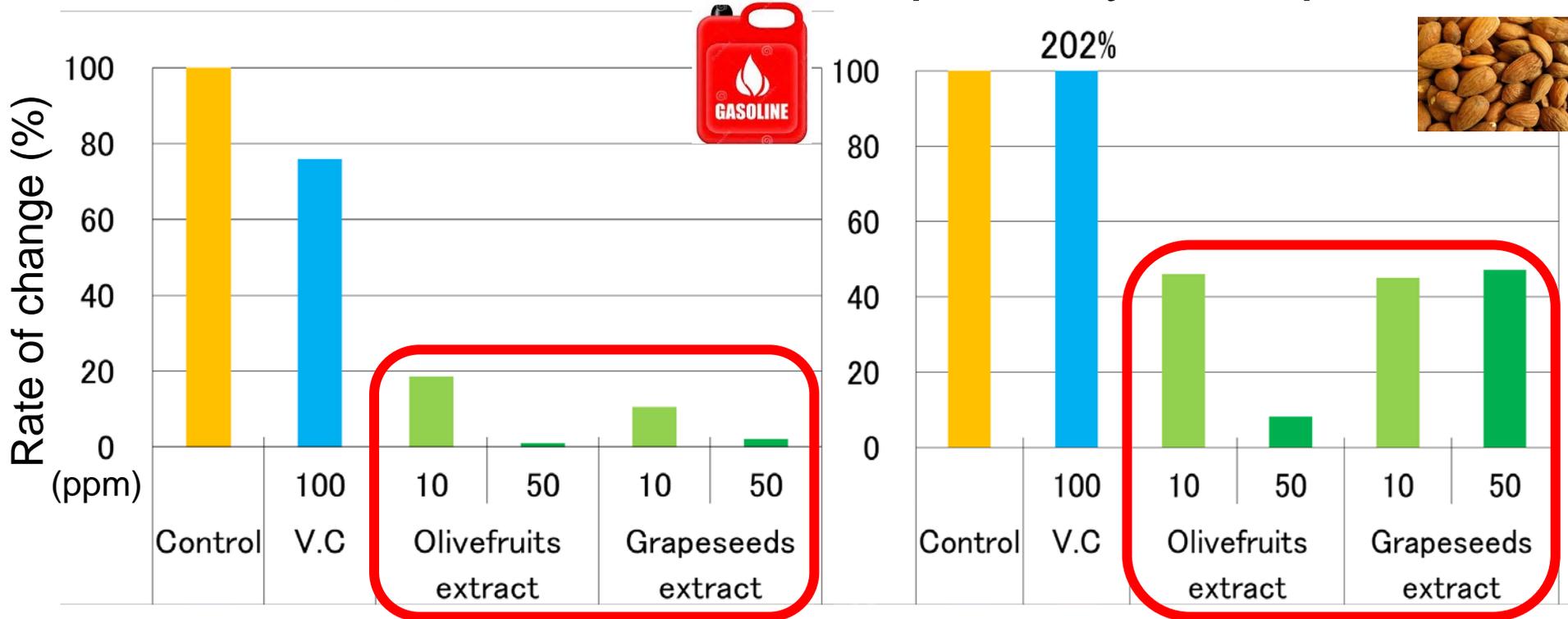
p-Cresol
(phenolic)

Result ① off-flavor formation

Some plant extracts were found to have an inhibitory effect on off-flavor generation

□ *p*-Cymene □

□ *p*-Methylacetophenone □



Rate of change : off-flavor generation without antioxidants =100

Mogitate

We developed “Mogitate” by using new methods



Strengthen freshness



Methylheptenone

Maintain freshness



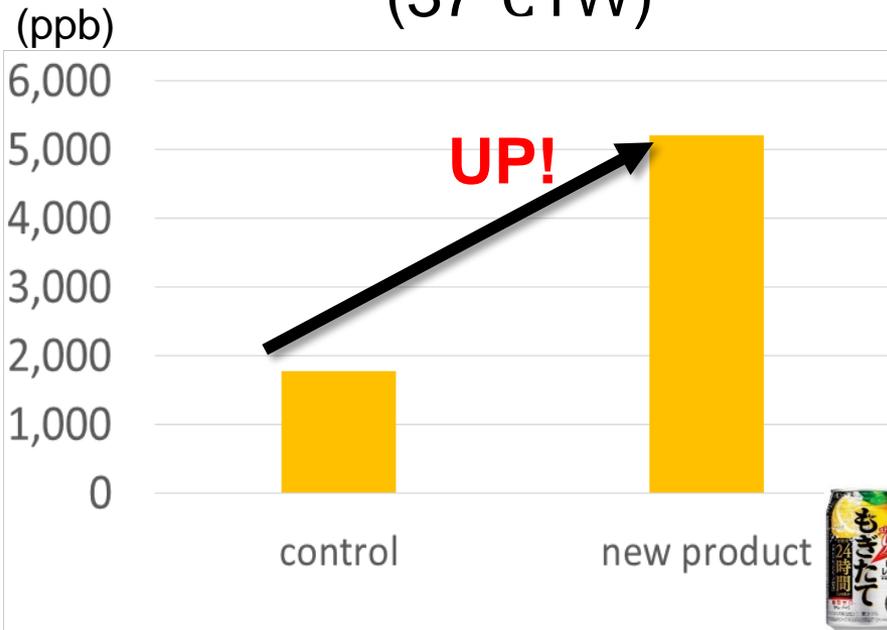
Antioxidants

Result ② effect on freshness

“Mogitate” maintains the fresh feeling even after storage

□ Citral □
(37°C1W)

□ Off-flavors □
(37°C1W)



■ Citral
(threshold:170ppb)

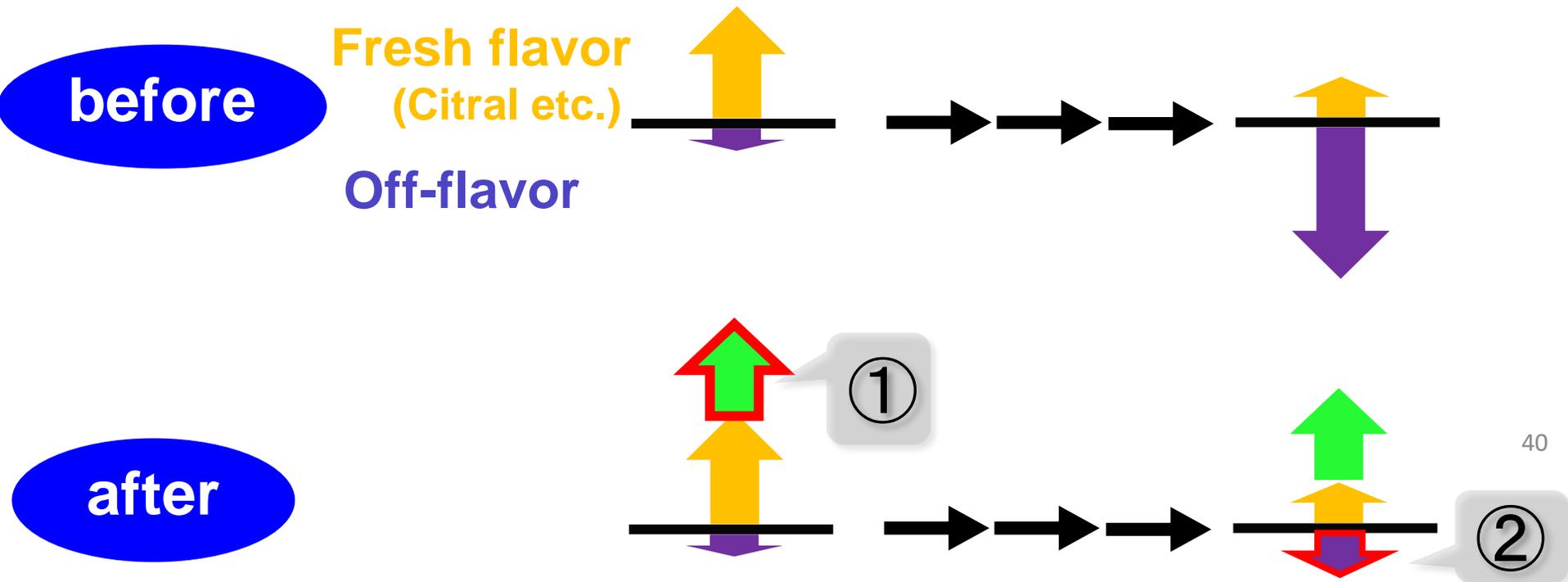
■ *p*-Cresol
■ *p*-Methylacetophenone
■ *p*-Cymene

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Summary

- We pursued needs for RTD's consumer, and found that is "fresher feeling of fruit juice"
- We developed new RTD by new methods of
 - ① usage of flavor components to strengthen freshness
 - ② antioxidants usage to prevent citrus off-flavor formation



Threshold

Flavor component	Threshold (ppb)
Citral	20
Methylheptenone	Less than 100
<i>p</i> -Cymene	130
<i>p</i> -Methylacetophenone	22
<i>p</i> -Cresol	20

Polyphenol materials

Extracts	primary ingredient
Bilberry	Procyanidin
Sweet tea	Ellagitannin
Olive fruits	Hydroxytyrosol Verbascoside
Red wine mash	Procyanidin
Grapeseeds	Procyanidin

CATA and QDA(Quantitative Descriptive Analysis)

	CATA	QDA
Training	unnecessary	necessary
Intensity	no measure	measure
Number of panels	More than 40	More than 7 □ 10

SBSE(Stir Bar Sorptive Extraction)

□Pre-treatment□

- Sample 1.0g + 10ppm internal standard (linalool-d5) 200 μ l
→ × 50 dilution
- Adsorption reaction with (40 °C 2hour)

【GC-MS】

<device>

- **Programmed Temperature Vaporizing Injection Port** (CIS4, Gerstel社製)
- Thermal Desorption Unit (TDU, Gerstel)
- GC System(7890B, Agilent Technologies)
- Mass Selective Detector(5977, Agilent Technologies社製)

<condition of injection>

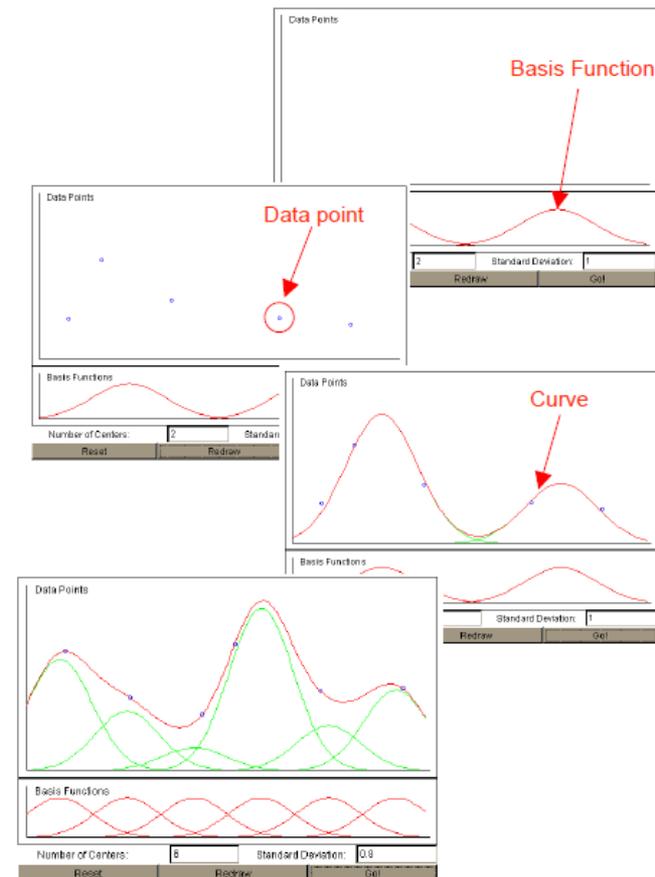
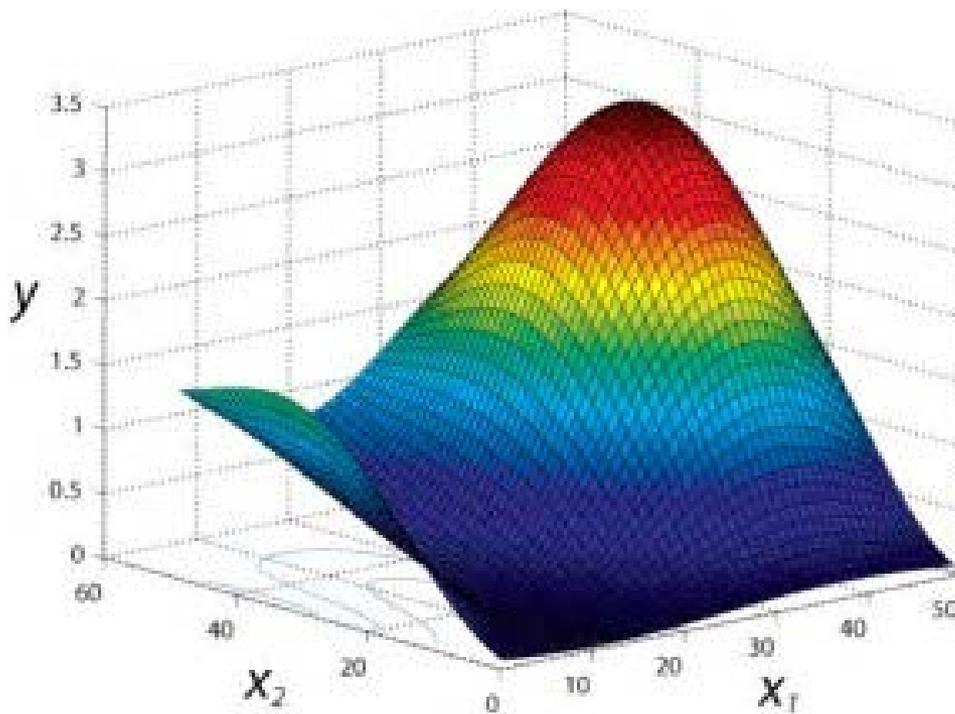
- TDU: 20 °C(1 min) - (720 °C / min) - 250 °C(3 min)
- CIS: -50 °C(1.5 min) - (12°C / sec) – 240 °C(45 min)

<condition of column>

- LTM column(1st:DB-WAX, 20 m × 0.18 mm; 0.3 μ m、2nd: DB-5, 10 m × 0.18 mm; 0.4 μ m, Agilent Technologies)
- 1st temperature: 40 °C(3 min) - (5 °C / min) – 180 °C(0 min)
- 2nd column temperature: 40 °C(31 min) - (5 °C / min) – 180 °C(0 min)

Response Surface Methodology (RSM)

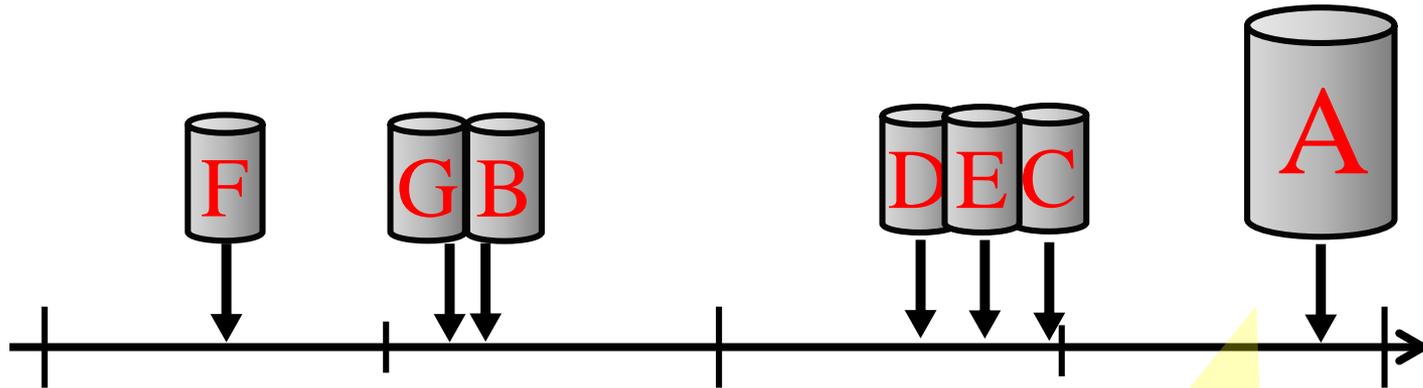
Response Surface Methodology (RSM) : modeling and analysis of programs in which a response of interest is influenced by several variables and the objective is to **optimize** this response.



Material

lemon-based RTD (prototype, commercial products) □ A~G

□ Ranking evaluation of Fresh feeling □



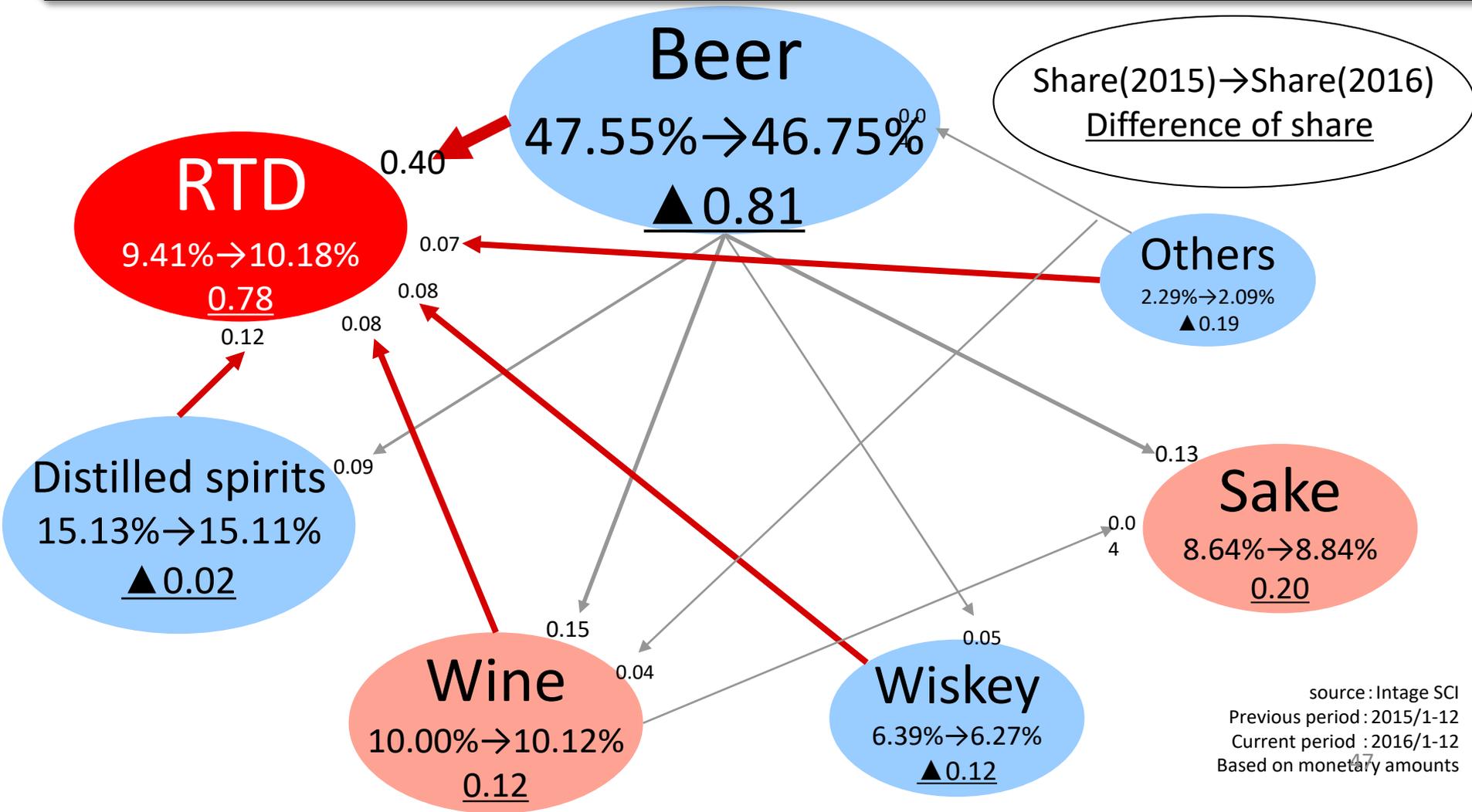
The most fresh
Prototype

□ evaluation item: fresh feeling of lemon juice

□ n=8

Flow of alcohol categories share

RTD market is growing because of inflow from beers, distilled spirits, wine and whiskey. 各カテゴリーからまんべんなくきている



source: Intage SCI
Previous period: 2015/1-12
Current period: 2016/1-12
Based on monetary amounts