Parsley

Julian A. Heyes
Heyes was with the New Zealand Institute for Crop and Food Research, Palmerston North, New Zealand. He is now with the Department of Food Science and Technology, Massey University, Palmerston North, New Zealand.

Scientific Name and Introduction

Petroselinum crispum (Mill.) Nyman ex A.W. Hill—parsley—is a member of the Apiaceae family. The edible foliage is grown as an annual and used as a garnish and food ingredient. Both curly-leaved (such as 'Deep Green,' 'Forest Green,' and 'Moss Curled') cultivars and flat-leaved (such as Plain, Plain Italian Dark Green, and Deep Green Italian) types are available. There is a subspecies, *P. crispum* subsp. *tuberosum*, Hamburg parsley, that has an edible root. Parsley has very high vitamin and nutrient content. It is highest in calcium, iron, and folate of all vegetables studied (Athar et al. 1999) and has among the highest contents of β-carotene, thiamin, riboflavin, and vitamins C and E. A high proportion of the carotene is 9-cis β-carotene, possibly active against cancer and cardiovascular disease (Benamotz and Fishler 1998).

Quality Characteristics and Criteria

The quality criteria for parsley are freshness, green color, freedom from defects or seed stems, and freedom from decay (AMS 2002).

Horticultural Maturity Indices

Parsley can be harvested progressively or cut all at one time. Long petioles are desirable for bunching. Most of the U.S. crop is harvested by hand.

Grades, Sizes, and Packaging

Only one grade is available (U.S. No. 1), which consists of parsley that meet quality criteria and have similar varietal characteristics; that is, curly-leaf and flat-leaf varieties are not mixed. Parsley is usually packaged in cartons or jumbo crates of 60 bunches, 9 to 11 kg (20 to 25 lb).

Precooling Conditions

Rapid removal of field heat without excessive drying helps retain green color and freshness. Parsley can be precooled with ice (package icing or liquid-icing [Cantwell and Reid 1992]) or by vacuum-cooling (Aharoni et al. 1989). Forced-air cooling or hydrocooling are commonly practiced (Joyce et al. 1986).

Optimum Storage Conditions

The recommended conditions for commercial storage of parsley are 0 °C (32 °F) with 95 to 100% RH (Cantwell 2002). Parsley can be stored for 1 to 2 mo under these conditions, compared to only 3 days at 18 to 20 °C (64 to 68 °F) with 85 to 90% RH (Lisiewska et al. 1997). The

endpoint of storage at 0 °C (32 °F) occurs when parsley wilts, at around 20% weight loss (Hruschka and Wang 1979). MAP is effective in extending storage life, but temperature changes and condensation must be avoided. Aharoni et al. (1989) showed that nonperforated polyethylene liners delayed yellowing and decay at low temperature. Park et al. (1999) achieved 77 days of storage at 0 °C (32 °F) and 35 days at 5 °C (41 °F) with good retention of firmness and vitamin C content by using a 40 µm-thick ceramic film. A preharvest spray with gibberellic acid may extend storage life (Lers et al. 1998). Hamburg parsley roots (without leaves) can be stored at 0 °C (32 °F) for several months (Bakowski et al. 1994, Elkner et al. 1998).

Controlled Atmosphere (CA) Considerations

Parsley can tolerate 8 to 10% O_2 and 8 to 10% CO_2 (Saltveit 1997), but this may be of little benefit at 0 °C (32 °F). An atmosphere of 10% O_2 and 11% CO_2 was optimal for delaying yellowing in parsley stored at 5 °C (41 °F) (Apeland 1971). Storage in 10% O_2 and 10% CO_2 (Yamauchi and Watada 1993) or 10% CO_2 (Lers et al. 1998) delayed yellowing at room temperature.

Retail Outlet Display Considerations

Parsley is often sold in unsealed bunches. Light reduces yellowing, but levels in retail shelves are too low to have a significant effect. Use of ice or water sprays is acceptable. If MAP is used during storage, care must be taken to prevent condensation during the retail period.

Chilling Sensitivity

Parsley is not chilling sensitive. It should be stored as cold as possible without freezing, which occurs at -1.1 °C (30 °F).

Ethylene Production and Sensitivity

Parsley leaves produce very little ethylene but are very sensitive to it (Joyce et al. 1986, Tsumura et al. 1993). Cantwell and Reid (1993) observed that parsley leaves produced 0.08, 0.44 and 0.80 µL kg^{-1} h^{-1} at 0, 10 and 20 °C (32, 50, 68 °F). As little as 0.4 µL L^{-1} is enough to accelerate yellowing if parsley is stored above 0 °C (32 °F) (Cantwell and Reid 1993). Ethylene application does not stimulate respiration in parsley (Inaba et al. 1989).

Respiration Rates

Temperature	mg CO_2 kg^{-1} h^{-1}
0 °C	22 to 38
5 °C	49 to 70
10 °C	78 to 150
15 °C	131 to 168
20 °C	176 to 221
25 °C	259 to 289

Data from Apeland (1971), Hruschka and Wang (1979), and Cantwell and Reid (1986).

Rates were measured 3 days after harvest.

To get mL CO_2 kg^{-1} h^{-1}, divide the mg kg^{-1} h^{-1} rate by 2.0 at 0 °C (32 °F), 1.9 at 10 °C (50 °F), and 1.8 at 20 °C (68 °F). To calculate heat production, multiply mg kg^{-1} h^{-1} by 220 to get BTU ton^{-1} day^{-1} or by 61 to get kcal $tonne^{-1}$ day^{-1}.

Physiological Disorders

Wilting and yellowing signal the end of shelf-life. No particular disorders are described for parsley.

Postharvest Pathology

Both *Erwinia* and *Botrytis* can cause postharvest damage from rots and mold (Ryall and Lipton 1979).

Quarantine Issues

There are no known quarantine issues.

Suitability as Fresh-Cut Product

Parsley's flavor and aroma were retained better in perforated film packages than in sealed film packs (Manzano et al. 1995). Food safety is a major concern. Chlorinated water is somewhat beneficial in reducing contamination (Park and Sanders 1992), but personal hygiene of the staff is paramount. Parsley has been implicated as a source of the infectious *Shigella* (Crowe et al. 1999) and *Citrobacter freundii*, causing gastroenteritis and hemolytic uremic syndrome (Tschape et al. 1995), and thermotolerant campylobacters (Park and Sanders 1992).

Special Considerations

Parsley has an extremely high respiration rate. Young leaves respire at a higher rate than old leaves at harvest, but the respiration rate does not decrease as much after harvest in older leaves as in younger leaves, so younger leaves store better (Apeland 1971).

Parsley contains furocoumarins, including psoralen (Manderfeld et al. 1997), which are effective antimicrobial agents but can act as phototoxins, inducing dermatitis (Lagey et al. 1995). Parsley is used as a medicinal plant to treat hypertension in Morocco (Ziyyat et al. 1997) and diabetes in Turkey (Tunali et al. 1999).

References

Aharoni, N., A. Reuveni, and O. Dvir. 1989. Modified atmospheres in film packages delay senescence and decay of fresh herbs. Acta Hort. 258:255-262.

Apeland, J. 1971. Factors affecting respiration and color during storage of parsley. Acta Hort. 20:43-52.

Athar, N., T.W. Spriggs, and P. Liu. 1999. The Concise New Zealand Food Composition Tables, 4th ed. New Zealand Institute for Crop & Food Research, Palmerston North, N.Z.

Bakowski, J., H. Michalik, and L. Umiecka. 1994. Effect of sowing and harvest date on the quality of root parsley and its storability. Biuletyn Warzywniczy 41:157-167.

Benamotz, A., and R. Fishler. 1998. Analysis of carotenoids with emphasis on 9-cis β-carotene in vegetables and fruits commonly consumed in Israel. Food Chem. 62:515-520.

Cantwell, M. 2002. Properties and recommended conditions for storage of fresh fruits and vegetables. *At* http://postharvest.ucdavis.edu/produce_information/storagefreshproduce.

Cantwell, M.I., and M.S. Reid. 1986. Postharvest handling of fresh culinary herbs. II. Respiration and ethylene production. Perishables Handling Quarterly 60:2-5.

Cantwell, M.I., and M.S. Reid. 1992. Postharvest handling systems: fresh herbs. *In* A.A. Kader, ed., Postharvest Technology of Horticultural Crops, 2nd ed., pp. 211-213. DANR Pub. no. 3311, University of California, Oakland, CA.

Cantwell, M.I., and M.S. Reid. 1993. Postharvest physiology and handling of fresh culinary herbs. J. Herbs, Spices and Medicinal Plants 1:93-127.

Crowe, L., W. Lau, and L. McLeod. 1999. Outbreaks of *Shigella sonnei* infection associated with eating fresh parsley—United States and Canada, July-August 1998. J. Amer. Med. Assoc. 281:1785-1787.

Elkner, K., M. Horbowicz, and R. Kosson. 1998. Effect of storage on contents of dietary fibre and its composition in some cultivars of red beet, root parsley and carrot. Veg. Crops Res. Bull. 49:107-120.

Hruschka, H.W., and C.Y. Wang. 1979. Storage and shelf life of packaged watercress, parsley and mint. Marketing Research Report 1102, U.S. Department of Agriculture, Washington, DC.

Inaba, A., Y. Kubo, and R. Nakamura. 1989. Effect of exogenous ethylene on respiration in fruits and vegetables with special reference to temperature. J. Jap. Soc. Hort. Sci. 58:713-718.

Joyce, D., M.S. Reid, and P. Katz. 1986. Postharvest handling of fresh culinary herbs. Perishables Handling Quarterly 58:1-4.

Lagey, K., L. Duinslaeger, and A. Vanderkelen. 1995. Burns induced by plants. Burns 21:542-543.

Lers, A., W.B. Jiang, E. Lomanies, and N. Aharoni. 1998. Gibberellic acid and CO_2 additive

effect in retarding postharvest senescence of parsley. J. Food Sci. 63:66-68.

Lisiewska, Z., W. Kmiecik, and A. Budnik. 1997. Effect of conditions and time of storage on technological quality changes of parsley leaves. Folia Hort. 9:21-29.

Manderfeld, M.M., H.W. Schafer, P.M. Davidson, and E.A. Zottola. 1997. Isolation and identification of antimicrobial furocoumarins from parsley. J. Food Protect. 60:72-77.

Manzano, M., B. Citterio, M. Maifreni, et al. 1995. Microbial and sensory quality of vegetables for soup packaged in different atmospheres. J. Sci. Food Agric. 67:521-529.

Park, C.E., and G.W. Sanders. 1992. Occurrence of thermotolerant campylobacters in fresh vegetables sold at farmers outdoor markets and supermarkets. Can. J. Microbiol. 38:313-316.

Park, K.W., H.M. Kang, E.M. Yang, and J.C. Jung. 1999. Effects of film package and storage temperature on quality of parsley in modified atmosphere storage. Acta Hort. 483:291-298.

Ryall, A.L., and W.J. Lipton. 1979. Handling, Transportation, and Storage of Fruits and Vegetables, 2nd ed., vol. 1. AVI, Westport CT.

Saltveit, M.E. 1997. A summary of CA and MA requirements and recommendations for harvested vegetables. *In* M.E. Saltveit, ed., 7th International Controlled Atmosphere Research Conference, July 13-18, 1997, University of California, Davis, vol. 4, pp. 98-117. University of California, Davis CA.

Tschape, H., R. Prager, W. Streckel, et al. 1995. Verotoxinogenic *Citrobacter freundii* associated with severe gastroenteritis and cases of hemolytic uraemic syndrome in a nursery school—green butter as the infection source. Epidem. Inf. 114:441-450.

Tsumura, F., Y. Ohsako, Y. Haraguchi. 1993. Rapid changes in parsley leaves during storage in controlled or ethylene-containing atmosphere. J. Food Sci. 58:619-625.

Tunali, T., A. Yarat, R. Yanardag, et al. 1999. Effect of parsley *(Petroselinum crispum)* on the skin of STZ-induced diabetic rats. Phytotherapy Res. 13:138-141.

AMS [USDA Agricultural Marketing Service]. 2002. Quality Standards—Fresh Fruits and Vegetables. *At* http://www.ams.usda.gov/AMSv1.0/standards.

Yamauchi, N., and A.E. Watada. 1993. Pigment changes in parsley leaves during storage in controlled or ethylene-containing atmosphere. J. Food Sci. 58:616-618, 637.

Ziyyat, A., A. Legssyer, H. Mekhfi, et al. 1997. Phytotherapy of hypertension and diabetes in oriental Morocco. J. Ethnopharmacol. 58:45-54.

The editors of this Handbook will appreciate your input for future editions of this publication.

Please send your suggestions and comments to HB66.Comments@ars.usda.gov.