

## Chapter 8. **Rosaceae: The rose family**

# The rose family:

## Rosaceae

### ROSACEAE (Rose Family)

**General physiognomy.** Plants of highly variable habits and leaf designs, from herbaceous ephemerals to long-lived woody shrubs and trees. Flowers with five separate sepals, five separate petals, and numerous stamens attached to a shallow cuplike or bowl-shaped hypanthium, derived from an enlargement of the floral receptacle.

**Vegetative morphology.** Herbaceous annuals, perennials, shrubs, and small trees with alternate leaves that often bear stipules. Leaves may be simple, highly dissected, compound, entire, or toothed.

**Reproductive morphology.** Flowers red, pink, yellow, or white; tiny to large; with an enlarged receptacle or hypanthium resembling single roses, arranged in various ways, from solitary flowers to racemes and spikes. Generally five sepals, five petals, and numerous stamens attached to the saucer- or bowl-shaped hypanthium. Pistils may be single with a superior to inferior ovary, multiple on an enlarged receptacle, or borne inside an enlarged hypanthium. The family has a multiplicity of fruits, including achenes, follicles, drupes, accessory fruits, aggregate fruits, and pomes. None of the members of the family, however, harbors true capsules or berries.

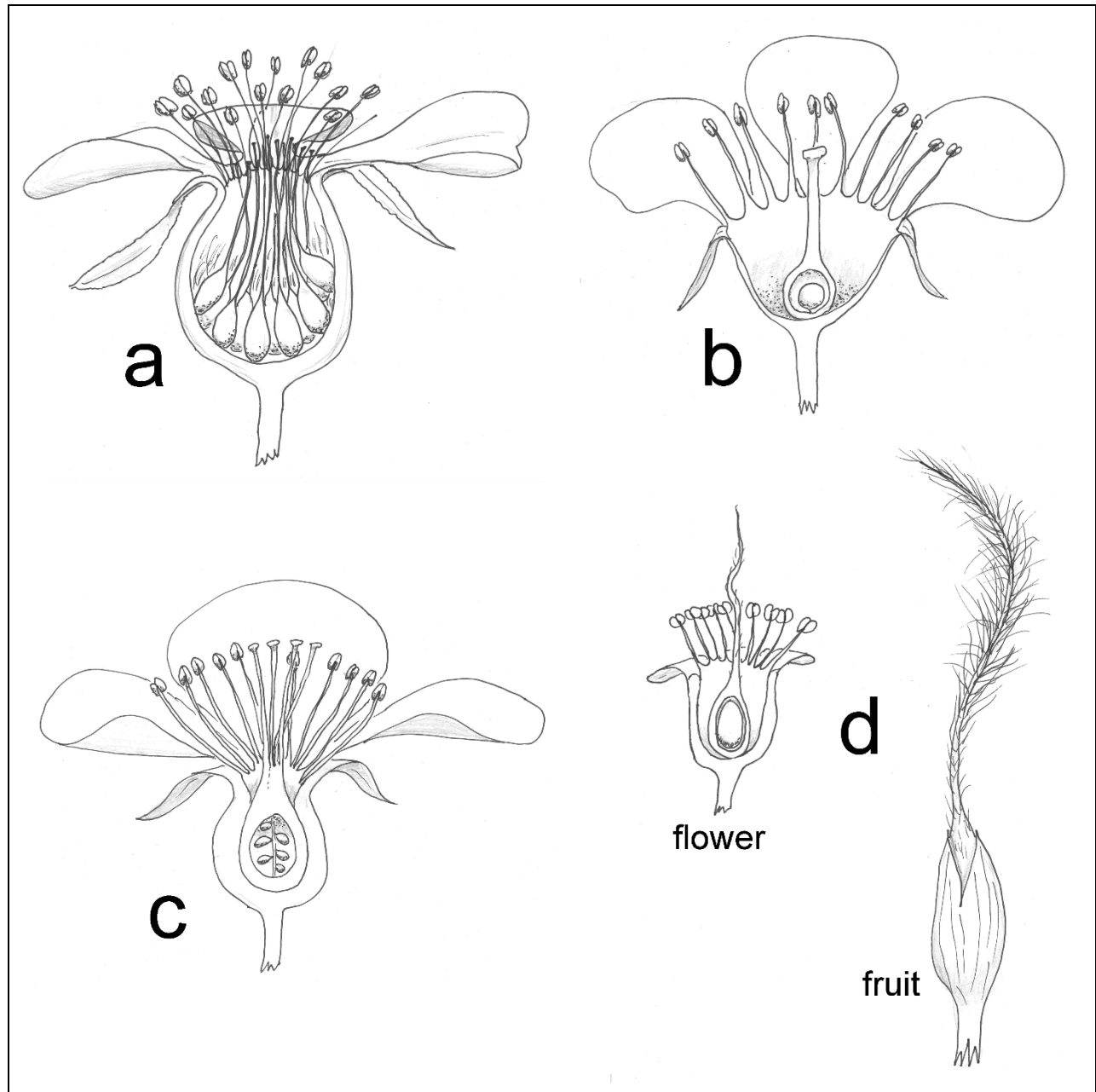
**Subfamilies.** In the California flora the family can be divided into four subfamilies: **Rosoideae**, the rose subfamily; **Prunoideae**, the cherry subfamily; **Maloideae**, the apple subfamily, and **Spiraeoideae**, the mountain mahogany subfamily:

1. In the subfamily **Rosoideae** many apocarpous pistils mature separately into achenes (as in the rose) or drupelets (as in the raspberries) and form aggregated fruits.
2. In the **Prunoideae** a single monocarpellate pistil matures into a relatively large, one-seeded drupe, as in the cherries and peaches.
3. In the subfamily **Maloideae** the ovary is inferior, completely surrounded by the overgrowth of the hypanthium, and, as a result, the fruit is a pome.
4. Finally, in the subfamily **Spiraeoideae** the gynoecium consists of one to many apocarpous pistils that mature into dry follicles bearing one or many seeds, or into wind-dispersed achenes with a plumose style that aids in wind dispersal.

**Taxonomic relationships.** The flower design of the Rosaceae is reminiscent of some members of the buttercup family (Ranunculaceae) but the herbaceous roses have stipules on their leaves and a row of sepal-like bracts outside the actual sepals. Some of the species with small flowers also have a design like certain saxifrages (Saxifragaceae), but saxifrage flowers lack sepal-like bracts and generally have two separate to partly joined pistils.

**Biodiversity and distributions.** A prominent family of 3,000 species found throughout the world but with the greatest diversity in the northern hemisphere.

**Economic uses and ethnobotany.** The family is noted for its wide variety of edible fruits including apples, pears, peaches, plums, cherries, almonds, strawberries, raspberries, and more. The rose, arguably the world's most popular flower, is a phenomenon in gardens and for the cut-flower trade, with hundreds of named cultivars. Many other ornamentals for gardens include a large array of shrubs and flowering trees. Attar of roses, also called essence of rose, is a fragrant essential oil distilled from fresh petals of *Rosa damascena*, cultivated in Anatolia (Turkey) and Bulgaria. Rose oils are a valuable ingredient of fine perfumes and liqueurs.



**The Rosaceae at a glance:** Despite their highly variable morphologies, plants in the family are recognizable by their five separate petals and numerous stamens, attached to a bowl-shaped hypanthium derived from the enlargement of the floral receptacle. (a) Plants in the subfamily **Rosoideae** have many pistils maturing separately while attached to a fleshy enlarged receptacle to form aggregated fruits (*Rosa californica*). (b) The **Prunoideae** have a one-ovuled pistil that develops into a one-seeded drupe (*Prunus ilicifolia*). (c) The **Maloideae** have a single pistil formed by the fusion of 5 or less carpels fused to a surrounding hypanthium to yield a pome (*Heteromeles arbutifolia*). (d) The **Spiraeoideae** have separate dry carpels that ripen into follicles bearing one or many achenes (*Cercocarpus betuloides*).

## Darwin at the fruit market: The evolution of fruits in the Rosaceae



Vincenzo Campi (1536–1591) Fruit Seller (Wikimedia Commons) with added Darwin portrait.

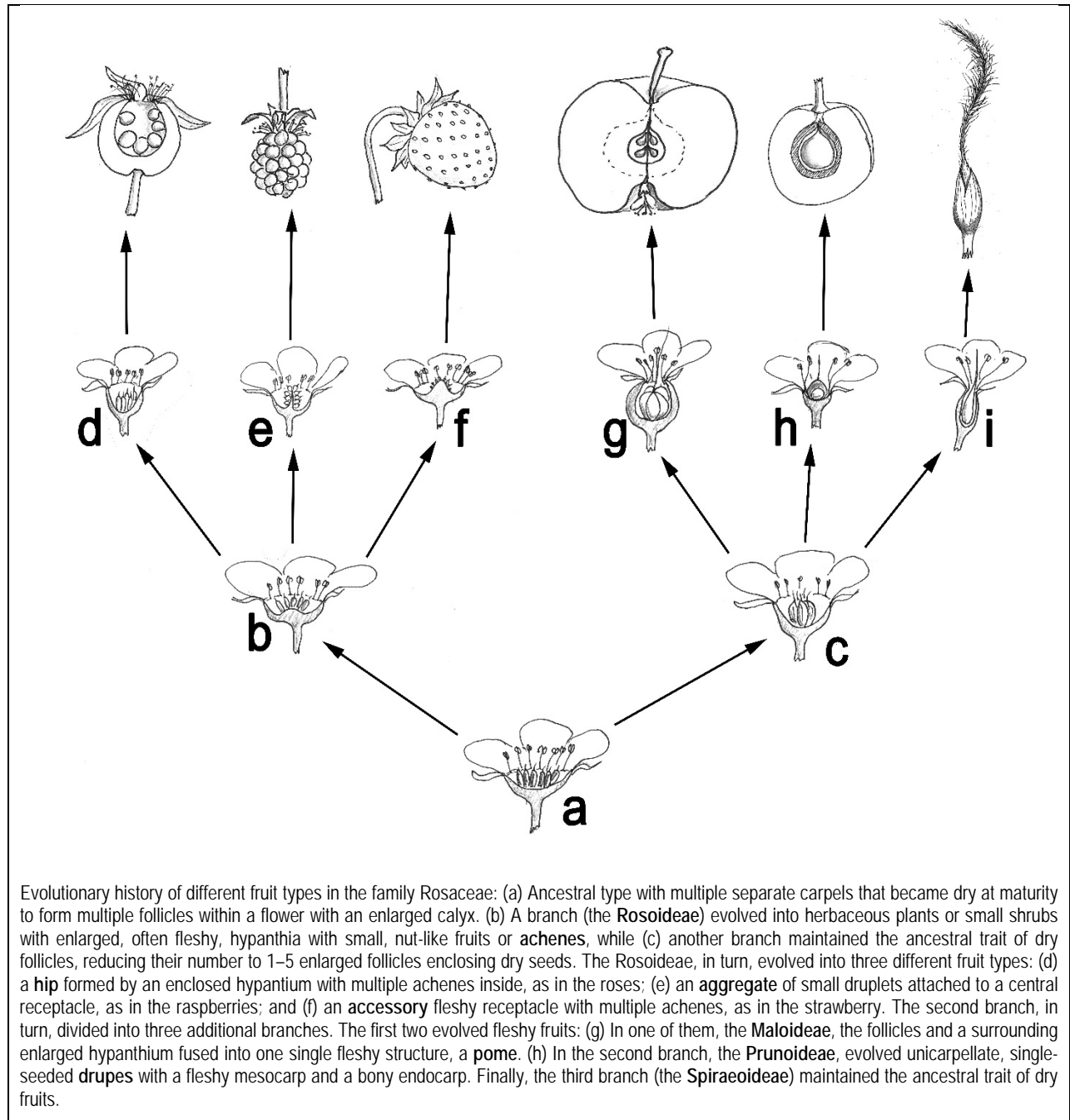
The family Rosaceae provides humans with an extraordinary diversity of fruits like apples, pears, quinces, loquats, apricots, plums, cherries, peaches, almonds, raspberries, sloes, rose hips, and strawberries, to name just a few. The contrasting forms and shapes is so striking that the family has been subdivided into subfamilies taking the type of fruit as the main distinctive character.

Indeed, the diversity of fruits in the Rosaceae is unparalleled; the family provides us with sweet flavorful products in the form of drupes, pomes, and aggregate fruits of different types. Evolutionary biologists are still trying to answer the question of how can a single family, with remarkably similar flowers, have evolved fruits as contrastingly

different in size and shape as the ones in this family.

Studies in molecular biology\* have shed light on the evolution of fruit morphology in the Rosaceae. The ancestor of the family had multiple separate carpels that became dry at maturity to form multiple follicles within a flower with an enlarged calyx, quite similar to the floral morphology of modern buttercups. A branch within this original lineage evolved into herbaceous plants or small shrubs with composite leaves and enlarged, often fleshy, hypanthia. This lineage gave origin to the subfamily **Rosoideae**, that includes roses (*Rosa* sp.), strawberries (*Fragaria* sp.), and raspberries (*Rubus* sp.). A second branch in the evolutionary tree of the family maintained the ancestral trait of dry fruits, developing 1–5 enlarged follicles enclosing dry seeds or **achenes**. This branch—the **Spiraeoideae**—includes the dry-carpelled members of the family like the chamise (*Adenostoma fasciculatum*) and the mountain mahogany (*Cercocarpus betuloides*). In a third branch of the family the follicles and the surrounding hypanthium fused into one single structure and became fleshy, as a result of selection for fruit dispersers, giving origin to the inferior-ovary branch of the family, the **Maloideae**. Finally, a last branch evolved from single-carpelled, single-seeded flowers in which the ovary developed a fleshy mesocarp and a bony endocarp to form a drupe, giving origin to the cherry subfamily, the **Prunoideae**.

\* Xiang, Y. et al. 2016. Evolution of Rosaceae fruit types based on nuclear phylogeny in the context of geological times and genome duplication. *Mol. Biol. Evol.* 34(2):262–281.



**California genera and species.** The region has 26 native genera and three nonnative genera. Some of the most common species in the Inland Empire are the following:

*Prunus ilicifolia* (holly-leaf cherry) – Small tree of foothill chaparral, yields a small drupe with a thin, bittersweet mesocarp.



*Heteromeles arbutifolia* (toyon) – Evergreen shrub of moist chaparral slopes. The small (2–4 mm) apple-like pomes ripen in fall.



*Rosa californica* (California rose) – Small shrub forming dense thickets with decumbent, very prickly stems. Small pink roses borne on terminal stem shoots.



*Rubus ursinus* (California blackberry) – A widespread native of riverbanks and moist canyons. Plants are often monoecious (one-sexed).



*Adenostoma fasciculatum* (greasewood, chamise) – Dominant component of the chaparral; small flowers in densely clustered panicles, fruits are dry achenes.



*Cercocarpus betuloides* (mountain mahogany) – Common in foothill chaparral with dense, birch-like leaves. The fruit is a large, single-seeded achene with a plumose spiral tail developed from the enlarged style.

