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Editorial

Towards multifunctional ornamental horticulture

Rumo a uma horticultura ornamental multifuncional

Chao Yu[1,*]

[1] Beijing Forestry University, Beijing, China.

Ornamental horticulture has evolved beyond its traditional focus on aesthetics to become a multifunctional system that provides a range of benefits, including landscape enhancement, ecological services, health benefits, and productive value. The appeal of ornamental plants lies primarily in their aesthetic qualities and their role in garden design. Flower and leaf characteristics, plant form, and fragrance collectively determine their ornamental value while contributing to the seasonal succession of blooms and the spatial layering of garden landscapes. Beyond their ornamental value, many species also serve as important food, medicinal, and industrial resources. Their petals, inflorescences, bulbs, and root bark contain a variety of bioactive and useful compounds, including sugars, carotenoids, polyphenols, terpenoids, and alkaloids, which have applications in food, pharmaceuticals, and the production of natural pigments, fragrances, and extracts. For example, lily bulbs are used as both food and traditional medicine, and their bioactivity has been linked to polysaccharides, saponins, and alkaloids. Similarly, chrysanthemum flower heads have a long history of use in teas and traditional medicine, owing to their flavonoids, chlorogenic acid, and volatile oils.

Reconciling ornamental quality with productive value within a single genotype requires an understanding of the relationships between biosynthetic pathways and the metabolites they produce. Under natural conditions, the accumulation of high-value secondary metabolites in fruits is generally limited, restricting their commercial exploitation. Advances in omics technologies have facilitated the systematic characterization of metabolic networks. Once key biosynthetic pathways have been identified, metabolic engineering and synthetic biology can be used to redirect metabolic fluxes and enhance the accumulation of target compounds. Such interventions can largely preserve the ornamental phenotype, thereby positioning fruiting ornamentals as renewable biological production platforms. However, ornamental quality and production functions are not necessarily compatible. Increases in fruit size, changes in pigmentation, or alterations in metabolite composition may disrupt the overall ornamental appeal of a plant. In addition, the use of these plants as raw materials requires careful evaluation of food safety and processing suitability. Fruits from various ornamental plant groups therefore represent potential sources of fragrances, natural pigments, and medicinal compounds, offering opportunities to integrate landscape and production value in ornamental horticulture.

Rosa holds a prominent position in ornamental horticulture, with exceptionally rich germplasm diversity, and has long served as a model genus for research on flower color, fragrance, and morphology (Fig. 1). Petals are not only the primary ornamental feature but also the main sites for the synthesis of terpenoids, phenylpropanoid pigments, and volatile aroma compounds. Considerable differences in metabolic profiles among cultivars provide valuable opportunities for investigating the genetic and biochemical basis of these traits. The fragrance of roses also underlies their long-established use in the fragrance industry, with essential oils and concretes from rose petals widely used in perfumery and household products. In some parts of Europe, rose hips have traditionally been used to make preserves, infusions, and health foods. In other regions, however, the fruits are generally removed during pruning, and established harvesting and processing practices remain lacking. Research on rose hips has focused on fruit morphology, quality assessment, compositional analysis, and processing applications. Substantial variation has been reported among accessions in the concentrations of sugars, organic acids, vitamin C, carotenoids, and phenolic compounds. In some wild species, ascorbic acid concentrations exceed 700 mg/100 g fresh weight.

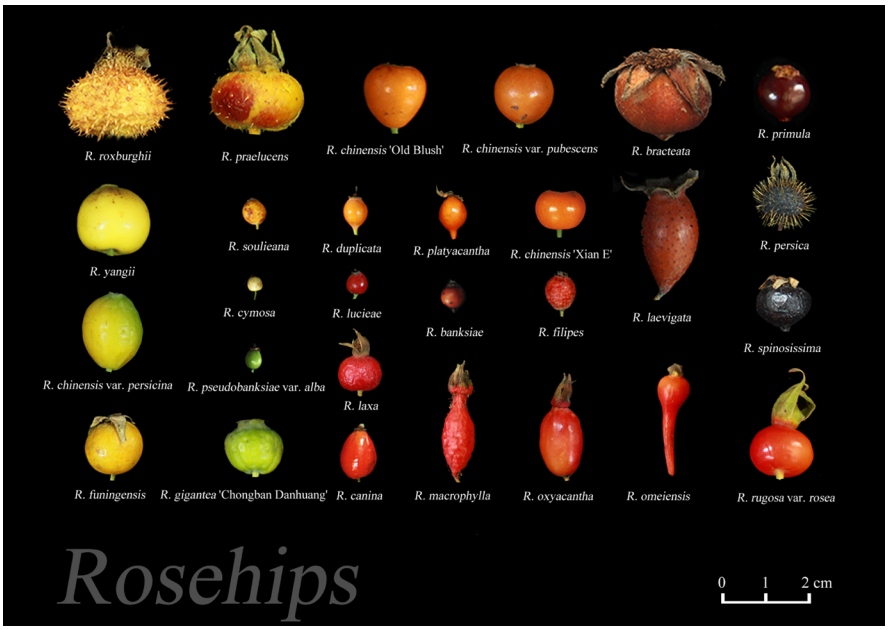

Fig. 1. Hip diversity in the genus *Rosa*

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Total phenolics and carotenoids contribute to fruit color and antioxidant capacity, while seed oil is rich in unsaturated fatty acids, particularly linoleic and α-linolenic acids. Most rose hip extracts exhibit pronounced antioxidant activity, highlighting their potential applications in functional foods, natural pigments, and fragrance products. Despite this potential, research on rose hips remains limited to a relatively small number of species worldwide. Metabolic regulation and processing suitability are still insufficiently characterized, while variations in quality associated with genotype, growing location, and fruit maturity hinder the establishment of a stable raw-material supply. Breeding efforts aimed at developing cultivars suitable for both flower and fruit production also remain limited. Furthermore, constraints in processing technologies continue to impede the transformation of rose hips from horticultural by-products into value-added products.

Future research should make better use of the existing *Rosa* germplasm collections by extending phenotypic and functional evaluations to wild accessions with fruit-bearing potential. Multi-omics approaches should be applied to elucidate the biosynthesis and accumulation of sugars, phenolic acids, carotenoids, and oils, as well as the genetic relationships between floral and fruit traits. These efforts would provide a basis for breeding strategies that jointly improve flower and fruit traits, with the aim of developing genotypes that combine high ornamental value with desirable nutritional qualities in the fruit. In parallel, processing technologies should be optimized to promote the value-added utilization of horticultural by-products. Together, these efforts would establish a continuous pathway from germplasm evaluation and mechanistic investigation to cultivar development and product formulation. This would help realize the dual potential of *Rosa* for producing both ornamental flowers and fruit and advance ornamental horticulture toward a multifunctional model that balances landscape benefits with resource production. In the long term, realizing the full value of rose hips will depend not on any single technological advance but on the coordinated development of germplasm evaluation, mechanistic research, breeding, and processing. Explicitly incorporating fruit traits into ornamental horticulture evaluation frameworks and establishing selection criteria that consider both flowers and fruits may therefore provide a more practical starting point.

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