



2015 ASBC Annual Meeting

June 14–17, 2015

La Quinta Resort and Club

La Quinta, CA



What compound is primarily responsible for the metallic flavor in beer?

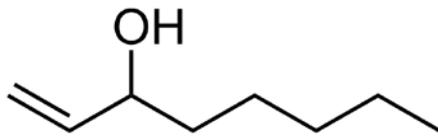
Norio Doi, Minoru Kobayashi, Susumu Masuda, Masayuki Aizawa
ASAHI BREWERIES Ltd., Ibaraki, Japan

Outline

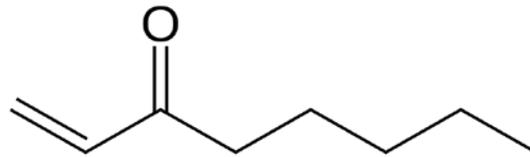
- **Introduction**
- **Metallic flavor in beer**
- **Metallic flavor when eaten together with food and beer**
- **Summary**

What causes metallic flavor?

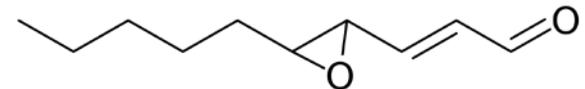
Several compounds have been reported to cause a metallic flavor in alcoholic beverages.



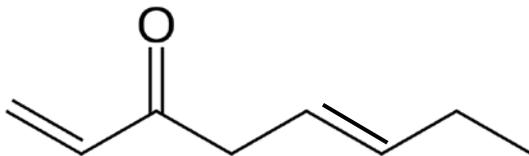
1-octen-3-ol



1-octen-3-one



4,5-epoxy-2-decenal



1,5-octadien-3-one

J. Agric. Food Chem., 59, 3264–3272, 2011

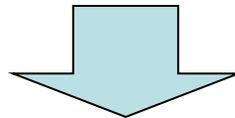
J. Brew. Soc. of Japan, 101, 957–963, 2006

What compound is primarily responsible?

No paper has identified the main compound.

Because;

- There are many metallic-tasting compounds in beer.**
- Several are highly reactive target compounds.**
- The very low concentrations of these compounds in beer are sufficient to produce a metallic taste.**



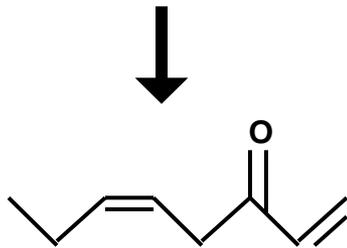
It is difficult to compare the concentrations of these compounds in beer.

What is the precursor ?

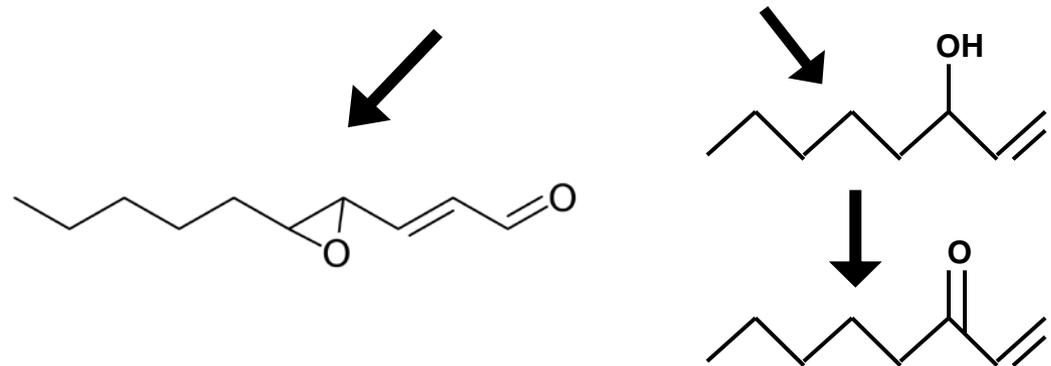
There are several precursors to metallic flavor.



ω -3 fatty acids



ω -6 fatty acids



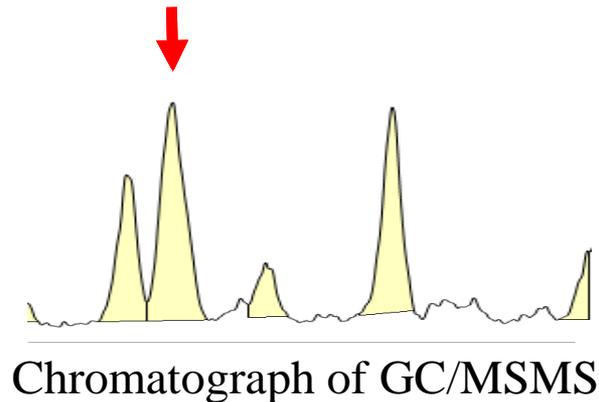
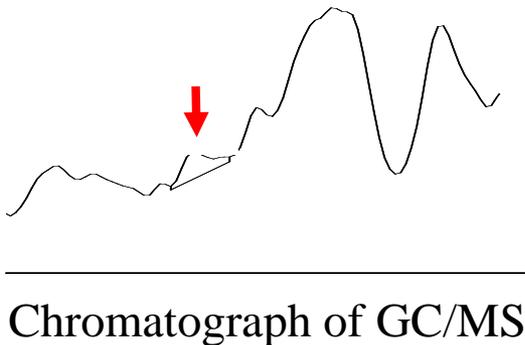
Identifying the primary responsible compound is very important for controlling the concentrations of these precursors!

How to achieve it ?

A higher resolution and more sensitive GC/MS detection method is required.

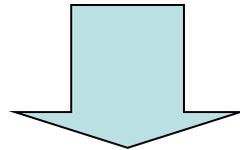
Approaches

- high resolution and highly sensitive detection using GC/NCI-MSMS.
- calculate the number of flavor units in each compound



Metallic flavor in beer with/without food

- 1) Beer alone sometimes provides a metallic flavor.**
- 2) Drinking beer while eating can also give a metallic taste.**



The aim of this study is to identify the compounds primarily responsible in both cases.

Metallic flavor in beer

GC/Olfactometry analysis

Sample preparation

- Beer sample (350 ml) was extracted with ethyl acetate.
- Concentrated to 1 ml with nitrogen gas purge.

Retention Index (DB-Wax)	Compound	Odor
1296	1-octen-3-one (OEO)	metallic/mushroom
1369	1,5-octadien-3-one (ODO)	metallic/mushroom
1987	4,5-epoxy-2-decenal (Epoxydecenal)	metallic

Threshold concentration of these compounds in beer:

Establishing orthonasal /retronasal thresholds

1) Orthonasal threshold:
drink beer **without** lid



2) Retronasal threshold:
drink beer **with** lid



Threshold concentrations in beer

Compound	Orthonasal threshold (ppt)	Retronasal threshold (ppt)
OEO	2.6	1.1
ODO	0.4	0.4
Epoxydecenal	59	11

GC/MSMS analysis

beer samples(100ml)



C18 solid phase extraction



(ODO/OEO)



PFBOA derivatization



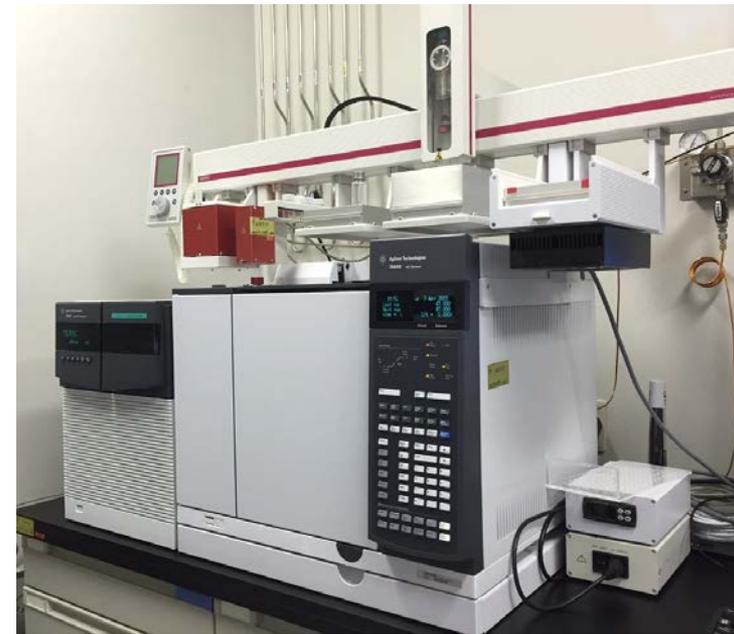
GC/NCI-MSMS



(Epoxydecenal)



SPME-GC/NCI-MS

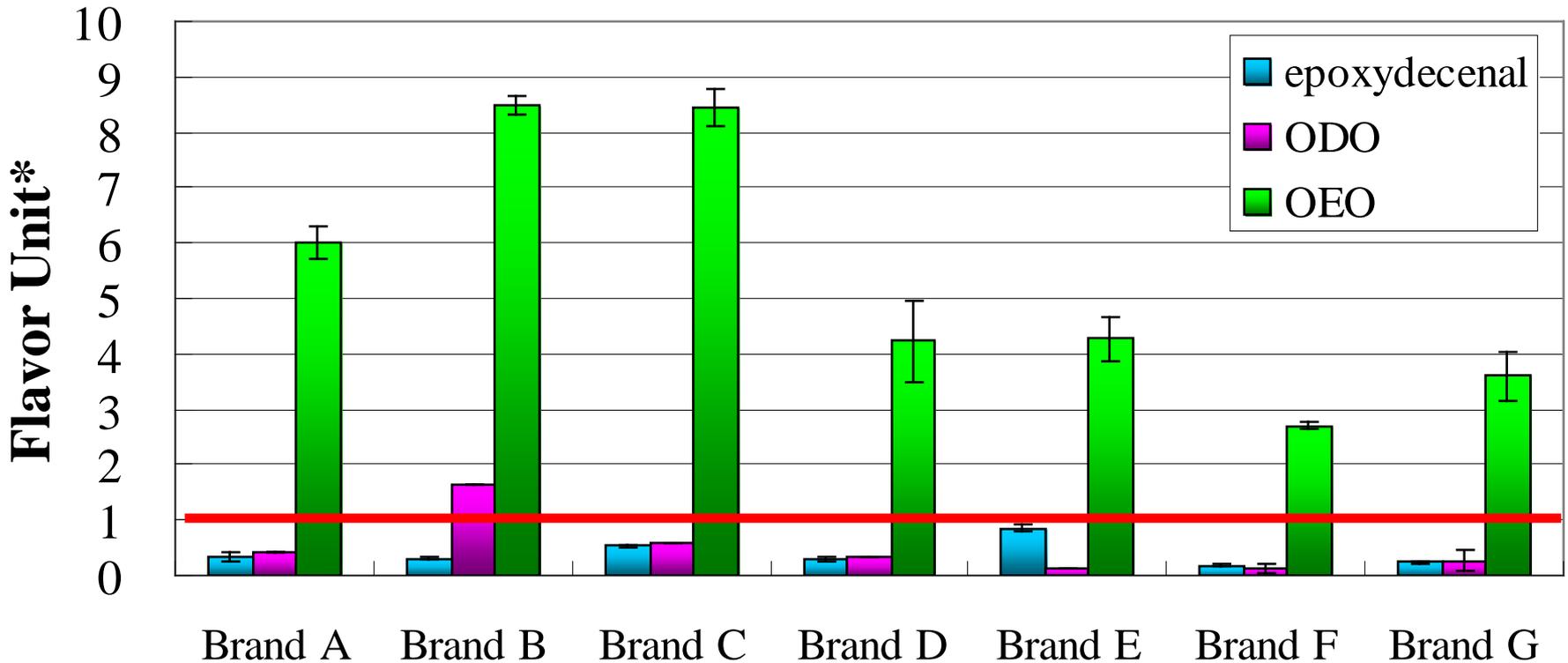


Highly sensitive GC/MSMS

Flavor unit* of each compound in beer

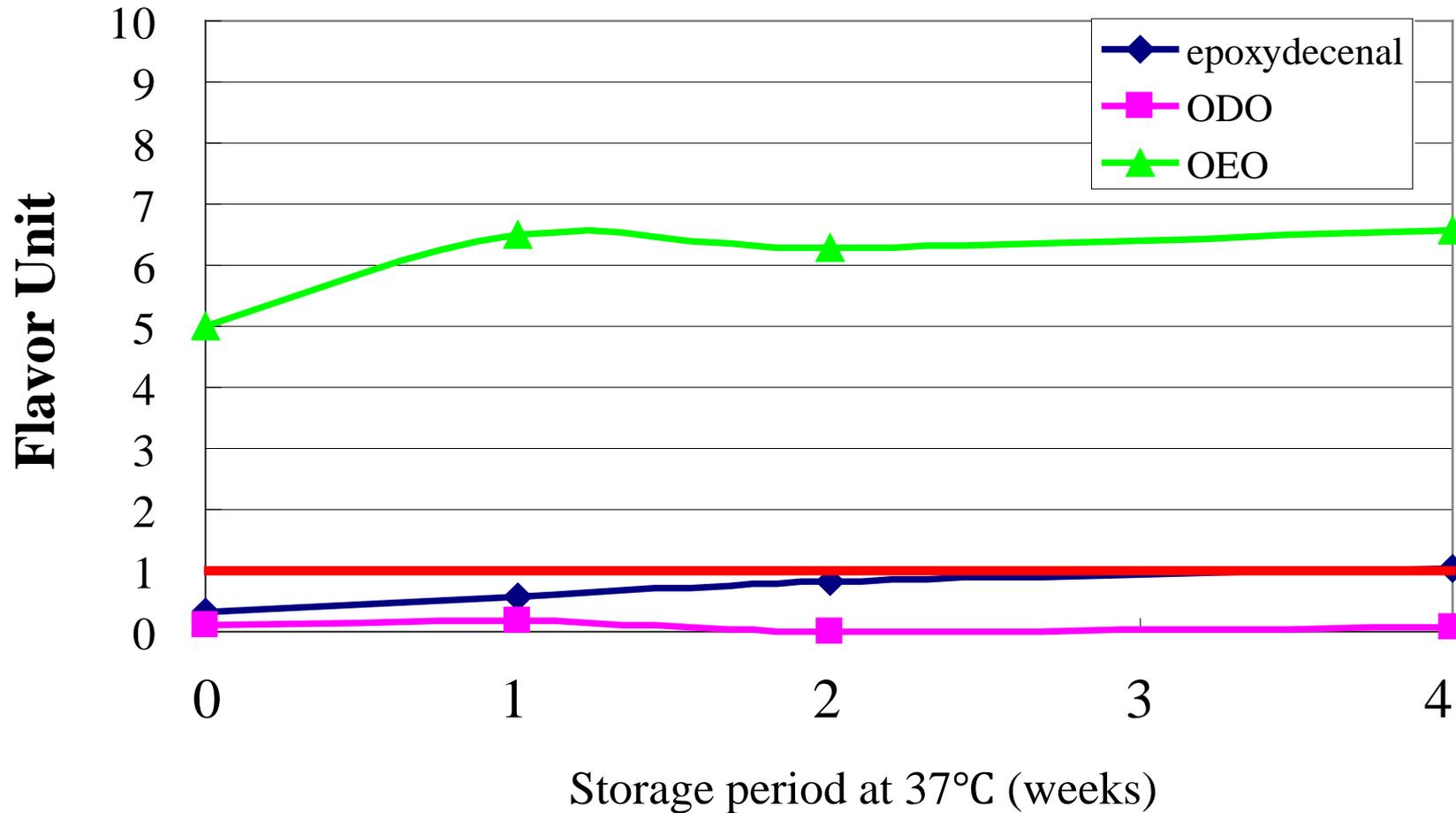
Samples

Japanese commercial beers contained all malt beers and low malt beers



(*)Flavor Unit = concentration/threshold

Changes in concentration of metallic compounds during beer storage



Short summary

- 1) We achieved a high resolution and highly sensitive analysis of compounds that impart a metallic flavor to beer.**
 - 2) The metallic flavor is sensed mainly through retronasal olfaction.**
 - 3) GC/O analysis identified 3 compounds responsible for metallic flavor: epoxydecenal, ODO, OEO.**
 - 4) Of these, OEO exhibits the highest number of flavor units.**
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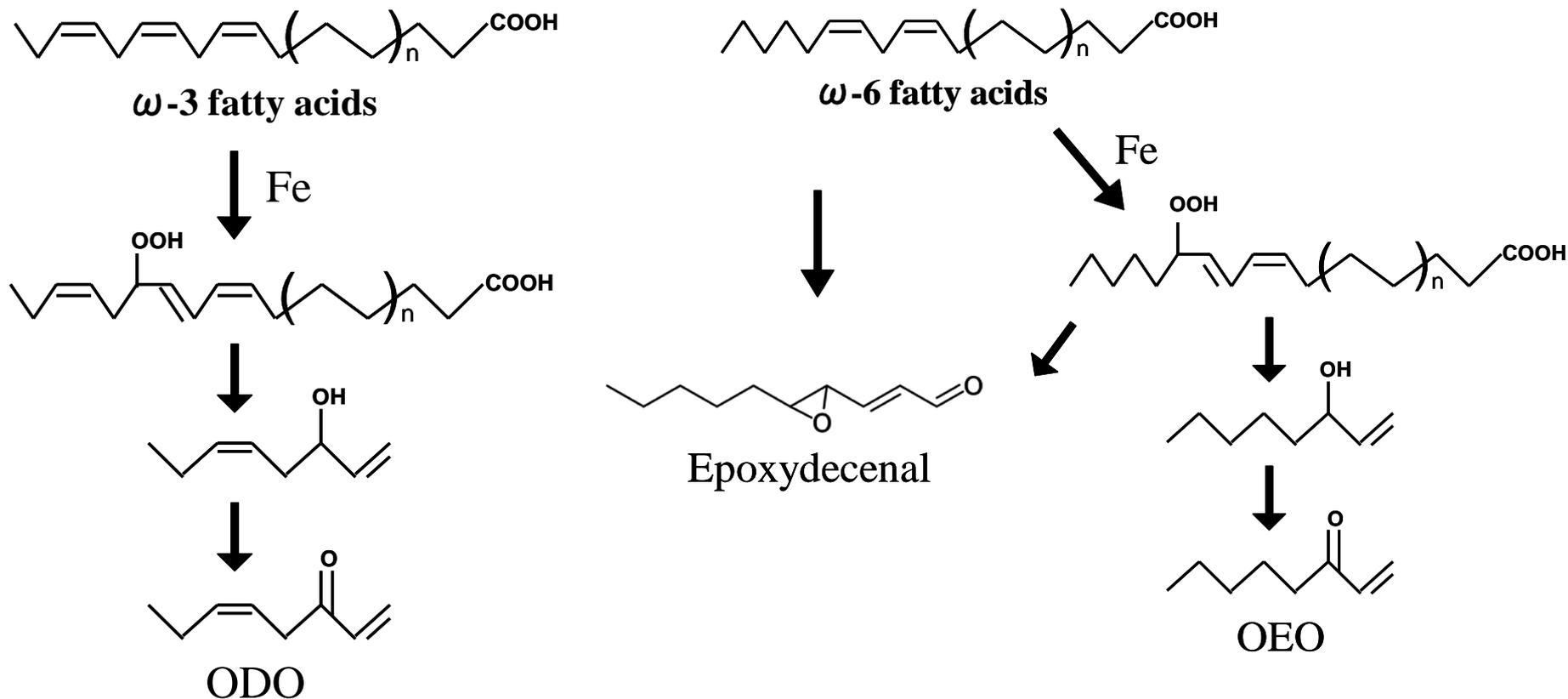
Metallic flavor when food and beer are enjoyed together

Pairing of beer and seafood

The pairing of alcoholic beverages like beer or wine with seafood can give a metallic flavor.



Synthetic pathways for metallic compounds



Aroma research, 4, 2003

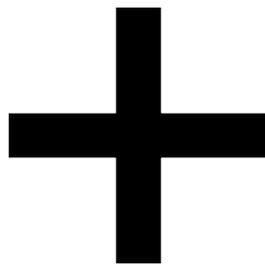
GC/MS analysis of metallic compounds

Sample preparation

- Put 2g of dried calamari into the mouth (did not swallow).
- Put 35g of beer into the mouth and chew 10 times.
- Spat out the beer and calamari and filtered.
- Repeated the procedure and collected 100ml of beer sample.

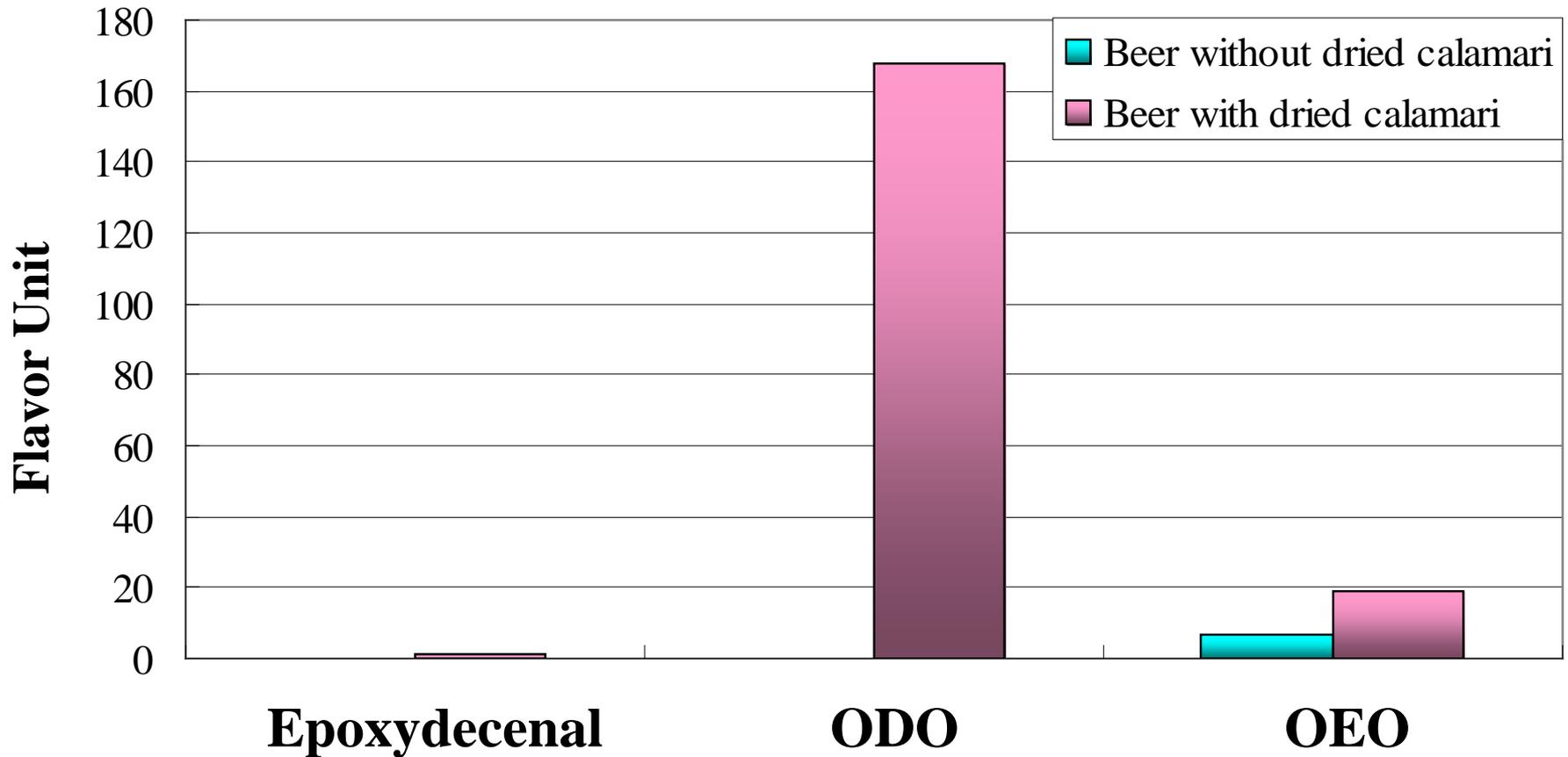


Beer

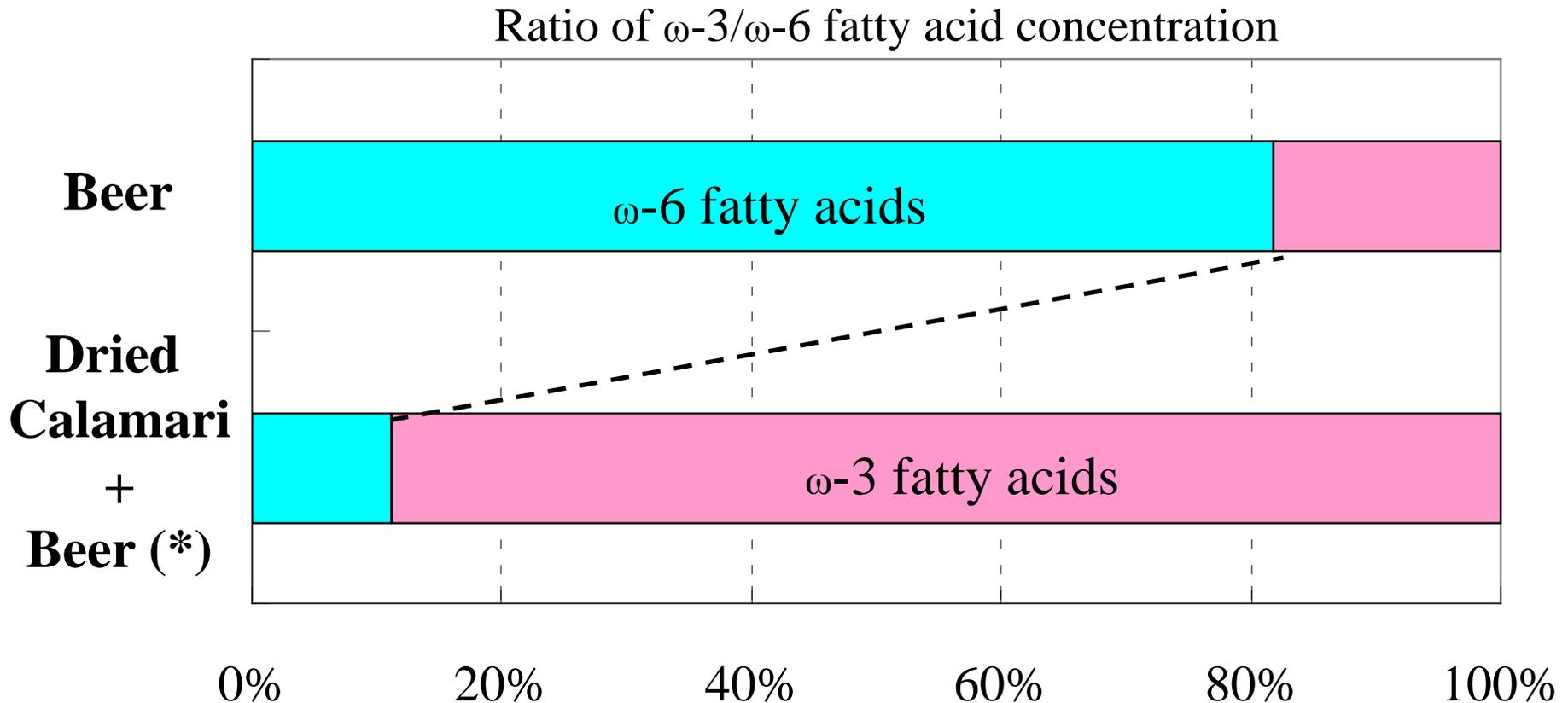


Dried calamari

Comparison of flavor units for metallic compounds



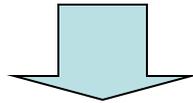
The ratio of fatty acids changes when beer and dried calamari are paired



(*)Ratio was calculated from 10g of dried calamari and 100g of beer.

‘The marriage of food and beer’

Our method for analyzing the source of metallic flavor is applicable to beer, and beer with food.



We can improve the quality of beer and propose good ‘marriage for beer’ by analyzing metallic flavor!



Summary

- 1) We achieved high resolution, highly sensitive analyses of compounds that impart a metallic flavor to beer.**
- 2) OEO is the primary compound responsible for metallic flavor when beer is consumed alone.**
- 3) ODO is the primary compound responsible for metallic flavor when seafood and beer are enjoyed together.**

Thank you for your kind attention!!

The Asahi logo is rendered in a bold, blue, italicized sans-serif font. The letters are closely spaced and have a slight shadow effect, giving it a three-dimensional appearance.

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The Science of Beer