# *Pyrus communis*

## Scientific Name

***Pyrus communis* L.**

## Synonyms

*Pirus communis* β *hortensis* Beck, *Pyrus asiae-mediae* Popov, *Pyrus balansae* Decne., *Pyrus bourgaeana* Decne., *Pyrus caucasica* Fed., *Pyrus communis* subsp. *bourgaeana* (Decne.) Nyman, *Pyrus communis* subsp. *caucasica (Fed.) Browicz, Pyrus communis* subsp. *pyraster (L.) Ehrh, Pyrus communis* var. *sativa* (DC.) DC., *Pyrus communis* var. *mariana* Willk., *Pyrus communis* var. *pyraster* L., *Pyrus domestica* Medik., *Pyrus elata* Rubtzov, *Pyrus medvedevii* Rubtzov, *Pyrus pyraster* (L.) Burgsd., *Pyrus sativa* DC. ex Lam. & DC., *Pyrus sylvestris* Moench, *Sorbus Pyrus* Crantz.

## Family

Rosaceae

## Common/English Names

Common Pear, European Pear, Dessert Pear, Pear, Pear Tree, Perry Pears, Soft Pear.

## Vernacular Names

***Brazil***: Pêra, Pereira;
***Chinese***: Xi Yang Li, Yang Li;
***Czech***: Hrušeň Obecná;
***Danish***: Almindelig Pære, Pære, Vild Pære;
***Dutch***: Eetpeer, Gewone Peer, Peer;
***Eastonian***: Harilik Pirnipuu;
***Finnish***: Päärynä, Päärynäpuu;
***French***: Poire, Poirier;
***German***: Birnbaum, Birne, Birnenbaum, Garten-Birne, Gemeine Birne, Holz-Birne, Holzbirnbaum, Holzbirne Kulturbirne, Mostbirnen, Wild-Birne, Wilder Birnbaum;
***Hungarian***: Körte(Fa), Nemes Körte;
***India***: Nashpati (Hindu), Salvag (Malayalam), Kishtabahira (Kashmiri), Naspati (Manipuri), Berikaya, Veripandu (Telugu);
***Indonesia***: Buah Pir,
***Italian***: Pera, Perastro, Pero, Pero Comune, Pero Domestic, Pero Selvatico;
***Japanese***: Seiyou Nashi, Seiyo Nashi;
***Korean***: Pyongbaenamu;
***Malaysia***: Buah Pir;
***Nepali***: Nasapati;
***Norwegian***: Pære, Pæretre;
***Polish***: Grusza Domowa, Grusza Pospolita;
***Portuguese***: Pereira;
***Russian***: Gruša;
***Serbian***: Kruska;

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***Slovaščina***: Hruška, Navadna Hruška, Žlahtna Hruška;
***Slovencina***: Hruška Obyčajná;
***Spanish:*** Pera, Peral, Perello, Piruétano;
***Swedish***: Päron;
***Thai***: Sali Thuean;
***Vietnamese***: Lê.

## Origin/Distribution

*Pyrus communis* is native to central and eastern Europe and southwest Asia. The European Pear is one of the most important fruits of temperate regions, being the species from which most domestic orchard pear cultivars grown in Europe, North America and Australia are developed.

## Agroecology

*Pyrus communis* is a temperate species and thrives in the warmer areas of the temperate zones. It prefers a mild summer and a cool to cold winter. It prefer full sun and rich, well drained, moist sandy loam to clayey loam soils rich in organic matter, with pH of 5.5–8.5.

## Edible Plant Parts and Uses

Most pears are dessert pears and eaten raw by themselves or with a robust cheese like Parmesan, Pecorino, Gorgonzola, Stilton or Roquefort. Pears are also a welcome addition to winter salads. Pears are poached in port or red wine spiced with cinnamon, cloves and pared lemon rind or in a vanilla flavoured syrup. A well-known dish is "Pears in Syrup" or "*Perys in Syrip*" using the fifteenth century spelling. For sautéed or grilled pear, pears are peeled, quartered or halved and the cores are scooped out with a melon baller. Dessert and cooking type pears can also be cooked in compotes, tarts, pies, terrines, trifles, pastries, cakes and the famed *Poires Belle Helene* (poached pears with vanilla ice cream and hot chocolate sauce). Pears are excellent for making a pear sherbert where the peeled pear is blended with sugar and a little lemon juice and freeze. Pears also make marvelous fritters and go well with ingredients such as nuts, spices, port and masala. Cooked pears are relished in savoury dishes with game and duck – made into chutney or casseroled with game birds or venison. Pears can be preserved or candied with sugar and vinegar or pickled with mustard seeds and horse radish. Pears are excellent for canning, they are peeled, halved, quartered or diced into pieces and cooked in syrup before canning. Peeled pears are also dried, crystallized and distilled into spirits like *eau-de-vie de poires, Poire William* and *Perry.*

## Botany

Small to medium sized, deciduous tree, 10–15 m high with an upright, conical crown and slender branches. Bark gray-brown to reddish brown bark, with shallow furrows and flat-topped scaly ridges. Branchlets tomentose when young, glabrous and brownish red when old. Leaves alternate, simple, ovate to elliptic, 2–7 cm by 2–3.5 cm, acute or short acuminate, base rounded or subcordate, margin serrate-crenate, shiny green above, paler and dull below (Plates 1 and 2); petioles 1.5–5 cm, slender; stipules caducous, linear-lanceolate, membranous. Raceme umbel-like, 6–9-flowered with caducous, linear-lanceolate bracts at the apex of a spur. Flowers 2.5–3 cm across, white, bisexual (Plate 1). Hypanthium

**Plate 1** Packham Pear leaves and flowers after anthesis

**Plate 2** Developing Packham pear fruits and leaves

**Plate 3** Developing Beurre Bosc pear fruits and leaves

**Plate 4** Harvested ripe Packham pears

**Plate 5** Harvested ripe Beurre Bosc pears

**Plate 6** Red Williams pears

campanulate, abaxially pubescent. Sepals deltoid-lanceolate, 5–9 mm, both surfaces pubescent, persistent. Petals white, obovate, 1.3–1.5 × 1–1.3 cm, base shortly clawed. Stamens 20, half as long as petals. Ovary 5-loculed, with 2 ovules per locule; styles 5, pubescent basally. Fruit a pome obovoid, turbinate or subglobose, 4–8 cm wide × 4.5–9.5 cm long, 5-loculed, pale green, yellow, brown or reddish tinged, dotted (Plates 3, 4, 5, 6, 7, 8a, 8b, 9a, 9b, 10a, 10b). Flesh juicy, soft, pale yellowish-white and sweet when ripe.

## Nutritive/Medicinal Properties

Pears are rich in nutrients and phytonutrients such as antioxidants. Proximate nutrient composition of fresh pear fruit (*Pyrus communis*) per 100 g edible portion excluding refuse 10% of the core, seeds and stem was reported as follows (UDSDA 2011): Water 83.71 g, energy 58 kcal (242kJ), protein 0.38 g, total lipid (fat) 0.12 g, ash 0.33 g, carbohydrate 15.46 g, fibre (total dietary)

**Plate 7** Bartlett pears


**Plate 9a** Harvested Corella pears


**Plate 8a** Williams pears (side view)


**Plate 9b** Close-view Corella pears


**Plate 8b** Williams pears (top view)


**Plate 10a** Miniature paradise pears 4–4.5 cm by 3.6–4.5, pale yellow


**Plate 10b** Miniature paradise pears, sweet, crunchy, white fleshed

3.1 g, sugars (total) 9.8 g, sucrose 0.78 g, glucose 2.76 g, fructose 6.23 g, lactose 0.01 g, maltose 0.01 g; minerals Ca 9 mg, Fe 0.17 mg, Mg 7 mg, P 11 mg, K 119 g, Na 1 mg, Zn 0.10 mg, Cu 0.082 mg, Mn 0.049 mg, F 2.2 μg, Se 0.1 μg; vitamins – vitamin C (ascorbic acid) 4.2 mg, thiamine 0.012 mg, riboflavin 0.025 mg, niacin 0.157 mg, pantothenic acid 0.048 mg, vitamin-6 0.028 mg, folate (total) 7 μg, total choline 5.1 mg, betaine 0.2 mg, vitamin A 23 IU, vitamin E (α-tocopherol) 0.12 mg, γ-tocopherol 0.03 mg, vitamin K (phylloquinone) 4.5 μg; lipids – total saturated fatty acids 0.006 g, 16:0 (palmitic acid) 0.005 g, 18:0 (stearic acid) 0.001 g; total monounsaturated fatty acids 0.029 g, 16:1 undifferentiated (palmitoleic acid) 0.001 g, 18:1 undifferentiated (oleic acid) 0.025 g; total polyunsaturated fatty acids 0.055 g, 18:2 undifferentiated (linoleic acid) 0.029 g; phytosterols 8 mg; amino acids – tryptophan 0.002 g, threonine 0.011 g, isoleucine 0.011 g, leucine 0.019 g, lysine 0.017 g, methionine 0.002 g, cystine 0.002 g, phenylalanine 0.011 g, tyrosine 0.002 g, valine 0.017 g, arginine 0.010 g, histidine 0.002 g, alanine 0.014 g, aspartic acid 0.105 g, glutamic acid 0.030 g, glycine 0.013 g, proline 0.021 g, serine 0.015 g; β-carotene 13 μg, β-cryptoxanthin 2 μg, and lutein + zeaxanthin 45 μg.

Studies showed that different European pear (*P. communis*) cultivars differed in their contents of different sugars and organic acids (Hudina and Štampar 2000). The fructose content in 18 European pear cultivars ranged from 23.7 to 66 g/kg and sorbitol varied from 12.5 to 24.9 g/kg. The early cultivars of pears contained more than 1 g/kg of citric acid and the late ones less than 1 g/kg. The Asian pear cultivars contained more total sugars than the European ones.

The total organic acid content in fruit of *P. communis* cultivars ranged from 0.86 to 3.51 mg/g FW (fresh weight) (Sha et al. 2011). Malic, citric, oxalic, shikimic, and fumaric acids were detected in all 10 cultivars, whereas tartaric and lactic acids were detected in only 4 cultivars. Malic and citric acids were the major constituents. The citric acid content was higher than the malic acid content in 1 cultivar. The malic acid content ranged from 0.69 to 2.61 mg/g FW accounting for 32–82% of the total, followed by citric acid with a content of 0.01–1.35 mg/g FW accounting for 1–52% of the total. The minor organic acids in the fruit were oxalic acid (0.01–0.24 mg/g FW) and acetic acid (0–0.30 mg/g FW), accounting for 0.4–11% and 0–10% of the total organic acid content, respectively. The content of quinic, shikimic, succinic, fumaric, tartaric, and lactic acids were relatively low. The organic acid composition among the cultivars did not differ significantly.

Similar dynamic patterns were found in the glucose, fructose, sucrose and sorbitol contents in leaves and fruits of the genetically related pear cultivars ‘Conference’ and ‘Concorde’ (Hudina et al. 2007). Leaf sugar was low at the beginning of the growing season when the leaves were not completely developed. Generally when sucrose increased in leaves it decreased in fruits. At the end of June the total sugar content in leaves reached its peak then rapidly decreased. At the same time, total sugar in fruits increased. From the beginning of August, total sugars in fruits increased regardless of the sugar content in leaves and likely due to decomposition of starch. After harvest, the contents of individual sugars (glucose, fructose, sucrose, and sorbitol) in the leaves decreased until the beginning of October when, just prior to leaf drop, they increased in all cultivars.

The average concentration of phenolic compounds in the Portuguese pear cultivar (*Pyrus*

*communis* L. var. S. Bartolomeu) harvested at commercial maturity stage was 3.7 g/kg of fresh pulp (Ferreira et al. 2002). Procyanidins were the predominant phenolics (96%), hydroxycinnamic acids (2%), arbutin (0.8%), and catechins (0.7%) were also present. The most abundant monomer in the procyanidin structures was (−)-epicatechin (99%). Sun-drying of these pears caused a decrease of 64% (on a dry pulp basis) in the total amount of native phenolic compounds. Hydroxycinnamic acids and procyanidins showed the largest decrease; the B2 procyanidin was not found at all in the sun-dried pear. Less affected were arbutin and catechins. Arbutin and chlorogeinc acids were found to be important phenolic compounds in pears (Cui et al. 2005). The mean concentration of arbutin in 3 pear cultivars was 0.083 mg/g FW and the mean concentration of chlorogenic acid was 0.309 mg/g FW as reported by analysis conducted in China. The main phenolic compounds in the fruit skin were arbutin and chlorogenic acid (Lin and Harnley 2008). Common pear was grouped into Group 4 that included Bartlett, Beurre, Bosc, Comice, D'Anjou, Forelle, Peckham, Red, Red D'Anjou, and Seckel. All were found to contain significant quantities of isorhamnetin glycosides and their malonates and lesser quantities of quercetin glycosides. Red D'Anjou, D'Anjou, and Seckel pears also contained cyanidin 3-O-glucoside.

Arbutin (hydroquinone-β-D-glucoside) was found to be synthesized in young pear leaves from shikimic acid, and more readily from phenylpropanoid compounds (Grisdale and Towers 1960). Flavonoids found in pear leaves included phloretin, phloridizin, (+)-catechin, (−)-catechin, apigenin, cosmosiin, luteolin and cinaroside (Kislichenko and Novosel 2007).

High molecular weight material recovered from the culture filtrate of cell suspension cultured *Pyrus communis* was found to compose of 81% carbohydrate, 13% protein and 5% inorganic material (Webster et al. 2008). The high molecular weight extracellular material consisted of three major and two minor polysaccharides: a (fucogalacto)xyloglucan (36%) in the unbound neutral Fraction A; a type II arabinogalactan (as an arabinogalactan-protein, 29%) and an acidic (glucurono)arabinoxylan (2%) in Fraction B; and a galacturonan (33%) and a trace of heteromannan in Fraction C. The main amino acids in the proteins were Glx, Thr, Ser, Hyp/Pro and Gly. The major proteins detected were two chitanases, two thaumatin-like proteins, a β-1,3-glucanase, an extracellular dermal glycoprotein and a pathogenesis-related protein.

Hydroquinone derivatives (arbutin and pyroside) were found in the flowers of four Polish pear cultivars (Rychlińska and Gudej 2003). Three triterpenoids were isolated from the stem bark of *Pyrus communis* and identified as lup-20(29)-ene-3α, 27-diol, lup-20(29)-ene-3α-ol and lup-20(29)-ene-3α, 28-diol (Mehta et al. 2003).

### Antioxidant Activity

When compared to the studied varieties Comice, Abate, General Leclerc and Passe Crassane, Rocha pear (peel and flesh) presented the highest content of total phenolics (Salta et al. 2010). Among them, chlorogenic, syringic, ferulic and coumaric acids, arbutin and (−)-epicatechin were detected as major components. In addition, among the tested varieties, Rocha pear presented the best antioxidant activities in the DPPH radical scavenging and ferric reducing power assays.

### Antiulcer Activity

Highly polymerized procyanidins extracted from 'Winter Nélis' pear fruit, orally administered (20 mg/rat) before 60% ethanol treatment, exhibited a high level of antiulcer capacity whereas chlorogenic acid alone seemed to have a negative effect (Hamauzu et al. 2007). The percentage of lesion area to total gastric surface area (ulcer index) increased with increases in ethanol concentration (40–80%) and the length of time after ethanol treatment (60–120 minutes). The trend of myeloperoxidase activity was similar to the trend of the ulcer index. A mixture of those polyphenols had a significant protective effect. The results suggested that the antiulcer effect of pear procyanidins may be due to their strong antioxidant activity.

### *Anticancer Activity*

An aqueous extract of *Pyrus communis* twigs showed inhibitory effect against S-180 sacrcoma cells (Liu and Zuo 1987). Hydroquinone isolated from the twig exhibited inhibitory effect against S-180 sarcoma cells (47.5%).

### *Antibacterial Activity*

Eight compound isolated from *Pyrus communis* twigs were identified as nonacosane (1), lupeol (2), β-sitosterol (3), betulin (4), betulinic acid (5), daucosterol (6), hydroquinone (7) and arbutin (8) (Liu and Zuo 1987). It was shown that the compounds 2, 3, 4, 5, 6 and 8 possessed some bacteriostatic activity against *Escherichia coli, Salmonella typhi, Shigella flexneri* and *Staphylococus aureus*. Ethyl acetate extract of *Pyrus communis* fruit was reported to exhibit antimicrobial activity against selected bacteria but not against fungi (Guven et al. 2006).

### *Allergenic Activity*

Pear is known as an allergenic food involved in the 'oral allergy syndrome' which affects a high percentage of patients allergic to birch pollen. Karamloo et al. (2001) isolated Pyr c 1, the major allergen from pear (*Pyrus communis*), and characterised as a new member of the Bet v 1 allergen family. The IgE binding characteristics of rPyr c 1 appeared to be similar to the natural pear protein. The biological activity of rPyr c 1 was equal to that of pear extract, as indicated by basophil histamine release in two patients allergic to pears. The related major allergens Bet v 1 from birch pollen and Mal d 1 from apple inhibited to a high degree the binding of IgE to Pyr c 1, whereas Api g 1 from celery, also belonging to this family, had little inhibitory effects, indicating epitope differences between Bet v 1-related food allergens.

### *Traditional Medicinal Uses*

The fruit is regarded as astringent, febrifuge and sedative in folk medicine.

## Other Uses

Pear trees are sometimes used as part of a shelterbelt planting. A yellow-tan dye is extracted from the leaves. It provides a heavy, tough, durable, fine grained, hard-wood that is used by cabinet and instrument makers. When covered with black varnish it is an excellent ebony substitute.

## Comments

Cultivars of *Pyrus communis* are quite distinct from Asian pear cultivars. *Pyrus communis* exhibits a closer genetic relationship with Xinjiang pear (*P. sinkiangensis*) among the Asian pears cluster.

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