Flavour components in the rhizome of soil-grown wasabi

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ABSTRACT

Wasabi, Japanese horseradish (*Wasabia japonica* (Miq) Matsum) is grown to prepare a green paste which is eaten with traditional Japanese dishes. The plant is grown as a perennial crop in Japan and is now also grown in New Zealand. The best quality wasabi products are produced from the rhizomes (stems) although other parts of the plant such as petioles and leaves also possess some pungency and are also used as raw materials. The characteristic flavour of wasabi comes from the volatile isothiocyanates (ITCs), which are evolved from glucosinolates by enzymatic hydrolysis when tissues are macerated. In this study the total isothiocyanate (ITC) and six different ITCs were measured in the rhizome of wasabi grown at Lincoln under four different soil treatments. The level of total ITC ranged from 2425 to 2810 mg/kg fresh weight, which was significantly higher than the values reported in the literature for wasabi grown in Japan (mean 1659 mg/ kg). Allyl isothiocyanate (AITC) was the main ITC and it contributed between 86 to 92% of the total ITC measured in the rhizomes. Overall, there were small changes in the individual ITCs as a result of the different treatments (control, lime, manure, lime and manure), however no correlation between ITC concentration and yield of plants was found. The total ITC contents quantified by GCMS were marginally higher than the total ITC's measured by UV spectrometry after approximately one year storage of paraffin oil extract at 0 to -4ºC.

Comparison of isothiocyanate yield of wasabi rhizome tissues grown either in soil or water

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Abstract
The isothiocyanate (ITC) content of wasabi, the Japanese horseradish (*Wasabi japonica*) was measured, by release from glucosinolates, in the rhizomes of plants grown in two traditional ways. Mature plants approximately 18 months old were harvested from two different commercial farms located in the south island of New Zealand. At one farm the plants were grown in raised soil beds while the plants in the other farm were grown in gravel irrigated by river water. Following harvest the

rhizomes from each growth medium were divided into five size groups based on the weight and length of the rhizomes. The different sized rhizomes were also subdivided into top, middle and bottom portions of the rhizomes and each portion was further subdivided into skin and cortex, and vascular and pith using a knife. The individual and total isothiocyanate content of each portion of the rhizomes were extracted using dichloromethane and measured using a GC- FPD technique.
The total isothiocyanate content of the rhizomes grown in soil increased (14.24 times) linearly from 15 to 100 g rhizome weight while the mean isothiocyanate content of the water grown wasabi increased (11.13 times) non-linearly for similar sized rhizomes. Water grown rhizomes in the weight range 20 to 60 g gave significantly ($P=0.030$) higher total ITC (2.2-2.9 times) than similar sized soil grown wasabi. Analysis of the tissues showed that the total and the individual isothiocyanates were found in significantly higher levels (73% and 64% respectively) in the skin and cortex compared to the vascular and pith tissues. Analysis of the isothiocyanate content of the different locations of the wasabi rhizome showed that the lower portion of the rhizome contained significantly higher levels of both total and individual ITCs compared to the middle and top portions of the rhizome.

Investigation of isothiocyanate yield of flowering and non-flowering tissues of wasabi grown in a flooded system

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ABSTRACT

Wasabi, (Japanese horseradish) is extensively used in Japanese cuisine because of its characteristic flavour. The plant is grown as a perennial crop in New Zealand. The highest quality products are produced from the rhizomes though other parts of the plants also contain some pungency. In this study the yields of individual and total isothiocyanates (ITCs) were measured in the four main parts of the plant, root, rhizome, petiole and leaves in mature flowering and non-flowering18-month old plants. The plants were grown without fertiliser in river water flooded beds. The total ITC and individual contents of allyl, 3-butenyl, 4-pentenyl and 5-hexenyl ITC of the roots and rhizomes of the flowering plants were all significantly higher ($p< 0.001$) than in the comparable non-flowering plant parts. The level of total ITC in the epidermis and cortex of the flowering plants was 3144.3 mg/kg fresh weight basis compared to 1773.0 mg/kg in the non-flowering tissue. The total ITC contained in the vascular and pith tissue was 2234.1 mg/kg fresh weight for the flowering plants compared to 1388.1 mg/kg fresh weight for the non-flowering plants. As there is some considerable differences between the ITC profiles in the flowing and non-flowering tissue of wasabi plants a change in the overall aroma profile may occur when the material is made into a processed product.

The effect of storage at different temperatures on the yield of isothiocyanates from wasabi rhizomes

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ABSTRACT

Wasabi rhizomes are commonly kept for varying lengths of time in cold storage as harvesting occurs at set times of the year and manufacturing into products, for instance, mayonnaise and sauces, occurs throughout the year. The yields of individual and total isothiocyanates (ITCs) from the rhizomes remained stable when stored at -10, -20 and -80^{o}C over a period of 8 weeks, except for 3-butenyl ITC which showed a significant fall after 3 weeks storage. The total ITC yield from the fresh rhizomes was 1857.8 mg kg^{-1} while the mean yield from the frozen rhizomes after 8 weeks of storage was 1859.7 mg kg^{-1}, allyl ITC comprising 94% of the total ITC. There was no significant advantage to rapidly freezing the rhizomes with liquid nitrogen when compared to slower conventional freezing techniques. No significant yield losses of ITCs could be observed when the rhizomes were stored at 4^{o}C for up to 6 weeks except for *iso*propyl ITC (the most volatile ITC), which showed a significant fall in values from week 3 onwards. The mean total ITC yield from the rhizomes after 6 week's storage at
-4˚C was 1379.6 mg kg^{-1} fresh weight, which was significantly lower than the mean total ITC when stored at -10^{o}C and lower temperatures (1874.3 mg kg^{-1} of fresh rhizome). Defrosting and then refreezing the rhizomes at -15˚C led to very significant losses of allyl and total ITCs. Defrosting led to a 99.7% loss of allyl ITC when previously frozen rhizomes were stored at 4^{o}C for 16 days. These data will considerably assist the efficient storage of this valuable material.