

# Research of Wasabi

## Japanese Traditional Spice

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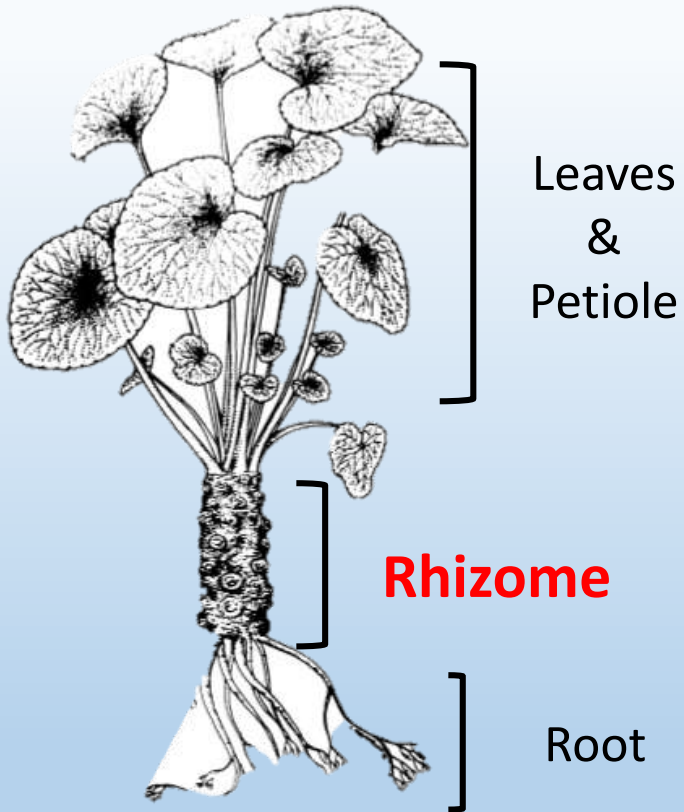
## VOC

Flavour and pharmaceutical properties of the volatile sulphur compounds of Wasabi (*Wasabia japonica*)

## Medical

Inhibitory effects of Japanese horseradish (*Wasabia japonica*) on the formation and genotoxicity of a potent carcinogen, acrylamide  
加熱調理により発生するアクリルアミド(発ガン性物質)に対する  
ワサビ摂取の医学的効能

# Introduction



wasabi (*Wasabia japonica*)

...mostly used for its pungent **Rhizome**

※ horseradish = 西洋ワサビ ≡ 山わさび(蝦夷山ワサビ)

habitat

naturally gravel beds of mountain stream (12~15°C)

▪ roots require high level of oxygen

→ commercially, Flooded Field Method is applied



These picture were taken at  
Daio Wasabi Farm in Nagano  
(Sep. 29, 2017)

# VOC from wasabi

Total amounts : Rhizome < Leaves < Root < Petiole

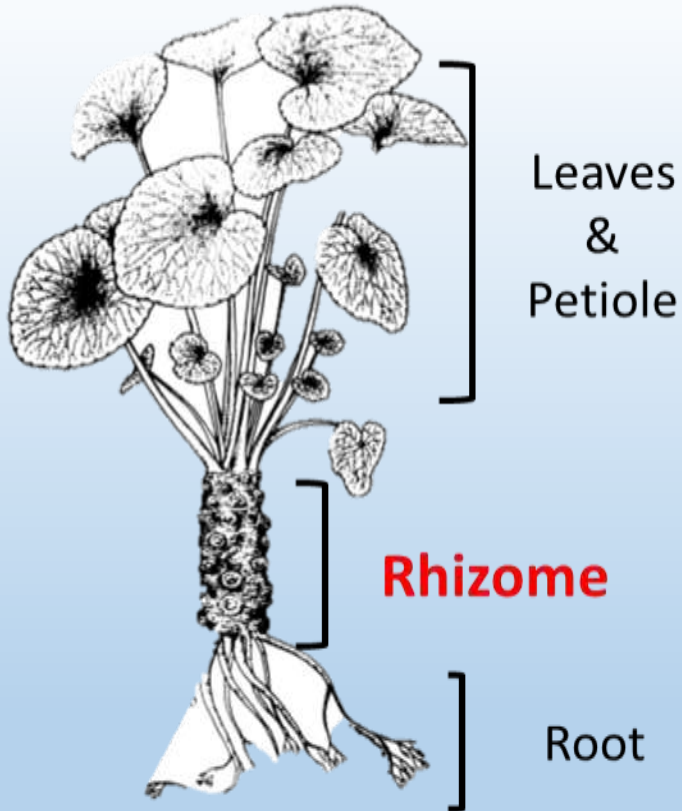
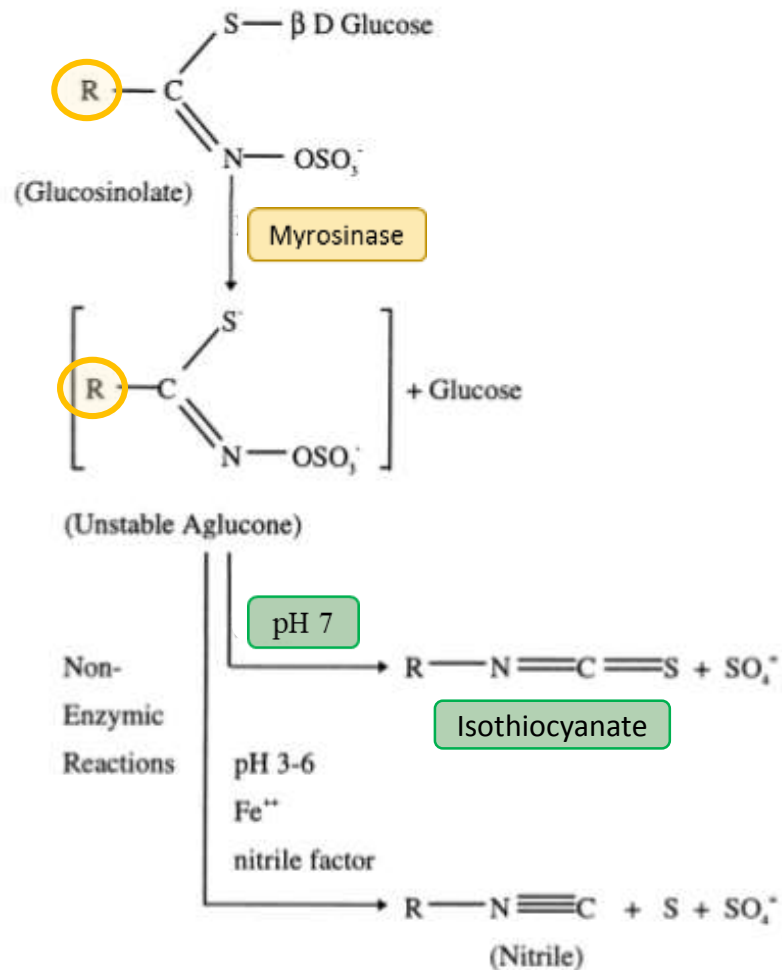


Table 3. Volatile components of essential oils extracted from different parts of upland wasabi (Kumagai *et al.*, 1994)

Peak No.	Compound ( NCS = isothiocyanate)	g/100 g essential oil		
		Petiole	Rhizome	Root
1	1-Penten-3-ol	0.63	0.01	—
2	3-Butenonitrile	2.35	0.87	4.39
3	Isopropyl NCS	0.33	—	—
4	<i>trans</i> -2-Hexenal	14.94	—	—
5	<i>sec</i> -Butyl NCS	0.81	0.6	4.39
6	<i>cis</i> -2-Penten-1-ol	0.31	0.02	0.03
7	Isobutyl NCS	1.05	0.03	0.11
8	1-Hexanol	0.03	0.14	0.09
9	Allyl NCS	55.07	83.26	79.39
10	Unknown	14.60	—	—
11	<i>trans</i> -2-Hexen-1-ol	0.51	0.54	0.09
12	3-Butenyl NCS	4.29	6.96	4.44
13	4-Pentenyl NCS	0.45	3.65	0.73
14	5-Hexenyl NCS	—	0.94	0.18
15	6-Heptenyl NCS	—	0.06	0.95
16	Unknown	2.65	—	0.08
17	4-Methylthiobutanonitrile	0.09	—	0.04
18	3-Methylthiopropyl NCS	0.39	0.13	0.41
19	6-Methylthiohexanonitrile	0.14	0.01	0.17
20	4-Methylthiobutyl NCS	—	0.01	0.15
21	7-Methylthioheptanonitrile	0.83	0.02	0.79
22	5-Methylthiopentyl NCS	0.08	0.58	0.36
23	6-Methylthiohexyl NCS	0.45	1.98	2.49
24	7-Methylthioheptyl NCS	0.16	0.18	0.73
Total mg oil/100 g plant (six measurements)		28.65 ± 3.65	158.02 ± 13.42	20.52 ± 2.52

# Mechanism : Isothiocyanate production



**Scheme 1.** Conversion of glucosinolates to isothiocyanates and nitriles (McGregor *et al.*, 1983).

Glucosinolate reaction with Myrosinase

Side chain	[reaction]	Flavor of isothiosyanate
Methyl		Lacrymator (催涙)
Isopropyl		Pungent
2-propenyl	➔	Pungent, Bitter, Lacrymator
3-Butenyl		Pungent, Aroma
4-Pentenyl		Acrid(ツンとする香り)
2-Phenylethyl		Watercress(クレソン)aroma

- Aglucose to Isothiocyanate

- pH = 7

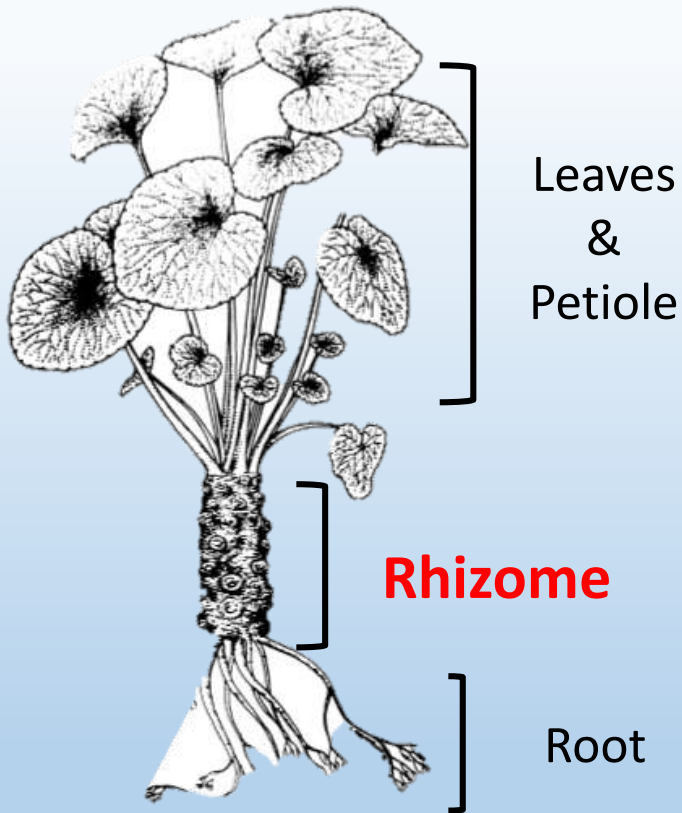
- Aglucose to Nitrile compounds

- pH = 3~6 or Fe<sup>3+</sup> ion and/or Nitrile factor

# Isothiocyanates from wasabi

\*<sup>a</sup> Root = Root + Rhizome

\*<sup>b</sup> Stem = Petiole



Isothiocyanate	Wasabi			Horseradish root
	Root <sup>a</sup>	Stem <sup>b</sup>	Leaf	
Allyl	111	18.6	22.8	96.6
n-Butyl	1.74	0.3	0.36	0.42
3-Butenyl	1.83	0.06	0.27	0.81
4-Pentenyl	3.9	0.66	0.78	0.10
5-Hexenyl	1.02	0.3	0.57	0.18
2-Phenylethyl	—	—	—	22.5
5-Methythiopentyl	0.48	0.27	0.12	—
6-Methylthiohexyl	1.89	2.64	1.14	—
7-Methylthioheptyl	1.44	0.6	0.33	—
5-Methylsulphinylpentyl	2.17	0.3	0.42	0.81
6-Methylsulphinylhexyl	7.8	2.52	5.4	0.9
7-Methylsulphinylheptyl	1.41	0.45	1.08	0.78

Total Amounts : **Japanese wasabi** > western wasabi (horseradish)

# Isothiocyanates from wasabi

Only found in wasabi, not in horseradish

## Allyl

Main pungent component (wasabi its "bite" )

## 6-Methylthiohexyl

Fresh wasabi flavor

## 7-Methylthiohexyl

Sweetish wasabi flavor

## 8-Methylthiohexyl (\*absent in this table)

Weakly pungent wasabi flavor

## Methylsulphinylalkyl

Although found in both species,  
the amounts is larger in wasabi than in horseradish

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# Isothiocyanate & Myrosinase

- Unsatbility of flavor due to its high volatility
  - Please prepare just before eating
- Attempt to improve storage performance
  - Dried-wasabi powder (freeze-drying, air-drying)
    - > possible to be stored for long periods

but... the fragility of wasabi Myrosinase

→ isothiocyanate in powdered-wasabi is decreased by 50% over 4weeks in room temperature





# Fragility of Myrosinase

※**Myrosinase can restore the loss of isothiocyanate**

## Differences in thermal-stability of Myrosinase

- Wasabi Myrosinase has lower stability  
(rapidly inactivated at temperature above 30°C)
- More thermal stable ones are added into wasabi powder  
(with powdered-mustard, -horseradish )

[demerit] additional unpleasant flavor may occur  
(ex. Turnrip(カブ) flavor from mustard)

# Medical effects of eating wasabi ①

Isothiocyanates have...

- inhibition effect of platelet aggregation (血小板凝集抑制作用)
- protective effect against carcinogen (発ガン性物質抑制作用) etc...

So, should we intake isothiocyanates more and more ?

• ~~Yes~~

• No

Some isothiocyanates act as tumor promoters above certain levels, especially, **phenylhexyl isothiocyanate**

# Medical effects of eating wasabi ①

Isothiocyanates have...

- inhibition effect of platelet aggregation (血小板凝集抑制作用)
- protective effect against carcinogen (発ガン性物質抑制作用) etc...

Adverse effect of **phenylhexyl isothiocyanate**

- A diet containing...

320 ppm ~ : increase in non-invasive colon adenocarcinoma

640 ppm ~ : increase both in invasive and non-invasive forms

# Medical effects of eating wasabi ②

foutunately, There is **no phenyl isothiocyanate** in wasabi !

...and if you want to intake 320 ppm of isothiosyanates,

Rhizome of wasabi must be mixed at the rate of **over 20%**

→ **normal** mixing rate is not claimed

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2-Phenylethyl	—	—	—	22.5



This is abnormal...  
(SASUKE, kita-24 kita-ku,)

# Finally...

Wasabi is necessary to traditional Japanese foods.  
Actually Japanese foods are very delicious even without wasabi, but the presence of it enhances the values.

The more you know about wasabi,  
the more you can enjoy Japan

(masui, 2017)

Thanks for your attention

