Chapter 9
Production Technology of Underutilized Vegetables of Apiaceae Family

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Introduction

Apiaceae family also called as Umbelliferae is known as the 16th largest family of flowering plants. It is a family of 3700 species and 434 genera (Gorvett 2017) and is commonly known as carrot, celery, parsley, or fennel family as it includes major and minor vegetables such as carrot (*Daucus carota*), celery (*Apium graveolens*), coriander/cilantro (*Coriandrum sativum*), cicely (*Myrrhis odorata*), cow bean (genus *Oxypolis*), cow parsnip (genus *Heraceleum*), cumin (*Cuminum cyminum*), dill (*Anethum graveolens*), lovage (*Levisticum officinale*), parsley (*Petroselinum crispum*), parsnip (*Pastinaca sativa*), fennel (*Foeniculum vulgare*), anise (*Pimpinella anisum*), asafoetida (*Ferula assa-foetida*), caraway (*Carum carvi*), smallage (*Apium graveolens*), water hemlock (genus *Cicuta*), water parsnip (genus *Sium*), turnip-rooted chervil (*Chaerophyllum bulbosum*), turnip-rooted parsley (*Petroselinum tuberosum*), and skirret (*Sium sisarum*). Several vegetables of this family are toxic such as hemlock water-dropwort (*Oenanthe crocata*), poison hemlock (*Conium maculatum*), and water hemlocks (*Cicuta* spp.). Research has shown that a few Apiaceae species can cause dermatitis when damp skin is exposed to bright sunlight (*Heracleum*, *Pastinaca*). Apiaceae plants are herbaceous and aromatic, and different parts of these plants such as roots, leaves, and stem are extensively used as food, flavor, repellents, spices, and also for medicinal purposes throughout the world. The essential oil derived from these vegetables is rich in antioxidants and aroma and also possesses antimicrobial properties. Along with that, these plants also possess anti-cancerous, hypoglycemic, hypolipidemic, hepatoprotective, and other activities because of which these plants are widely used as an alternative and healthy food for the prevention and treatment of many disorders (Aćimović et al. 2018). These vegetables are also a good source of phytochemicals, which are used for the prevention,

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Savita et al. (eds.), *Production Technology of Underutilized Vegetable Crops*,
https://doi.org/10.1007/978-3-031-15385-3_9

treatment, and curing of diseases as the plants belonging to this family possess ethno-medicinal properties.

S. No.	Name	Botanical name	Chromosome number
1	Turnip-rooted parsley	*Petroselinum tuberosum*	22
2	Turnip-rooted chervil	*Chaerophyllum bulbosum*	22
3	Skirret	*Sium sisarum*	40

Origin and Distribution

Since ancient times, the Apiaceae family was known to mankind. The family originated in Australasia (region including Australia, Tasmania, New Zealand, New Guinea, New Caledonia, and several island groups) (Nicolas and Plunkett 2014). Later, subfamilies of the Apiaceae family started to diverge along the southern hemisphere, Apioideae and Saniculoideae in Southern Africa, Azorelloideae in South America, and Mackinlayoideae in Australasia (Calviño et al. 2016). The Apiaceae family is scattered worldwide but is most prevalent and diverse in areas having temperate climate such as Eurasia and North America. It is rarely seen in areas with the tropical climatic conditions. Areas having arid climate and Mediterranean region favor the diversification of species. Asia has maximum number of genera (289) and the largest generic endemism (177) of the Apiaceae family, and Europe has 126 genera and only 17 are endemic. One hundred and twenty-one genera are found in Africa, whereas North Africa has 82 genera, 13 of which are endemic. Northern and Central America possess huge diversity with 80 genera and 44 endemics, whereas South America has less diversity with 35 genera and 15 of which are endemic. Twenty-seven genera with18 endemics are found in Oceania.

Turnip-Rooted Chervil

Turnip-rooted chervil originated from Eastern Europe, and during the first part of twentieth century, it was very popular in France (Bois 1927). Due to lower production of *C. bulbosum*, it almost disappeared in 1975. Since 1978, the National Institute of Horticulture of France (NIH) carried out a research program which helped in its rapid economic development (Péron 1989).

Turnip-Rooted Parsley

Europe and Western Asia are the native places of turnip-rooted parsley. It is cultivated for its aromatic leaves which also possess pharmaceutical properties.

Skirret

The word skirret has been derived from a Dutch word *suikerwortel*, which means "sugar root." Skirret is also known as skirwort and is mainly cultivated for its sweet, edible roots. This member of carrot family originated in Asia and is widely consumed in China and Japan.

Nutritional and Medicinal Uses

The Apiaceae family is known for its phytochemical diversity which was observed by humans from its odor and flavor; therefore, these vegetables are used for various purposes such as foods, beverages, flavorings, remedies, and industrial uses.

Turnip-Rooted Chervil

Turnip-rooted chervil has very high starch content (37% dry matter, containing 76% starch). It also contains other nutrients such as carbohydrates, sucrose, and reducing sugars. Starch is consumed as a staple food by majority of the people throughout the world. It is used in food and beverage industries and also plays a major role in paper and textile industry (Slattery et al. 2000). To meet the current demand of starch, only a few commercially available crops like potato, maize, and wheat are used (Martin and Smith 1995); therefore, cultivation and commercialization of turnip-rooted chervil can be a solution to the limited source of starch. The roots of turnip-rooted chervil are consumed both in raw and cooked form. The raw root has a starchy flavor and is aromatic and tough. Upon cooking, the roots are transformed into sweet and floury forms. Turnip-rooted chervil is called as gourmet vegetable due its biochemical properties and chestnut-like flavor (Imbault et al. 1985).

Turnip-Rooted Parsley

Turnip-rooted parsley, also known as Hamburg root parsley, is one of the most popular vegetables in central Europe (Holland, Germany, Poland, Hungary, and Austria). Its roots are rich in vitamin A, C, and K and also contain a good amount of copper, iron, and iodine. It is also rich in potassium, calcium, phosphorous, sodium, and folic acid. The roots can be consumed as both raw and cooked. Apart from roots, its leaves are also used to garnish soups and stews. The roots contain oxalates, which can get concentrated and crystallized in our body fluids; therefore, people with kidney- or gallbladder-related disorders should not consume turnip-rooted parsley.

Skirret

Skirret is mainly cultivated for its long white tuberous roots and etiolated sprouts. The tuberous roots of skirret are rich in dry matter (16%) and sugars especially sucrose (65% of dry matter). The sprouts of skirret have 8% dry matter and are a great source of sugars (12%) and proteins (25%). The sprouts are richer in vitamins than the roots. Sprouts that are cultivated under greenhouse have more vitamins as compared to those grown under open field conditions (Leclerc and Peron 1988). The roots can be consumed either raw as salad or cooked. It can be consumed after baking, roasting, and frying or as stew. Roots are sweet, firm, and floury but have a woody core. The woody core present in the root should be removed before cooking. Skirrets are good for people having digestion problems, loss of appetite, and chest complaints.

Botany

Turnip-Rooted Chervil

Turnip-rooted chervil is a biennial crop which grows up to a height of 4 feet. The leaves are alternate, spirally arranged, and pinnately compound. Its inflorescence is umbel and produces around 1000–36,000 flowers per plant. Flowers of turnip-rooted chervil are protandrous, and the style elongates only after pollen dehiscence; therefore, there is no self-pollination. It is a hermaphrodite plant and is pollinated by insects (entomophilous).

Turnip-Rooted Parsley

Turnip-rooted parsley is a herbaceous plant which is biennial in nature. It grows up to a height of 2 feet and spreads up to 15–23 cm. Vegetative growth of the plant is completed during the first year, whereas it produces yellow flowers and small dry

fruits during the second year. The lower leaves are bi- or triternately divided. It has umbel inflorescence and forms slender roots with white flesh.

Skirret

Skirret is a herbaceous, perennial plant which grows up to a height of 3–4 feet and spreads up to 30 cm width. Leaves of skirret are large, shiny, dark green, compound, and pinnate. It has umbel inflorescence which produces small white flowers. The roots of skirret are cylindrical, grayish white, and 6–8 inches long formed in clusters from the base of the stem like sweet potatoes. It is a hermaphrodite plant and is pollinated by insects (entomophilous).

Production Technology of Underutilized Vegetables

Climate and Soil Requirement of Underutilized Vegetables

Soil

Turnip-rooted chervil, turnip-rooted parsley, and skirret grow best in soil with 5.5–7.0 pH. Loamy soils which are loose, friable, well-drained, and rich in organic matter are best for the cultivation of these crops. Cultivation in heavy and clayey soils should be avoided. Deep to medium ploughing must be done to bring the soil to a desired physical condition as compaction of the soil affects the yield adversely.

Climate

Turnip-rooted chervil, turnip-rooted parsley, and skirret are cool season crops. The roots of these crops develop the best flavor, texture, and size at a lower temperature ranging from 15 to 20 °C. Rise in temperature can result in stunting, forking, bolting, and death of the plants.

Irrigation and Intercultural Operations in Underutilized Vegetables

Irrigation

Turnip-rooted chervil, turnip-rooted parsley, and skirret do not produce good roots under dry conditions; therefore, frequent irrigation is necessary. Drip irrigation system is highly efficient and recommended for their production. A light irrigation should be facilitated before the sowing of seeds for better germination.

Intercultural Operations

Hoeing is practiced during the initial stages of crop development to prevent weed growth, at least two hoeings should be done to prevent the weeds from growing. Chemicals such as influtalin/ethafluralin (1.1 kg/ha), linuron (1 kg/ha), or thiobencarb (6–8 kg/ha) can also be used to control the weeds.

Propagation Material, Edible Parts, and Planting Time of Underutilized Vegetables of Apiaceae Family

Plant name	Propagation material	Edible part	Planting time
Turnip-rooted chervil (*Chaerophyllum bulbosum*)	Seeds (biennial root vegetable)	Roots	October–December
Turnip-rooted parsley (*Petroselinum tuberosum*)	Seeds (annual, biennial root vegetable)	Roots and leaves	August–November
Skirret (*Sium sisarum*)	Seeds or root division (perennial root vegetable)	Roots	October–November

Postharvest Handling

Harvesting

Harvesting should be done at proper stage. Especially, Apiaceae plants grown for roots should be harvested during the cool weather as it will help in extending their storage life and maintaining their postharvest quality. Temperature above 27 °C

should be avoided during harvesting. Suitable time for harvesting is early morning or late evening. Harvesting during late evening is suitable for distant markets, whereas morning hour harvesting is suitable for the local market. Size is one of the best maturity indices to harvest most of the Apiaceae family crops. Plants grown both for leaves and roots should be harvested when the leaves and roots have attained a good size but are still tender and juicy. Careful handling must be done to avoid any bruises and cuts.

Harvesting Methods

Plants of the Apiaceae family can be harvested both manually and mechanically. Crops grown for roots are mowed or the roots are pulled out from the ground. Apiaceae plants grown for roots are separated from the leaves or green tops after harvesting the plant with the help of knife.

Cleaning and Washing

Washing or cleaning is done to remove dirt, dust, extraneous matter, and pathogenic load from the surface of vegetables. To ensure proper washing of the commodity, chlorine solution of 100–150 ppm can be used to prevent the buildup of inoculum during the storage. The pH of washing solution should be 6.5–7.5 as it gives the best results.

Sorting/Grading

Plants of the Apiaceae family grown for roots are sorted to remove diseased, damaged, misshapen, overmature, insect-infested, and rotten roots. Roots that are damaged by insect attack should be immediately removed and discarded for preventing further spread to the normal and healthy roots.

Roots lacking firmness, having roughness, poor color, sunburn, splitting, or cracking are also considered as of lower quality.

Storage and Packing

Apiaceae plants grown for roots can be stored at a temperature of 0–1 °C with relative humidity of 98–100% for up to 6–9 months. High humidity is important to maintain the crispness and also controls the desiccation of roots. To store the roots for a long period, artificial cooling must be done before storage. The best method of artificial cooling for the roots of Apiaceae family is hydrocooling. The roots of Apiaceae family are packed in crates, trays, sacks, plastic bags, or nets (Paltrinieri and Staff 2014).

Conclusion

Lack of good quality seeds, marketing, and proper postharvest facilities are the main reasons behind the lesser cultivation of these vegetables. Underutilized vegetables (skirret, turnip-rooted parsley, turnip-rooted chervil) of the Apiaceae family have been neglected for a long time, but proper utilization of such vegetables can contribute to the rural and national economy as these underutilized vegetables require lesser inputs to produce the desired amount of yield. These vegetables can easily withstand harsh and unfavorable climatic conditions which make them suitable to be grown the in remote and marginal land of the country to provide food for the poor rural people. These vegetables have higher nutritional value and consist of valuable nutrients like carbohydrates, proteins, vitamins, and minerals as well as some bioactive non-nutrients that contribute to dietary health which makes them more valuable for cultivation. Lot of farmers can get benefit from the diversification, introduction, and cultivation of these minor crops. New industries can be established, and rural community can be strengthened by the utilization of their products. Moreover, diversification also helps in crop rotation which benefits the agroecosystem by reducing pest and pathogen problems and also improves the soil fertility and texture (Van Soest 1993; Fritz and Myers 2002; Poincelot 2004).

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