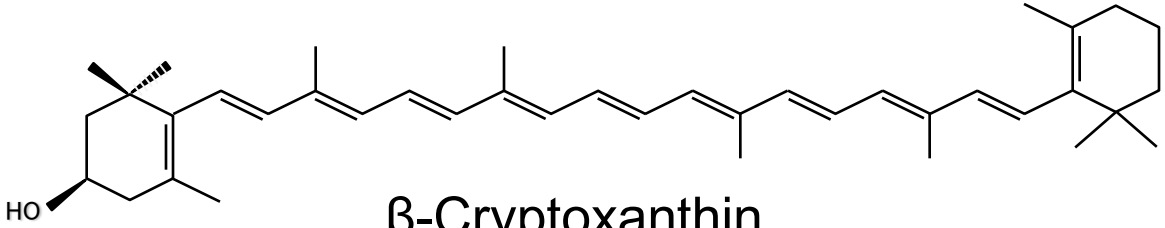
β-Cryptoxanthin prevents lifestyle-related diseases?

- Findings from the recent nutritional epidemiologic survey -

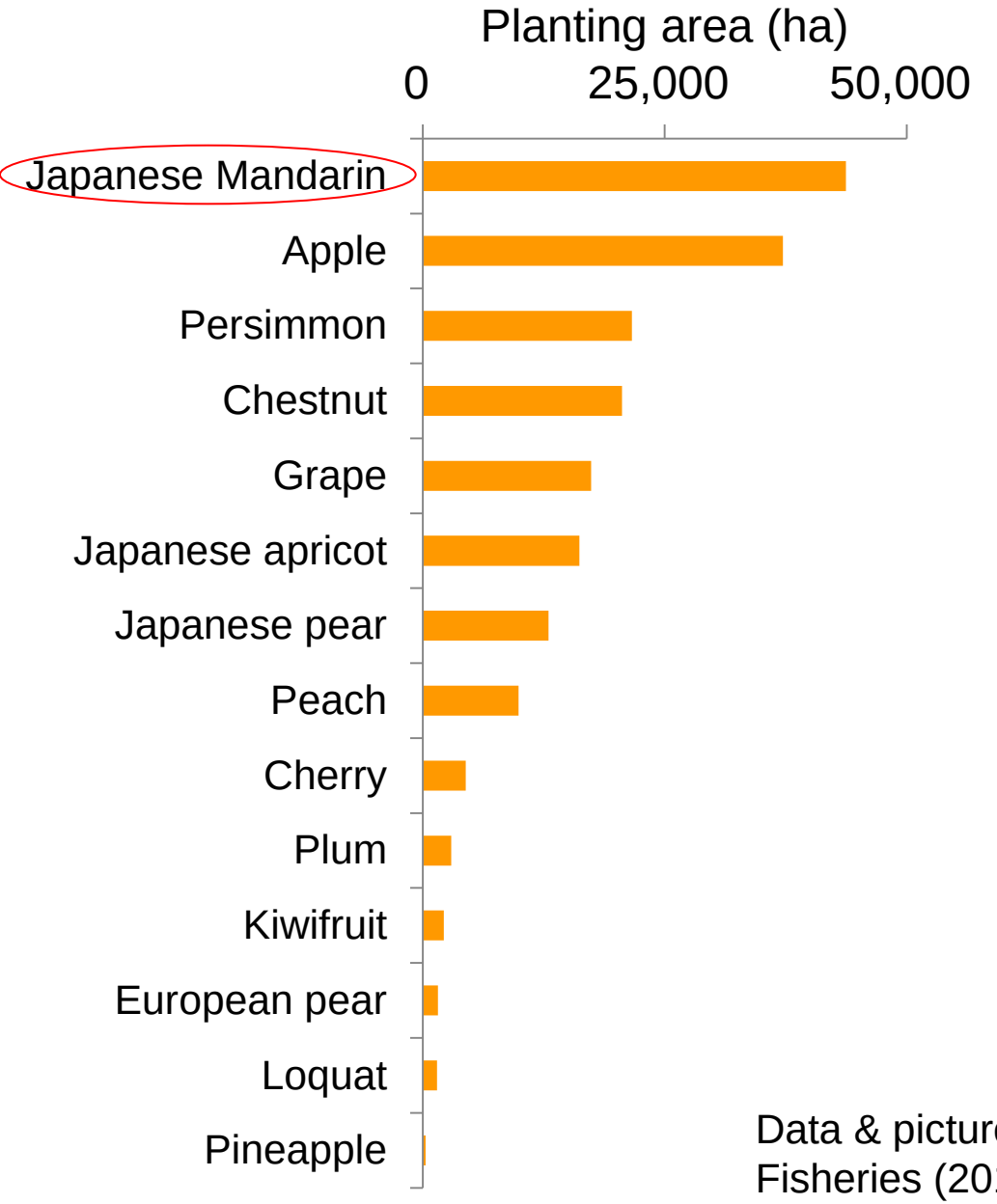


β-Cryptoxanthin

Naoko KOZAI, Tatsushi OGATA and Minoru SUGIURA

Japan International Research Center for Agricultural Sciences, Japan
NARO Institute of Fruit Tree Science, Japan

Fruit production in Japan



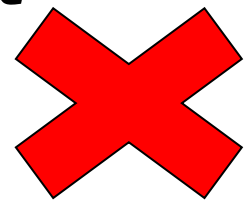
Japanese mandarin orange (*C. unshiu*) is the most popular fruit in Japan

Data & picture source: Ministry of Agriculture, Forestry and Fisheries (2013)

In Japan…

- ***Japanese fruit is very sweet***

  ‘Fruit is high-calorie food!’



- ***Fruit contains much fructose***

  ‘High intake of fruit causes hyperlipidemia or diabetes!’

Does high intake of fruit cause obesity, hyperlipidemia, or diabetes?

‘Does high intake of fruit cause obesity, hyperlipidemia, or diabetes?’

To test this hypothesis, we undertook the simple questionnaire survey.

Subjects:

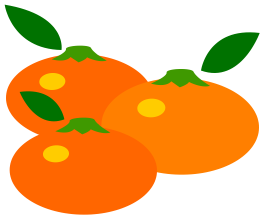
General consumer who lives in the area with one of the highest Japanese mandarin consumption levels in Japan.

Questions:

Age, sex, height, weight, frequency of mandarin eating (in season), and the history of disorders.

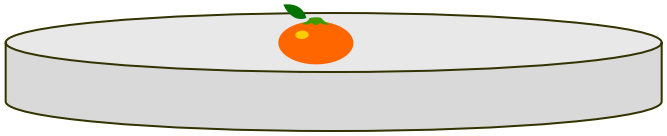
A total of 6,049 responses were obtained.

(2,118 male and 3,931 females)

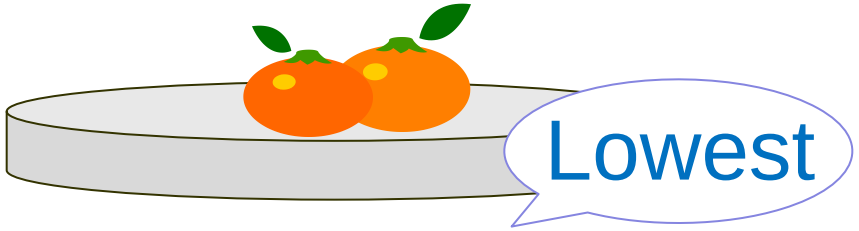


Japanese mandarin eater

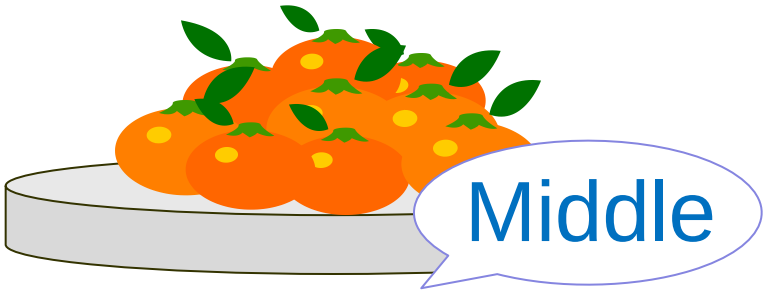
Frequency of mandarin intake (in season, Oct - Feb)



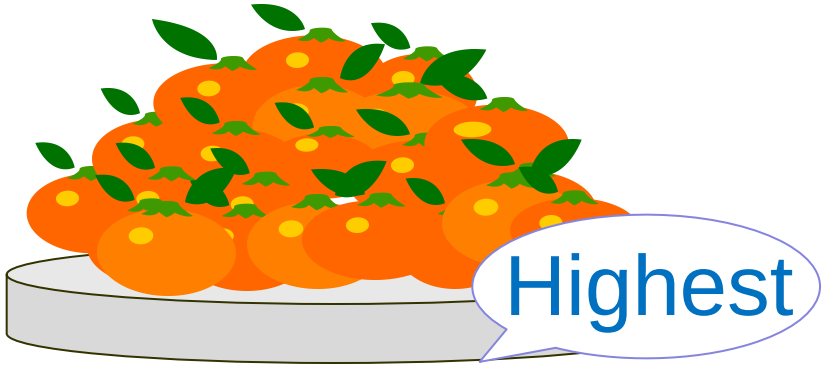
Ⅰ：Rarely eat
(2.7%)



Ⅱ：Less than 3 fruits / one week
(29.7%)

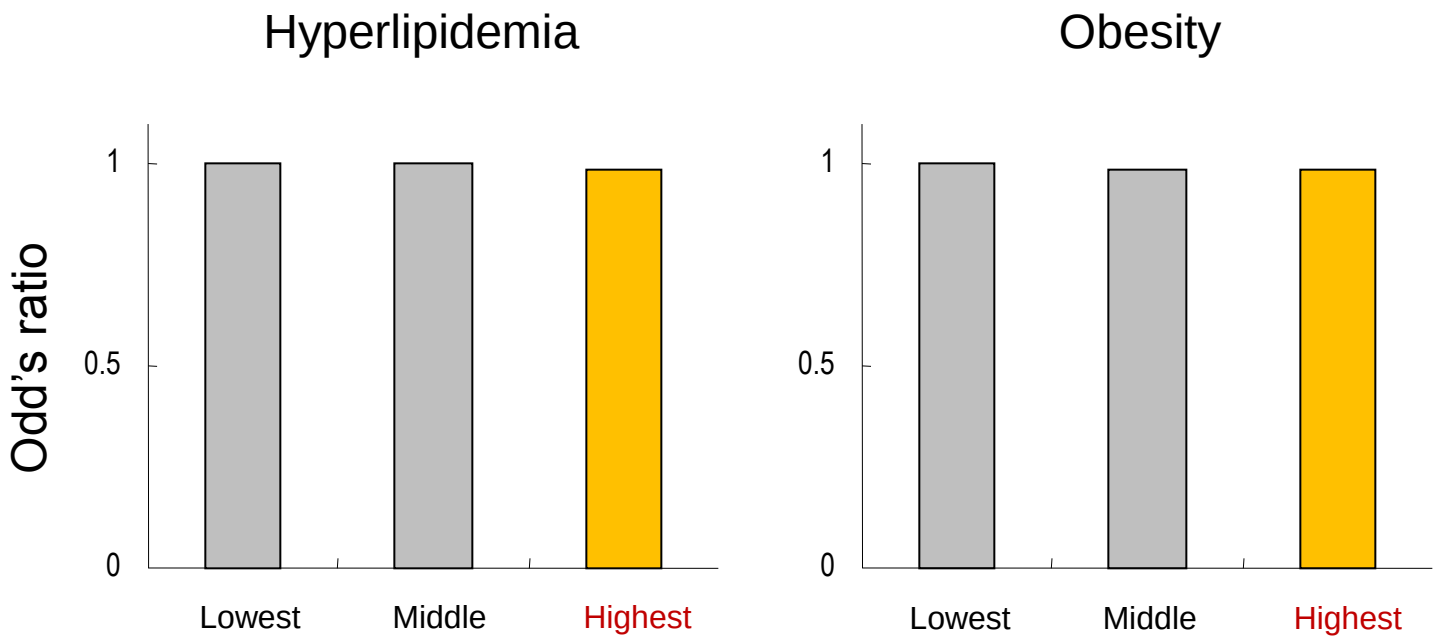


Ⅲ：1-3 fruits daily
(53.3%)



Ⅳ：More than 4 fruits daily
(14.3%)

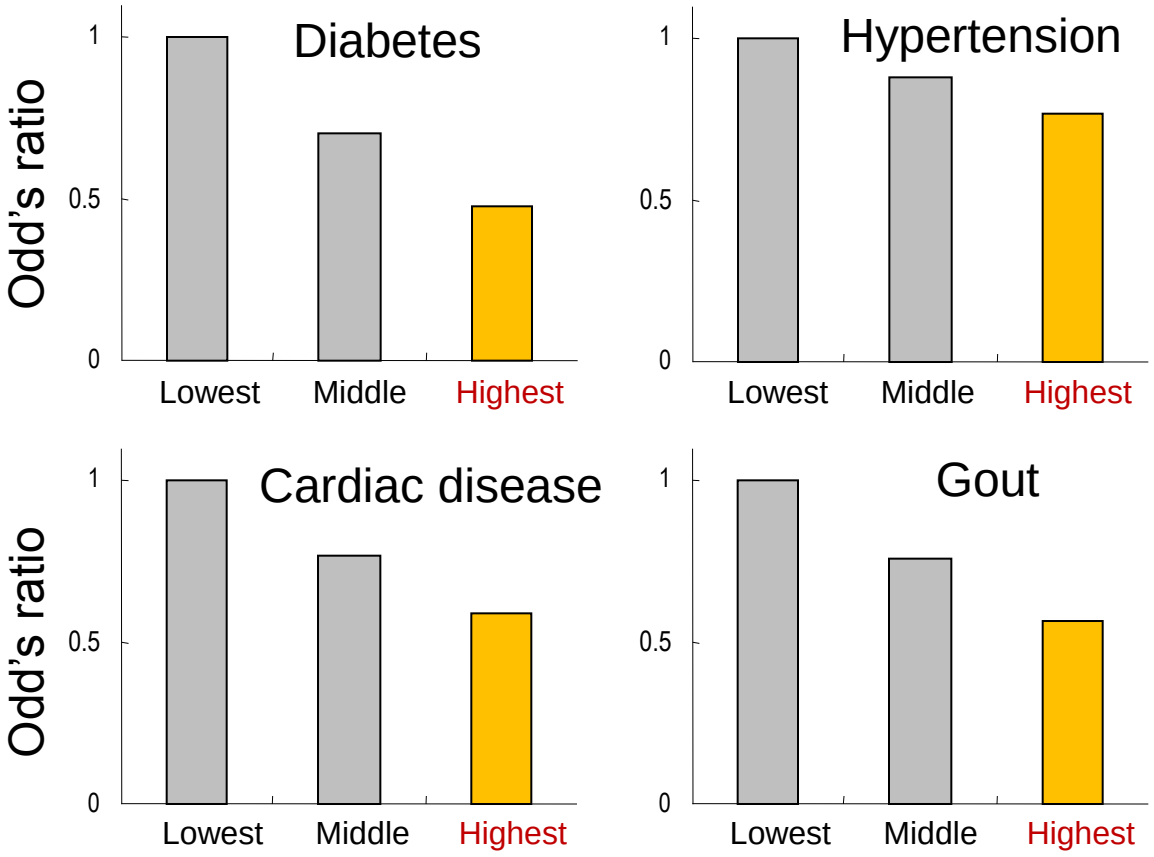
Results from the self-administered questionnaire survey



There were no relationship between mandarin intake and hyperlipidemia or obesity

Sugiura et al. ***J Health Sci*** 2002; 48: 366-369.

Results from the self-administered questionnaire survey



Low prevalence of lifestyle-related disease of big mandarin eater

Sugiura et al. ***J Health Sci*** 2002; 48: 366-369.

What ingredients are contained in Japanese Mandarin orange?

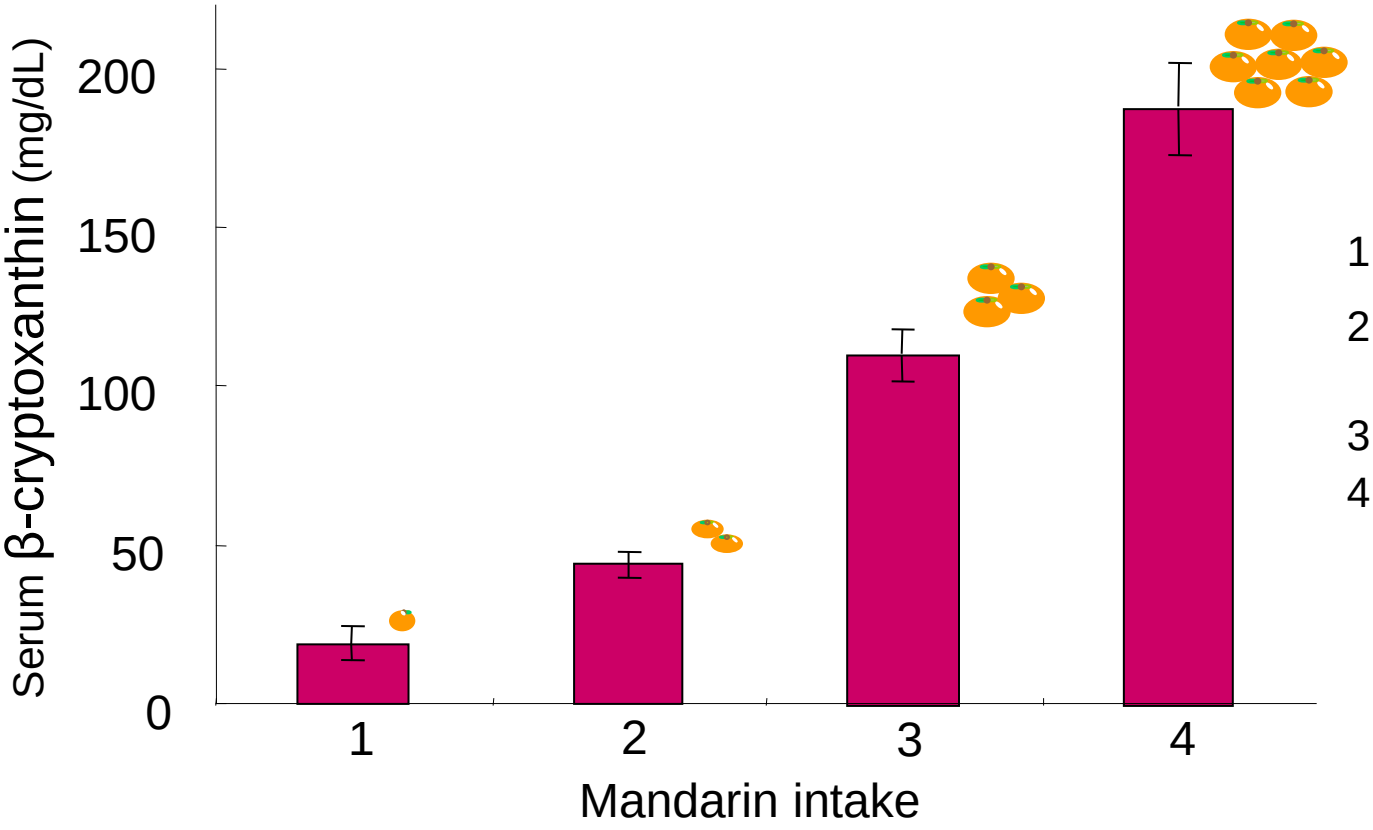
Ingredients

- Carbohydrate (Glucose, Sucrose, Fructose)
- Vitamins (Vitamin C, B_1, B_2, Folic acid)
- Citric acid
- Carotenoids (β-Cryptoxanthin, β-Carotene)
- Minerals (Potassium, calcium, iron)
- Fiber (soluble, insoluble)

New functional food factor ?

- Flavonoids (Hesperidin, Naringin)
- Limonoids (Limonin, Nomilin)
- Odorous constituents (D-Limonene, Linalool)

Serum β-cryptoxanthin level greatly increased according to an increase of Japanese Mandarin intake



1: rarely

2: less than 3 per one week

3: 1-3 daily

4: more than 4 daily

Sugiura et al. ***J Health Sci*** 2002; 48: 350-353.
Sugiura et al. ***J Nutr Sci Vitaminol*** 2004; 50: 196-202.

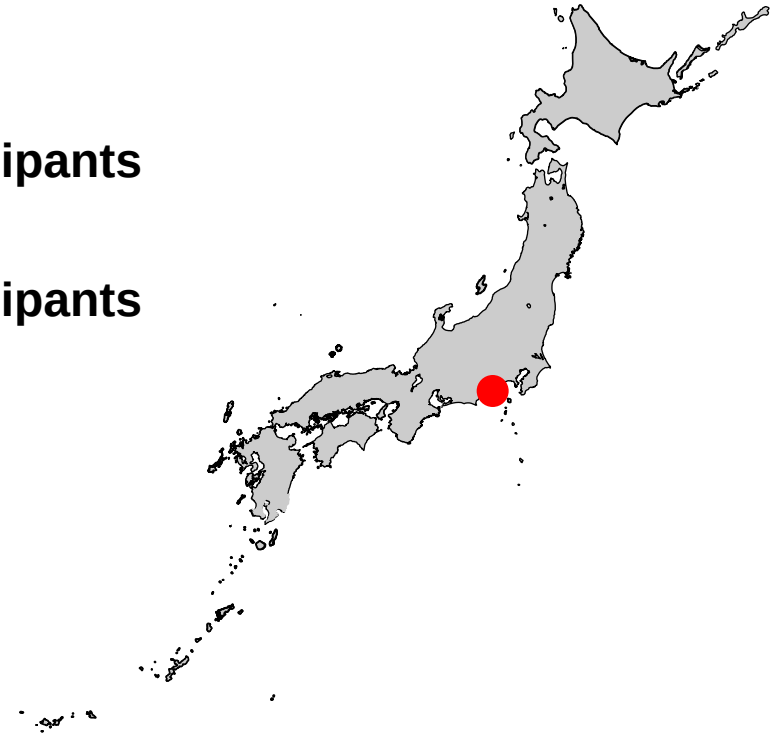
β-*cryptoxanthin with the risk of lifestyle-related diseases*

Recent nutritional epidemiologic findings

Nutritional Epidemiologic Survey: Mikkabi Study

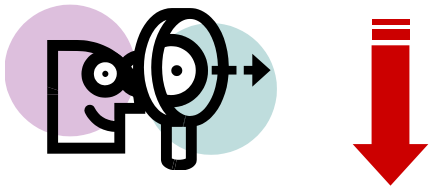
Population

The study utilized data derived from health examination of inhabitants aged from 30 to 70 years performed in the town of Mikkabi in Shizuoka Prefecture, Japan.



Research Schedule

2003 Baseline survey (Cohort 1) 886 participants
2004 Follow-up survey
2005 Baseline survey (Cohort 2) 701 participants
2006 Cohort 1 survey
2007 Follow-up survey
2008 Cohort 2 survey



2013 Cohort 1 survey
2015 Cohort 2 survey

Cohort 1
Diabetes, Atherosclerosis, Liver dysfunction survey

Cohort 2
Osteoporosis, Metabolic syndrome survey

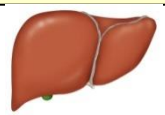
From the Mikkabi Study…

Serum β-cryptoxanthin with lower risk for…..

- **Liver dysfunction**
  - Alcohol-related increased serum gamma-GTP
  - Hyperglycemia-related increased serum ALT

Publications

J Epidemiol
15: 180-186 (2005)
Diabetes Res Clin Pract
71: 82-91 (2006)



- **Insulin resistance**
  - HOMA-IR estimated Insulin resistance

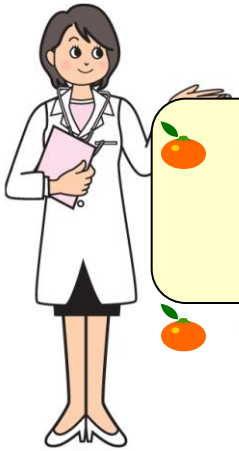
J Epidemiol
16: 71-78 (2006)

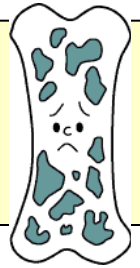
- **Arteriosclerosis**
  - Brachial-ankle pulse wave velocity

Atherosclerosis
184: 363-369 (2006)

- **Metabolic syndrome**
  - Interaction of smoking

Br J Nutr
100: 1297-1306 (2008)





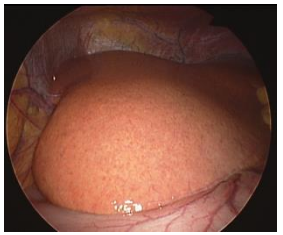
- **Osteoporosis**
  - Bone mineral density at radius

Osteoporosis Int
19: 211-219 (2008)
Osteoporosis Int
22: 143-152 (2011)
PLoS ONE
7: e52643 (2012)

- **Oxidative stress**
  - Induced by smoking and drinking

Br J Nutr
102: 1211-1219 (2009)

β-cryptoxanthin with the risk for liver dysfunction



High β-cryptoxanthin is inversely associated with serum γ-GTP in alcohol drinkers

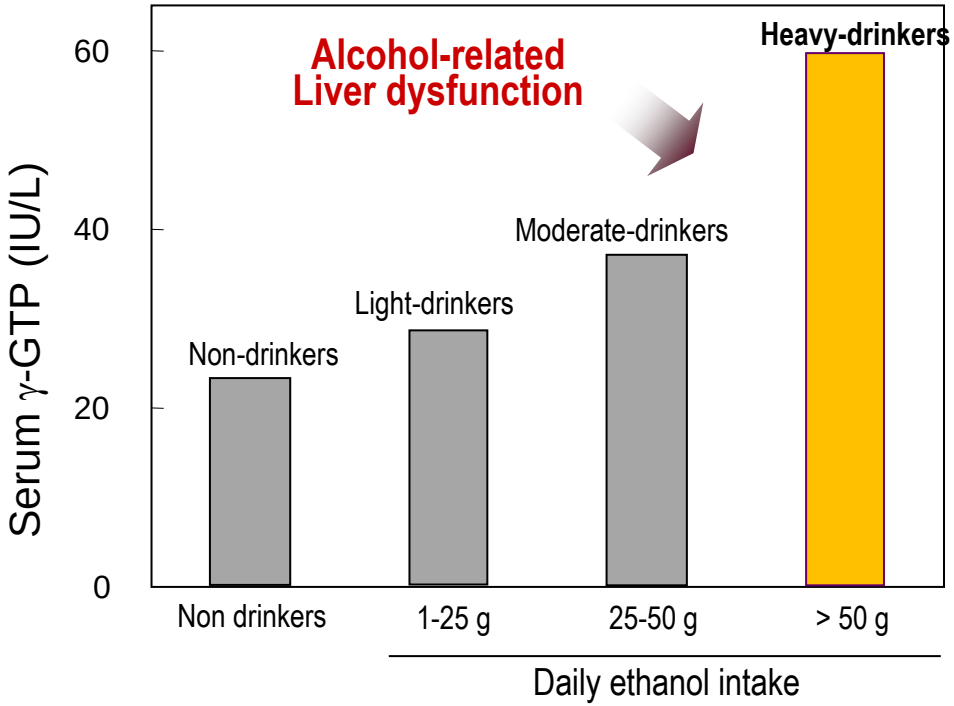
Excessive Alcohol Intake

↓

Generation of Free radical Species

↓

Liver Cell Damage



Serum ganma-GTP: gamma-glutamyltransferase

Specific indicator for alcohol liver disease

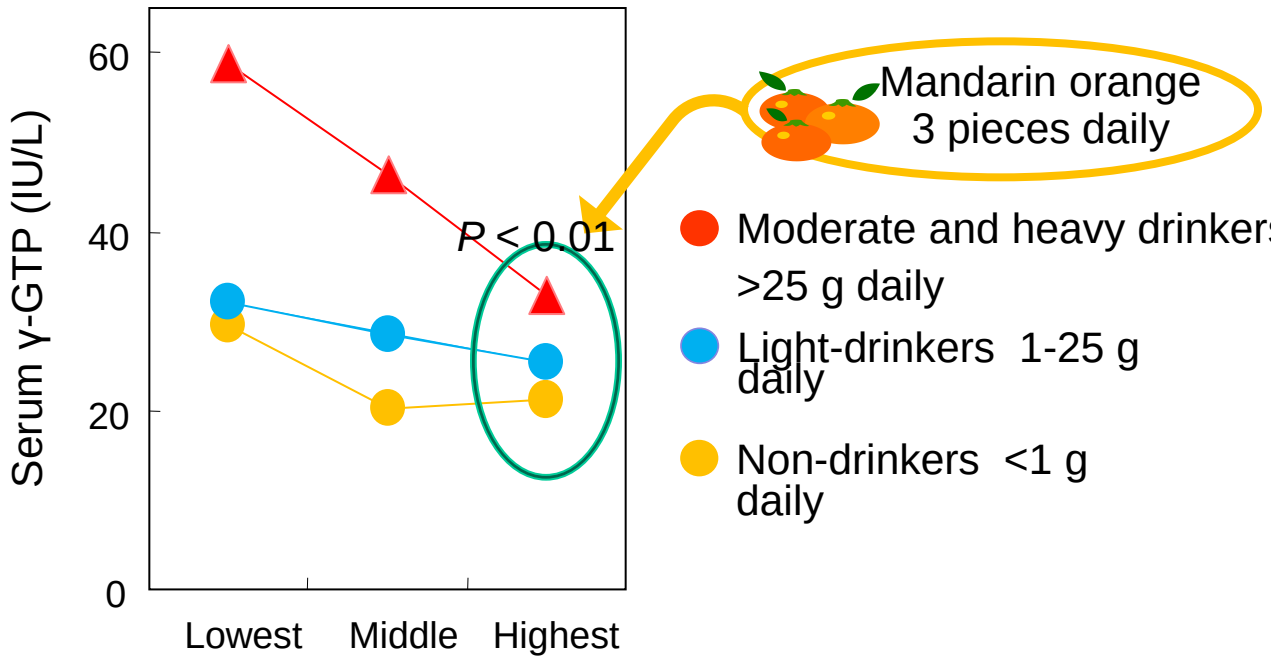
Alcohol 25 g = Whisky 80 mL

Confounding factors adjusted mean of serum γ-GTP

Confounding factors:

Age, BMI, total energy intake, smoking habits, etc.

These factors associate with serum γ-GTP level.



Sugiura *et al*. *J Epidemiol.* 2005; 15: 180-186.

β-cryptoxanthin may act as a suppressor against liver cell damage and may inhibit progression of liver dysfunction induced by alcohol.

High β-cryptoxanthin is inversely associated with serum aminotransferases in hyperglycemic subject

Diabetes (hyperglycemia)

↓

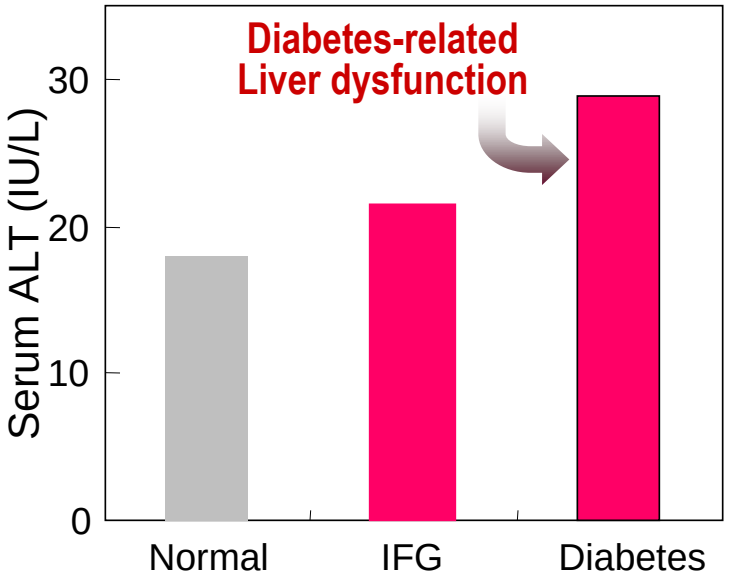
Glucose auto-oxidation

↓

Generation of Free radical Species

↓

Liver Cell Damage

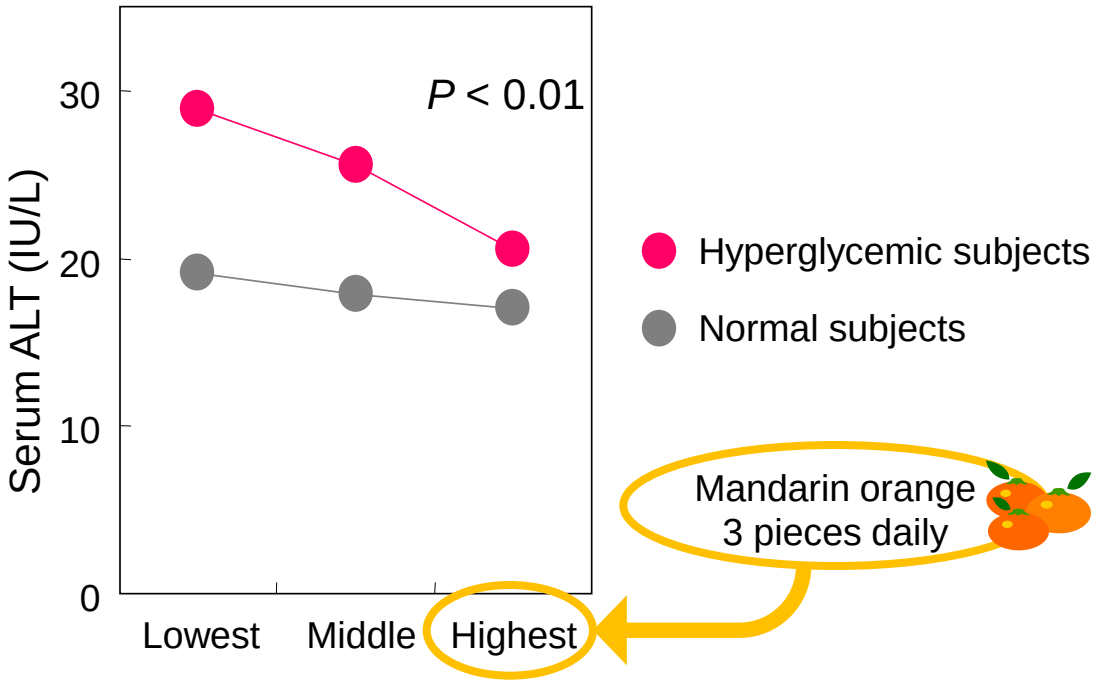


IFG: Impaired fasting glucose

Alanine aminotransferase (ALT):

Marker of liver dysfunction

Confounding factors adjusted mean of serum ALT



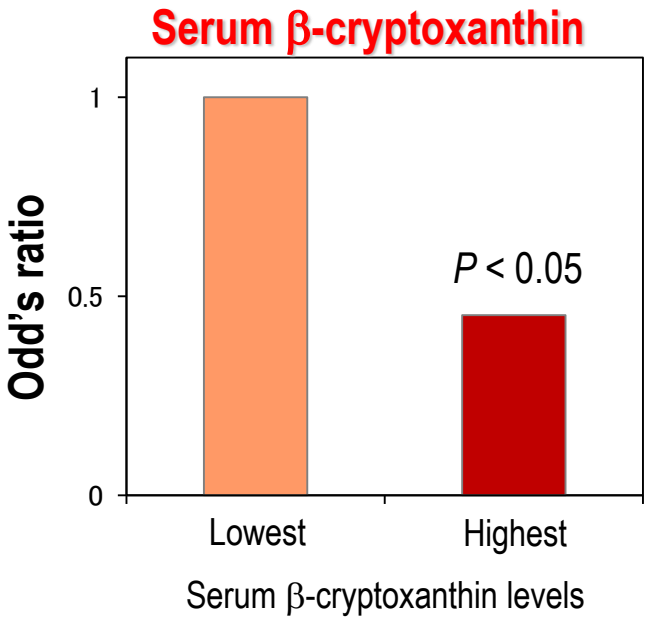
Tertile of serum beta-cryptoxanthin levels

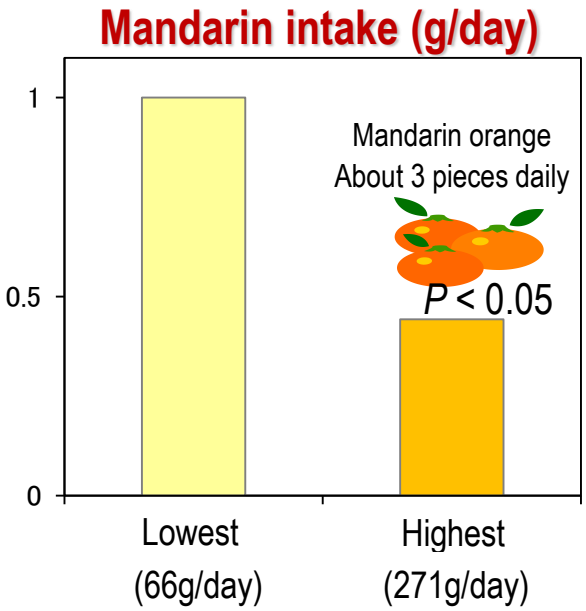
Sugiura et al. ***Diabetes Research and Clinical Practice*** 2006; 71: 82-91.

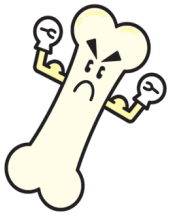
β-cryptoxanthin may act as a suppressor against liver cell damage in the earlier pathogenesis of liver dysfunction induced by hyperglycemia.

β-*cryptoxanthin with the risk for Osteoporosis*

Serum β-cryptoxanthin (mandarin intake) with the risk for osteoporosis



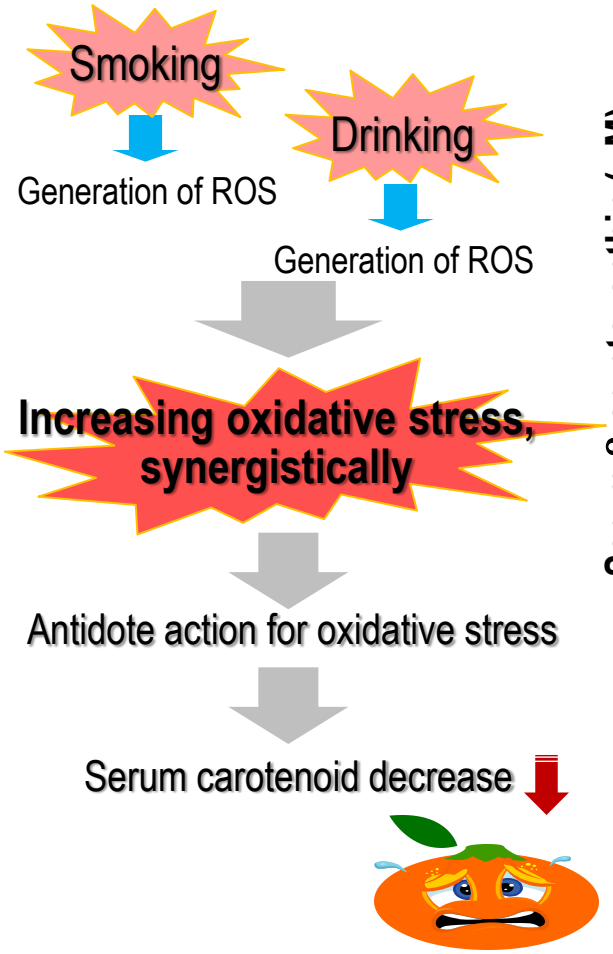




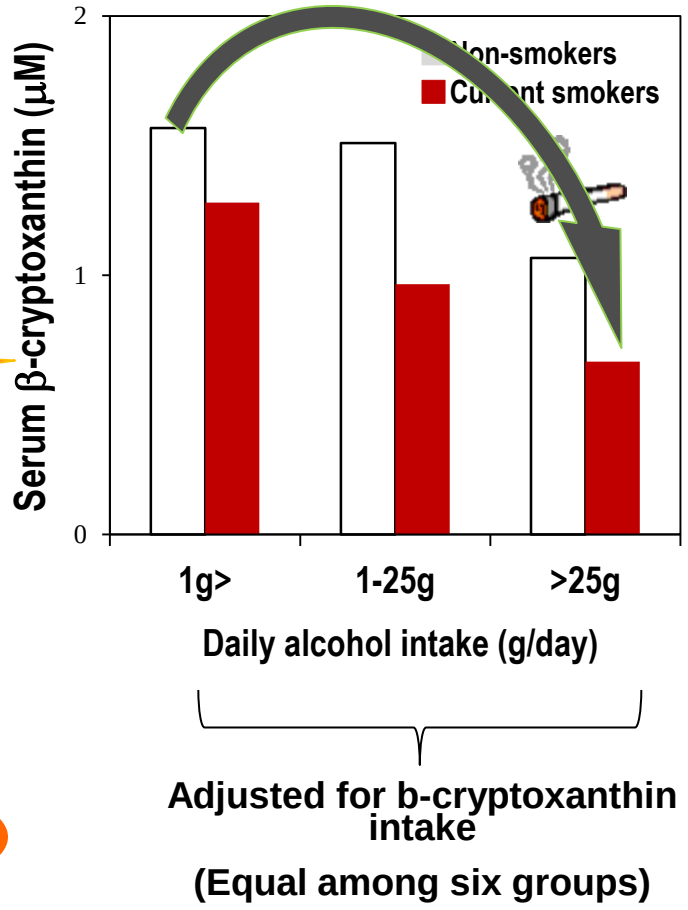
Sugiura et al. ***Osteoporosis Int*** 19: 211-219 (2008)

β-cryptoxanthin might affect on bone health

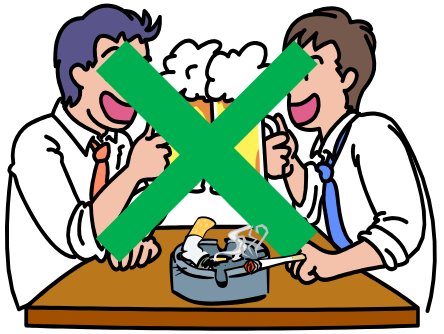
Defending against oxidative stress induced by smoking and drinking



52% decrease!



Even if the same amount of β-cryptoxanthin is consumed, the serum concentration of β-cryptoxanthin would be extremely lower in alcohol drinkers among current smokers compared with non-drinkers among non-smokers.



Sugiura et al. ***Br J Nutr*** 102: 1211-1219 (2009)

Conclusion

High Serum β-cryptoxanthin associated with the lower risk for…

- Alcohol- and Diabetes-related Liver dysfunction
- Osteoporosis in post-menopausal female
- Insulin Resistance
- Arteriosclerosis
- Metabolic syndrome in current smokers
- Oxidative stress in smokers among regular alcohol drinkers

Further cohort and intervention studies, and mechanism studies will be required.


Thank you