

Introduction to Some Indigenous Vegetables in Japan

Yukihiro Fujime^{1,2,3}

Faculty of Agriculture, Kyoto Prefectural University, Shimogamo, Sakyo, Kyoto, Japan 606-8522

Additional index words. allium, classification, daikon, indigenous vegetable, Japan, variation

Abstract. Although Japan has a clear change of the seasons, the winter is mild, because it is surrounded by the sea. Even if it snows in the coastal area of the Japan Sea in the winter, it does not snow so heavily in the Pacific Ocean area. Because there is much rain in the summer and the air temperature and relative humidity are high, many horticultural crops are grown in the cool upland region, including the Hokkaido area. The Japanese islands are long from south to north covering north latitude 24° and 46°. Many indigenous vegetables such as water dropwort, japanese hornwort, wasabi, japanese butterbur, rakkyo, chinese chive, asatsuki, goldband lily, mioga ginger, and japanese pepper as well have been grown throughout ≈2000 years, being domesticated under selections and are now in modern Japan popular and important vegetables. Many variations have been produced under different climatic as well as soil conditions. Daikon, turnip, japanese bunching onion, komatsuna, kyona, taro, and eggplant have many variations in the growing areas. A lot of varieties are found particularly in daikon and turnip whose shape and color include small round, large round, long, and conical and white, green, and red, etc. Kyona and komatsuna belong to the same species, *Brassica rapa*, and also there are many useful variations as leaf vegetables in this species. Japanese bunching onion as an example has also many variations and in east Japan, the leaf sheaths are etiolated by hilling with soil during the winter and etiolated leaf sheaths are harvested in the spring, whereas in west Japan, the leaf sheaths are grown without hilling and green leaves are harvested. Those variations from indigenous vegetables are selected under every condition and various cultural methods were developed in growing areas. People have devised ways also how of cooking and using them depending on their eating habits as an established food culture.

There are many indigenous vegetables in Japan. Japan is an island nation and has many vegetables transferred from tropical Asia with ancient origin. The geographic situation of Japan is complex with the presence of high mountainous zones on the coastal area. The difference of latitude is also great enough from Okinawa to Hokkaido. Moreover, there is also a mountainous area in the central part of the Japanese islands. The climate is greatly different between the Pacific Ocean side and the Japan Sea side. Because various vegetables have been grown with a long history, considerable variations are accumulated in the form and growth pattern. There are some references on the leaf, fruit, and root of Japanese vegetables (Aoba, 1982, 1983) and on traditional vegetables (Takashima, 1982, 2003). To popularize the Japanese traditional vegetables in the world, descriptions should be written in English. The English descriptions concerning physiological and ecological characteristics of these vegetables are not enough (Organizing Committee of JSHS, 1994). The following is an introduction to the indigenous vegetables in Japan.

LAND, NATURAL CONDITIONS, AND CLIMATES OF JAPAN

The Japanese islands are long from south to north between north latitude 24° and 46°. Most of the land is covered with mountains

(62%), hills (11.8%), plateaus (11%), and low ground (13.8%). Although Japan has a clear shift of the seasons, the winter is mild because it is surrounded by the sea. Although it snows much in the coastal area of the Japan Sea side in the winter, it is often fine in the Pacific Ocean coastal side. Because there is a lot of rain in the summer (1467 mm annual rainfall in Tokyo) and both the air temperature and relative humidity are high in Japan (31.7 °C maximum mean temperature in August in Tokyo), many horticultural crops are grown in the cool upland region, including the Hokkaido area. A winter day is defined by the daily minimum temperature being lower than 0 °C. Winter days of Sapporo, Aomori, and Niigata in the area of the Japan Sea side are 135, 117, and 51 d, respectively. On the other hand, winter days of Tokyo, Kochi, and Kagoshima on the Pacific Ocean side are 20, 36, and 17 d, respectively. A day when the daily maximum temperature is 25 °C or

higher is defined as a summer day. Summer days of Sapporo, Aomori, and Niigata are 46, 57, and 88 d, respectively. On the other hand, summer days of Tokyo, Kochi, and Kagoshima are 105, 138, and 151 d, respectively.

INDIGENOUS VEGETABLES: KIND AND CHARACTER

Many indigenous vegetables (Table 1) such as water dropwort, japanese hornwort, wasabi, japanese butterbur, rakkyo, chinese chive, asatsuki, goldband lily, mioga ginger, and japanese pepper have been grown since ≈2000 years ago (Table 2). Some vegetables have been introduced to Japan from east and south Asia and have been grown since the dawn of the history of Japan. These vegetables have been domesticated through selection and are still today important vegetables. Many variations have been established under different climatic and soil conditions, whereas these

Table 1. Classification and names of vegetables indigenous to Japan.

Family	Indigenous	Variations established in Japan
Cruciferae	(wasabi) <i>Wasabia japonica</i>	(daikon) <i>Raphanus sativus</i> L. daikon group (turnip) <i>Brassica rapa</i> L. rapifera group (komatsuna) <i>Brassica rapa</i> L. perviridis group (mizuna, mibuna) <i>Brassica rapa</i> L. japonica group (japanese bunching onion) <i>Allium fistulosum</i> (wakegi) <i>Allium ×wakegi</i>
Liliaceae	(rakkyo) <i>Allium chinense</i> (chinese chive) <i>Allium tuberosum</i> (asatsuki) <i>Allium schoenoprasum</i> L. var. <i>foliosum</i> Regel (goldband lily) <i>Lilium auratum</i> (japanese butterbur) <i>Petasites japonicus</i>	
Compositae		
Araceae		(taro) <i>Colocasia esculenta</i>
Solanaceae		(eggplant) <i>Solanum melongena</i>
Umbelliferae	(water dropwort) <i>Oenanthe javanica</i> (japanese hornwort) <i>Cryptotaenia canadensis</i> DC. subsp. <i>japonica</i>	
Zingiberaceae	(mioga ginger) <i>Zingiber mioga</i>	
Rutaceae	(japanese pepper) <i>Zanthoxylum piperitum</i>	

Received for publication 13 Dec. 2011. Accepted for publication 6 Feb. 2012.

This paper was part of the workshop “Asia’s Indigenous Horticultural Crops” held 26 July 2009 at the ASHS Conference, St. Louis, MO, and sponsored by the Working Group of Asian Horticulture (WGAH).

I thank Dr. Eishi Nakamura for his helpful reviews of the manuscript.

¹Retired from Kyoto Prefectural University.

²Current address: 35-602, Kitatenjinmochi, Kinugasa, Kita, Kyoto, Japan 603-8376.

³To whom reprint requests should be addressed; e-mail yfujime@rio.odn.ne.jp.

vegetables have been cultivated. There are some minor indigenous vegetables such as udo, water shield, water chestnut, and edible amaranthus. The comments on those minor vegetables were omitted here. The classification and scientific names were from the description of the Japanese Society for Horticultural Science (Jap. Soc. Hort. Sci., 2005).

Water dropwort, seri in Japanese (*Oenanthe japonica* DC). These are aquatic, herbaceous perennial plants that are found wild in wet places throughout Japan (Fig. 1). In the fall and the winter, it produces a lot of radical leaves, which are the object of harvesting. Its use is similar to watercress (*cruciferae*). This fresh green has a fragrant smell. It bears many stolons in the spring and summer and bolts and flowers in the midsummer. It is propagated by stolons.

Japanese hornwort, mitsuba in Japanese (*Cryptotaenia canadensis* DC. *subsp. japonica* Hand.). This is a herbaceous perennial plant whose aboveground part is damaged by frost in the winter. It is propagated by seeds. A root-mitsuba and a cut-mitsuba are blanched by hilling and a string-mitsuba is cultivated in hydroponic conditions without blanching.

Wasabi, wasabi in Japanese (*Wasabia japonica* Matsum.). Wasabi is an aquatic perennial plant, which grows wild in the streams of mountains throughout Japan. Wasabi is grown for its rhizomes, which are used as a condiment. It is normally propagated by offsets. Whole plants have the flavor and could be used. Wasabi is a cool-season crop and needs shading from the strong sunshine during the summer months. Its production is confined to regions where water temperature is preferred at ≈ 10 to 15°C throughout the year.

Japanese butterbur, fuki in Japanese (*Petasites japonicus* Maxim.). Japanese butterbur is a perennial herbaceous and dioecious plant. The petioles are mainly used. The blade and flower buds are also used. It bears three to four long, thin rhizomes, and the rhizome develops several big leaves with long petioles. Japanese butterbur grows vigorously in the spring and fall but the leaves die back in the winter. Akita-fuki (*Petasites japonicus* ssp. *giganteus* Kitam.) is native to the cool regions of Japan whose leaf is huge, developing a petiole 2 m long and a blade 1.5 m in diameter.

Rakkyo, rakkyo in Japanese (*Allium chinense* G. Don). Rakkyo is perennial and tillers vigorously. Each shoot forms a small bulb (2 to 5 cm long) at the base. One bulb multiplies into six to nine (large-bulb type) or 10 to 15 (multiple-bulb type) bulblets in a year. It is propagated from bulbs (Table 3). Bulb formation is promoted by long days in the spring, and in the summer, the plant becomes semidormant, the leaves being withered. It is blanched for softening tissue and moderating smell. Growth and development are late compared with other alliums.

Chinese chive, nira in Japanese (*Allium tuberosum* Rottler ex Spreng.). Chinese chive is a perennial plant and has vigorous branches on rhizomes. The green leaves are mainly used, but flower buds and scapes are also

Table 2. Historical records of vegetable cultivation in Japan.

Period	Kind of vegetables	
	Indigenous	Be introduced from China and tropical Asia
BC20C to 7 C	(chinese chive) <i>Allium tuberosum</i>	(perilla) <i>Perilla frutescens</i> (oriental melon) <i>Cucumis melo</i> L. var. Makuwa group (turnip) <i>Brassica rapa</i> L. rapifera group (ginger) <i>Zingiber officinale</i> (japanese bunching onion) <i>Allium fistulosum</i> (cucumber) <i>Cucumis sativus</i> (daikon) <i>Raphanus sativus</i> L. daikon group (lotus root) <i>Nelumbo nucifera</i> (edible burdock) <i>Arctium lappa</i> (taro) <i>Colocasia esculenta</i>
	(japanese butterbur) <i>Petasites japonicus</i> (water dropwort) <i>Oenanthe javanica</i> (mioga ginger) <i>Zingiber mioga</i> (asatsuki) <i>Allium schoenoprasum</i> L. var. <i>foliosum</i> Regel (japanese pepper) <i>Zanthoxylum piperitum</i> (wasabi) <i>Wasabia japonica</i> (goldband lily) <i>Lilium auratum</i> (rakkyo) <i>Allium chinense</i> (Kumazawa, 1953, modified)	(eggplant) <i>Solanum melongena</i> (garlic) <i>Allium sativum</i>



Fig. 1. Indigenous vegetables of Japan.

Table 3. Comparison of growth and development in *allium* crops.

	Spring	Summer	Fall	Winter	Stem	Leaf	Propagation	Dormancy
Wakegi	P	HB			Hollow	Round	Bulbs	Summer
Rakkyo	H	P B	F			Round	Bulbs	Summer
Chinese chive	PH	F	H	P		Flat	Seeds	Winter
Asatsuki	BF	P			Hollow	Round	Bulbs	Summer
Japanese bunching onion	P		H	H	Hollow	Round	Seeds	Winter
Onion	H		P		Hollow	Round	Seeds	Summer

B = bulb; F = flower; H = harvest; P = planting/sowing.

used. Blanched and etiolated leaves are occasionally used. Chinese chive is usually propagated by seeds in commercial propagation and is also propagated by dividing the clumps.

Asatsuki in Japanese, a variety of chive (*Allium schoenoprasum* L. var. *foliosum* Regel). Asatsuki is planted in late summer and harvested in winter or spring (Table 3). The stem is hollow and the leaf is round.

Asatsuki has no seeds but produces bulbs. Bulbs are formed in early summer and enter into dormancy after flowering.

Goldband lily, yurine in Japanese (*Lilium auratum* Lindl.). Goldband lily is an ornamental plant and bulbs are harvested from November to February. It has a slightly bitter and sweet taste and the texture is similar to potato/globe artichoke. It can be propagated

by scaling and bulblets. Each clove is separated and cooked for chawan-mushi (steamed egg custard). Ginkgo-nuts (*Ginkgo biloba* L.) are also used for chawan-mushi.

Mioga ginger, myoga in Japanese (*Zingiber mioga Roscoe*). In Japan mioga ginger is found growing wild in semishady places in the mountainous area. Mioga ginger is grown for its young inflorescences and young shoots, which are used as a condiment. It is a perennial plant, growing 40 to 100 cm high. Because the flowers rarely set seeds, mioga is propagated by the underground stems. The plant is killed by frost, but the underground stems are hardy to cold. The optimum temperature for growing is 20 to 30 °C. Young inflorescence production is achieved by planting rhizomes toward the end of March. Harvesting is carried out from July to late October. Blanched shoots are obtained by growing mioga ginger in underground pits. The plant is lifted late fall up to early winter and replanted in blanching beds kept warm by compost or an electric cable. The plants are exposed to the light shortly before harvesting to make them reddish-tinged.

Japanese pepper, sansho in Japanese (*Zanthoxylum piperitum* DC.). Japanese pepper is a dioecious shrub 3 m high. Branches have thorns, 5 to 10 mm long. It grows wild in the hills and mountains all over Japan. Flower buds are formed at the end of branches and yellowish green flowers bloom in April to May. Fruits are green in the summer and the ripened fruits turn to reddish brown in September. It is propagated by seeds or grafting. Young leaves, flowers, and fruits are harvested and are used as condiments.

SPREAD OF INTRODUCED VEGETABLES IN JAPAN

Many variations of shape and characters in vegetables have been established while they have been cultivated under different climatic (hot/cool/cold) and soil conditions (sand/clay/loam). As the Japanese welcome the coming of new seasons, early-season cultivars have been selected and earlier harvests have been preferred. Because people consume vegetables mainly just after harvest, their freshness and high quality are naturally most evaluated. Because they use almost every plant part such as sprouts, stems, leaves, flowers, seeds, fruits, and roots, different characters of shape, color, smell, and texture have been selected and propagated (for example, root of edible burdock, subterranean root of louts, bulbs of gold-band lily, and ginkgo fruits). Daikon, turnip, Japanese bunching onion, kyona, taro, and eggplant have especially been selected with many variations at different cultivation areas. Almost of these vegetables had been introduced to Japan until 12 C but komatsuna and kyona have been established well in Japan.

Daikon, daikon in Japanese, *Raphanus sativus* L. daikon group. Daikon is one of the major vegetables in production and planting area in Japan (Table 4). Although it differs with respect to the size, shape, color, and quality depending on the cultivars (Fig. 2),

the chromosome number in all daikons is identical ($n = 9$). Some shapes are round (2 kg), huge round (15 to 30 kg), or very long (1.5 m long) and neck colors are white and green. Some curve at the neck.

Turnip, kabu in Japanese, *Brassica rapa* L. *rapifera* group. White oriental types are cultivated in the western part of Japan and colored oriental types are grown along the coastal area of the Japan Sea (Fig. 3).

Table 4. Vegetable production in Japan (2006).

Vegetable	Planted area (ha)	Production (t)	Ship (t)
Total	505,500	14,324,000	11,752,000
Root vegetable	184,800	5,645,000	4,502,000
Daikon	38,300	1,650,000	1,264,000
Turnip	5,390	150,700	119,800
Taro	14,400	174,700	102,700
Leaf and stem vegetable	179,200	5,320,000	4,475,000
Komatsuna	5,650	90,800	74,800
Japanese butterbur	690	16,900	13,700
Japanese hornwort	1,240	18,400	17,200
Japanese bunching onion	22,700	491,900	378,800
Chinese chive	2,200	62,700	56,000
Fruit vegetable	110,100	2,495,000	2,021,000
Eggplant	11,100	371,900	275,200

Agriculture & Livestock Industries, 2006.

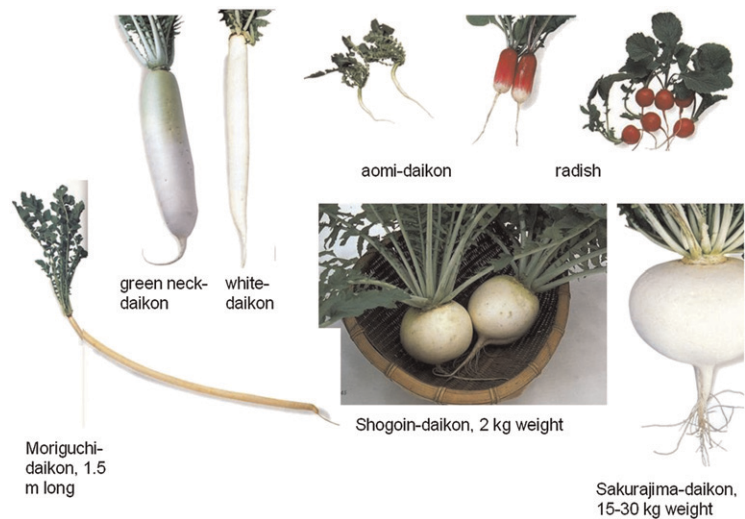


Fig. 2. Classification of daikon by shape. (Vegetable supply stabilization fund, 1997).

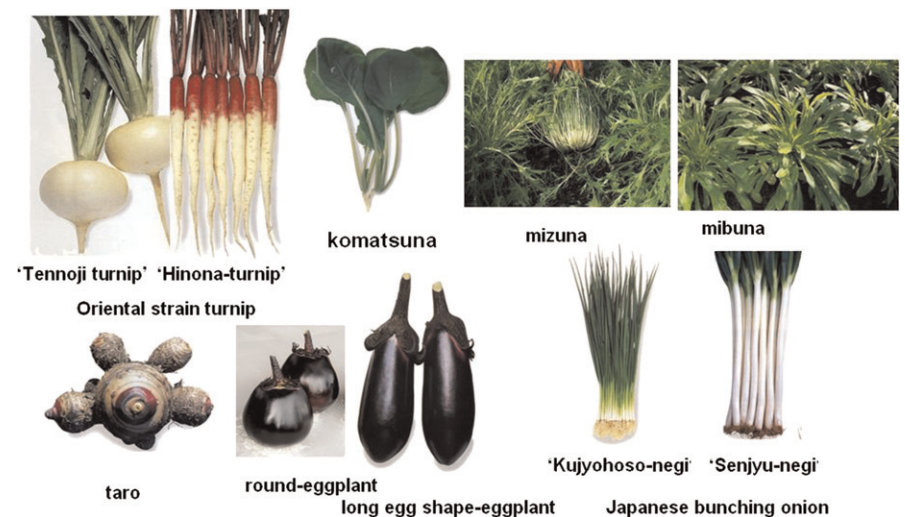


Fig. 3. Variations occurred in different growing conditions.

Table 5. Nutrition of vegetables indigenous to Japan (wt/100 g fresh weight).

Vegetable	Potassium (mg)	Calcium (mg)	Magnesium (mg)	Phosphorus (mg)	Iron (mg)	Carotene (μ g)	B ₁ (mg)	B ₂ (mg)	Niacin (mg)	Carbon (mg)	Fiber (g)
Chive	330	20	16	86	0.7	740	0.15	0.16	0.8	26	3.3
Rakkyo	230	14	14	35	0.5	0	0.07	0.05	2.1	23	21.0
Chinese chive	510	48	18	31	0.7	3500	0.06	0.13	0.6	19	2.7
Goldband lily	740	10	25	71	1.0	0	0.08	0.07	0.7	9	5.4
Japanese bunching onion	220	54	18	31	0.7	1900	0.05	0.09	0.5	31	2.9
Taro	640	10	19	55	0.5	5	0.07	0.02	1.0	6	2.3
Daikon	230	24	10	18	0.2	0	0.02	0.01	0.3	12	1.4
Turnip	280	24	8	28	0.3	0	0.03	0.03	0.6	19	1.5
Eggplant	220	18	17	30	0.3	100	0.05	0.05	0.5	4	2.2
Komatsuna	500	170	12	45	2.8	3100	0.09	0.13	1.0	39	1.9
Mizuna	480	210	31	64	2.1	1300	0.08	0.15	0.7	55	3.0
Japanese butterbur	330	40	6	18	0.1	49	0	0.02	0.1	2	1.3
Japanese hornwort	500	47	21	47	0.9	3200	0.04	0.14	0.7	13	2.3
Water dropwort	410	34	24	51	1.6	1900	0.04	0.13	1.2	20	2.5

Resources council, science and technology, 2005.

European strains are highly tolerant to cold weather and so are grown in the eastern part of Japan.

Komatsuna, *komatsuna* in Japanese, *Brassica rapa* L. *perviridis* group. There are many leaf vegetables in this group of *B. rapa* such as komatsuna and kyona (mizuna and mibuna).

Mizuna and *mibuna*, *mizuna* and *mibuna* in Japanese, *Brassica rapa* L. *japonica* group. Approximately 300 years ago (Edo era), mizuna had enlarged turnip-like roots, which were too hard to use. The present mizuna was improved to decrease the size of the root. Also an entire leaf type (mibuna) has been selected from the pinnatisect leaf type (mizuna).

Taro, *satoimo* in Japanese, *Colocasia esculenta*. Taro has been cultivated in Japan earlier than the rice cultivation has started. There are three types of corm growth; daughter corm type, daughter and mother corm type, and mother corm type. Not only bulb, but also boiled and dried petioles (zuiki in Japanese) are used.

Eggplant, *nasu* in Japanese, *Solanum melongena*. The eggplant cultivation has a long history of more than 12 centuries. Since their introduction to Japan, its growing has spread to all parts of the country and there exist many local cultivars in the Edo era (1615 to 1867). There are many different shapes: small round, round, egg-shaped, long egg-shaped, long, and giant long. As to use, some are used for pickles or boiling and baking.

Japanese bunching onion, *negi* in Japanese, *Allium fistulosum*. Japanese bunching onion has also many variations and in east Japan, leaf sheaths are blanched by hilling with soil and blanched sheaths are harvested (white negi). In west Japan, leaf sheaths are grown without hilling and green leaves are harvested (green negi). The difference in the characteristics of

japanese bunching onion and the other alliums are explained in the paragraph on asatsuki (Table 3).

PRODUCTION OF VEGETABLES AND NUTRITION

In root vegetables daikon and taro are the largest in planting area and production (Table 4). In leaf and stem vegetables, japanese bunching onion and komatsuna are the largest in area and production. Eggplant is also important as a fruit vegetable. Table 5 shows the nutrition of some indigenous vegetables. These values are not so different from other vegetables, but chinese chive, komatsuna, japanese hornwort, japanese bunching onion, water dropwort, and mizuna contain high carotene. It is reported that some of these indigenous vegetables contain functional constituents (Nakamura, 2008).

JAPANESE FOOD CULTURE

The Japanese evaluate the freshness of vegetables, having devised condiments such as miso, soy sauce, and vinegar and also established cooking mainly by means of steam, boiling, simmering, and parboiling. On the other hand, pickled vegetables can be preserved for a long time and so many vegetables have been pickled with vinegar, miso, rice bran, salt, malted rice, mustard, and sake lees. There are two types of pickles in Japan. One is the ordinary pickles, which are pickled with salt (chinese cabbage) or rice bran (daikon). The other is processed pickles, which are pickled with sake lees (daikon, cucumber, and wasabi), malted rice (daikon and chinese cabbage), miso (eggplant, daikon, japanese

butterbur, and edible burdock), mustard (eggplant), and vinegar (turnip, daikon and rakkyo) after preliminary pickling with salt. Because our food custom is closely related with seasonal shifts, daily life, ceremonies such as entrance and graduation of school, and weddings and religions, homestyle and official-style cooking and tea ceremony dishes have been developed. Different qualities of vegetables have been required for each dish and so many delicate variations in shape, color, smell, and texture have been arranged.

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