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Value Addition of Chrysanthemum

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Abstract

Value addition in chrysanthemums enhances the intrinsic worth of these flowers through various modifications, making them more appealing and useful across different markets. This process is crucial in the floricultural and commercial sectors, aiming at maximizing profitability by transforming chrysanthemums into higher-value products. This chapter presents the most common value addition techniques for chrysanthemums. First, the dry flower technique preserves the natural beauty of flowers, extending their usability for a longer period. Methods such as air-drying, pressing, or chemical treatments of chrysanthemums make them suitable for decorative purposes year-round. Second, tinting enhances the economic and aesthetic value of chrysanthemums, particularly targeting simple white and light-colored flowers. By using food coloring dyes, these flowers are transformed into vibrant creations in a range of novel color shades, increasing their appeal in the floral market. Lastly, the culinary applications and the nutritional and medicinal value of edible chrysanthemums, such as garland chrysanthemum (*Chrysanthemum coronarium*) and chrysanthemum tea crafted from the dried flowers of *Chrysanthemum morifolium* and *Chrysanthemum*

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indicum, are explored. These applications not only utilize the flowers' aesthetic qualities but also capitalize on their health benefits.

Keywords

Dry flower technique, edible chrysanthemum, edible flowers, sustainability, tinting

12.1 Introduction

Chrysanthemums are among the most widely cultivated ornamental flowers globally, celebrated for their vibrant colors, diverse forms, and long-lasting blooms. Their versatility makes them popular as fresh-cut flowers, loose flowers, or potted ornamentals. Beyond their traditional role in ornamental horticulture, chrysanthemums hold immense potential for value addition, transforming their utility into various high-value products. The floriculture industry increasingly recognizes the economic and cultural importance of chrysanthemums, driving efforts to maximize their market potential through innovation and diversification. Value addition in chrysanthemums involves leveraging their inherent properties for diverse applications. This includes decorative uses, such as dry flower technology, which preserves the flowers' natural beauty for year-round purposes through techniques such as air-drying, pressing, or chemical treatments. Tinting is another innovative approach that enhances the aesthetic and economic value of chrysanthemums, especially for simple white and light-colored varieties. By introducing vibrant color shades using food dyes, these flowers become more appealing in the floral market, catering to evolving consumer preferences.

Additionally, chrysanthemums offer culinary and medicinal applications, particularly edible varieties such as *Chrysanthemum coronarium* and *C. morifolium*. Known for their bioactive compounds, including flavonoids and sesquiterpenes, these flowers provide antioxidant, anti-inflammatory, and antimicrobial benefits. Products such as chrysanthemum tea and essential oils cater to the growing demand for natural and wellness-oriented solutions, further expanding their market. Their cultural significance, particularly in Asia, adds another dimension to their value, as they are integral to traditional medicines, teas, and ceremonial uses. The concept of value addition not only enhances economic returns for growers but also aligns with sustainable agricultural practices by reducing postharvest losses and optimizing resource use. By exploring innovative processing techniques and targeting diverse markets, the chrysanthemum industry can transition from a traditional floriculture sector into a dynamic contributor to global agribusiness. This chapter delves into the strategies, applications, and future potential of value addition in chrysanthemums, discussing their role in fostering a diversified and sustainable floral economy.

12.2 Dry Flower Technology in Chrysanthemum

Dry flower technology offers extensive potential as an eco-friendly, durable, and versatile alternative to fresh flowers for various decorative and commercial purposes. Dried flowers extend usability beyond seasonal constraints,

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significantly contributing to global floriculture industry (Singh and Laishram, 2010; Kumari, 2022). The practice of drying flowers to preserve their beauty and extend their usability beyond the natural bloom period is a tradition with deep historical roots. The technique of drying flowers, known as "Oshana," in Japan, originates in Asia before spreading to Europe, revered for its ability to maintain the aesthetic qualities of flowers indefinitely (Bhutani, 1990; Joyce, 1998). In the floriculture sector, dry flower production has become a significant industry, particularly in India, which has emerged as one of the leading exporters of dry floral and plant products globally (Rajaram *et al.*, 2009). This industry not only caters to traditional uses such as herbariums and botanical identification but has also carved out a substantial niche in the decorative arts and commercial sectors, from home décor to fashion industry. In today's shift from eco-consciousness to sustainability, the use of natural plant products such as dried flowers, petals, leaves, stems, seeds, and roots has become a primary choice among urban populations for interior decoration, as well as for aesthetic and commercial purposes (Dhatt *et al.*, 2007). India's dry flower market has achieved remarkable growth, with a business volume reaching around $12 million, dominated by products such as potpourri that alone accounts for $6.6 million (Sindhuja *et al.*, 2017). The annual growth rate of 8–10% in demand for dry flowers signals expanding opportunities for entrepreneurs within the global floricultural trade (Singh, 2009).

Chrysanthemums, with their vibrant colors and intricate petal structures, are particularly well suited for dry flower preservation, enabling their use in everything from greeting cards to floral designs and festive decorations. Traditionally and spiritually, chrysanthemum flowers are revered in various religious contexts, often used in temples, churches, and gurdwaras, where their role in worship is significant. Due to their perishable nature, these flowers unfortunately do not retain their beauty for long and typically become waste after their ceremonial use. Recently, however, dry flower technology has been employed to extend their usefulness. By preserving worshipped flowers, this technology facilitates the creation of value-added products, thereby sustaining their spiritual and aesthetic significance beyond the initial ritual context (Vikas Kumar, 2022a). This section delves into how dried chrysanthemums are utilized in creating long-lasting floral arrangements, wreaths, and other decorative items, displaying their enduring appeal in home décor and fashion industries. As we explore the art and science of drying chrysanthemums, we will highlight their unique characteristics that make them ideal for preservation and their versatile use in various artistic and commercial applications. We will also discuss the various drying methods, including air, sun, oven, and microwave drying, as well as more sophisticated techniques such as freeze-drying and embedded drying (Bhattacharjee and De, 2003).

12.2.1 Selection criteria in chrysanthemum for drying purpose

Selecting chrysanthemums for drying involves considering several key criteria to ensure the flowers preserve well and maintain their aesthetic qualities. Here

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are the main factors to consider when selecting chrysanthemums for drying purposes:

12.2.1.1 Flower maturity/optimal harvesting stage

Choose flowers that are just at or slightly before peak bloom. Flowers that are too mature may lose petals during the drying process, while those that are not mature enough may not display their full color and shape. For air-drying, select flowers at the bud or partially opened stage, as these will continue to open during the drying process, which is crucial for achieving the best aesthetic in naturally shrunken and rustic-looking blooms.

12.2.1.2 Varietal characteristics

The variety of chrysanthemum affects how well the flowers will hold up and maintain their shape during drying.

- **Robustness and suitability:** Some cultivars are more robust and suitable for drying than others. Choose those known to respond well to your chosen drying method and avoid varieties prone to color fading or petal drop.
- **Color retention:** Some varieties of chrysanthemums retain their color better than others when dried. Typically, deeper and brighter colors yield more vivid results post-drying.
- **Petal density and structure:** Flowers with denser petals tend to dry better, retaining more of their original form and structure.
- **Shape and size:** Consider the shape and size of the flowers in relation to their intended use post-drying. Larger flowers may require longer drying times or specific methods such as freeze-drying to preserve their shape accurately.
- **Stem length:** Consider the final use of the dried flowers. If requiring long stems for versatility in arrangements, air-drying is preferable. If the design permits shorter stems, the silica gel method might be more appropriate due to its superior color and form retention.

12.2.1.3 Health of the flowers

Only healthy flowers free from pests, diseases, and blemishes should be chosen, as damaged or diseased flowers will not dry well and can deteriorate further during the process.

12.2.1.4 Moisture content

Flowers with lower initial moisture content will dry faster and are less likely to mold (surface growth of fungus, especially on damp or decaying matter). Avoid flowers that have been rained on recently unless they can be thoroughly dried before the process begins.

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12.2.1.5 Harvesting time

Harvest chrysanthemums in the late morning after the dew has evaporated to reduce excess moisture and facilitate a more consistent drying process.

12.2.1.6 Overall aesthetics and appearance post-drying

Consider how the flower's appearance will change after drying and select varieties that are known to maintain their aesthetic appeal.

12.2.1.7 Drying method compatibility

Different drying methods may require specific flower traits. For example, flowers intended for microwave drying should be uniform in size and moisture content for uniform drying.

12.2.1.8 Intended use

The purpose for which the flowers are dried can also influence selection. Long stems provide more flexibility for floral arrangements and designs, while short stems are suitable for compact craft arrangements where the focus is on the bloom itself.

12.2.2 Different drying techniques for chrysanthemums to enhance preservation and quality

Dehydration is a crucial process for extending the storage life of flowers, enabling the preservation of their physical and biochemical properties. This process is essential for inhibiting enzymatic degradation and preventing microbial growth, thus maintaining the integrity of the flowers for longer periods (Ahrne *et al*., 2007; Pereira *et al*., 2007). Additionally, dehydration facilitates the extraction of valuable pigments. The period from harvesting to consumption can be lengthy, during which biochemical changes may affect the nutraceutical value of chrysanthemum flowers. Dehydration techniques significantly impact the retention of total anthocyanins and their antioxidant activities. Therefore, it is crucial to optimize various dehydration methods to maximize the retention of these beneficial compounds for edible or nutraceutical purposes. The quality and appearance of dried flowers are significantly influenced by the drying method employed (Pant and Singh, 2023). Each drying method affects the texture, color, and structural integrity of chrysanthemums differently, making the choice of technique crucial depending on the desired outcome of the drying process. Each drying method has its specific applications and benefits, and selecting the right one depends on factors such as the intended use of the dried flowers, desired quality of the product, and available resources. Recent studies and experiments have continuously explored and optimized these methods to enhance the ornamental and commercial value of dried chrysanthemums:

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12.2.2.1 Air-drying

This method involves hanging plant materials on ropes or wires in either dark or sunny conditions for expedited drying. It requires a warm, clean, dark, and well-ventilated area with low humidity (Raghupathy *et al.*, 2000). Alternatively, flowers can also be spread over blotting sheets or newspapers under similar conditions (Datta, 1997). For chrysanthemums, it is advisable to start the drying process when the flowers are at the bud or partially opened stage, as they continue to open while drying (Sell, 1993).

12.2.2.2 Shade drying

Commonly used for producing powders for the food and feed industries, shade drying has drawbacks such as contamination risks, especially during rainy seasons, and prolonged drying times (Maskan, 2000).

12.2.2.3 Oven-drying

Hot air and microwave ovens provide faster drying, with controlled temperatures tailored to the specific plant species. Higher temperatures accelerate transpiration and moisture vaporization, potentially causing significant moisture loss in a short time and adversely affecting carotenoid content (Mayak and Halevy, 1980). Oven-drying at moderate temperatures (40°C) for 35–50 hour can preserve the color and structure of chrysanthemums without altering the physical dimensions of the floral parts. (Pandya *et al.*, 2001). Drying in a hot air oven or embedding in borax or sawdust are particularly effective methods for rapid drying and maintaining the aesthetic quality of dried chrysanthemum flowers (Mandal *et al.*, 2023).

12.2.2.4 Microwave drying

Microwave drying is the quickest method, though it may result in lower-quality flowers (Gurjar *et al.*, 2023). However, it is particularly effective for preserving key bioactive compounds in chrysanthemum flowers, maintaining high levels of anthocyanins and antioxidants crucial for enhancing the flowers' nutritional and pharmaceutical value. This method outperforms traditional methods such as shade drying and hot air oven-drying (Ullas *et al.*, 2018).

12.2.2.5 Press drying

Primarily used by botanists for herbarium preparations, this method involves placing flowers and foliage between newspaper sheets or blotting papers, spaced out to allow moisture to escape. Corrugated boards are incorporated between layers to facilitate vapor release. The process can be accelerated by placing the sheets in an oven at an appropriate temperature, typically

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around 50–60°C (Bhutani, 1990; Datta, 1997). Recently, Vikas Kumar (2022a) explored an innovative method of preserving chrysanthemum flowers that were collected after temple use. The flowers were dried using a wooden press for 4–5 days. During this process, the petals were evenly spread out on blotting paper, with additional layers of blotting paper placed between two wooden plates. This was done in a sandwich-like model, stacking approximately eight to ten wooden plates on top of each other to help preserve the original color of the flowers. The resulting flattened petals are ideal for artistic applications; they are tailored to fit printed images on various backdrop materials such as ivory sheets, canvas sheets, jute mats, photo paper, corrugated papers, and handmade papers. The dried florets are cut to match the shapes of the images and affixed with adhesive. To ensure longevity and protect against moisture, these floral images are encased in glass photo frames (Fig. 12.1). Properly sealed from moisture, these framed floral images can last more than 20 years.

12.2.2.6 Embedded drying

Various media, including sand, borax, silica gel, and sawdust, are used for embedding flowers. Sand and borax are cost-effective but require more time to effectively dry the flowers (Bhutani, 1990, 1995). A mix of borax and cornmeal has shown promising results for chrysanthemums, effectively retaining color and shape (Sell, 1993). Microwave oven-drying after embedding in silica gel has yielded the best color and shape retention (Bhalla *et al*., 2006). Embedding chrysanthemum flowers in silica gel and drying them at 50°C for 48 hour in a hot air oven produces high-quality dried flowers (Dahiya *et al*., 2003). Chrysanthemum flowers can also be preserved using a resin embedding technique (resin is a viscous substance that hardens to create a durable, glass-like finish, Vikas Kumar *et al*., 2022b). Initially, the flowers are dried in silica gel for 3–4 days. After this drying phase, they are placed into silicone molds filled with a resin solution. This solution is made by mixing two parts resin with one part hardener, stirred for 3–4 min to ensure proper mixing, and then poured into the molds to achieve a self-leveling effect. The silicone molds are used to create various decorative items such as name boards, paperweights, pen stands, and alphabet decorations. In embedded drying, the resin solution in the molds should reach a semisolid state before the dried flowers are carefully positioned within it. Once the resin partially solidifies around the flowers, an additional layer of resin is added to fill the molds and left to set overnight. This method effectively encapsulates chrysanthemum flowers in resin, enhancing their durability and aesthetic appeal. The resin preservation maintains the flowers' beauty for years, making them suitable for long-lasting decorative products (Vikas Kumar *et al*., 2022b; Fig. 12.2). Additionally, pretreating chrysanthemum flowers with a glycerol–water solution at a 1:3 ratio for 24 hour before embedded drying has proven beneficial.

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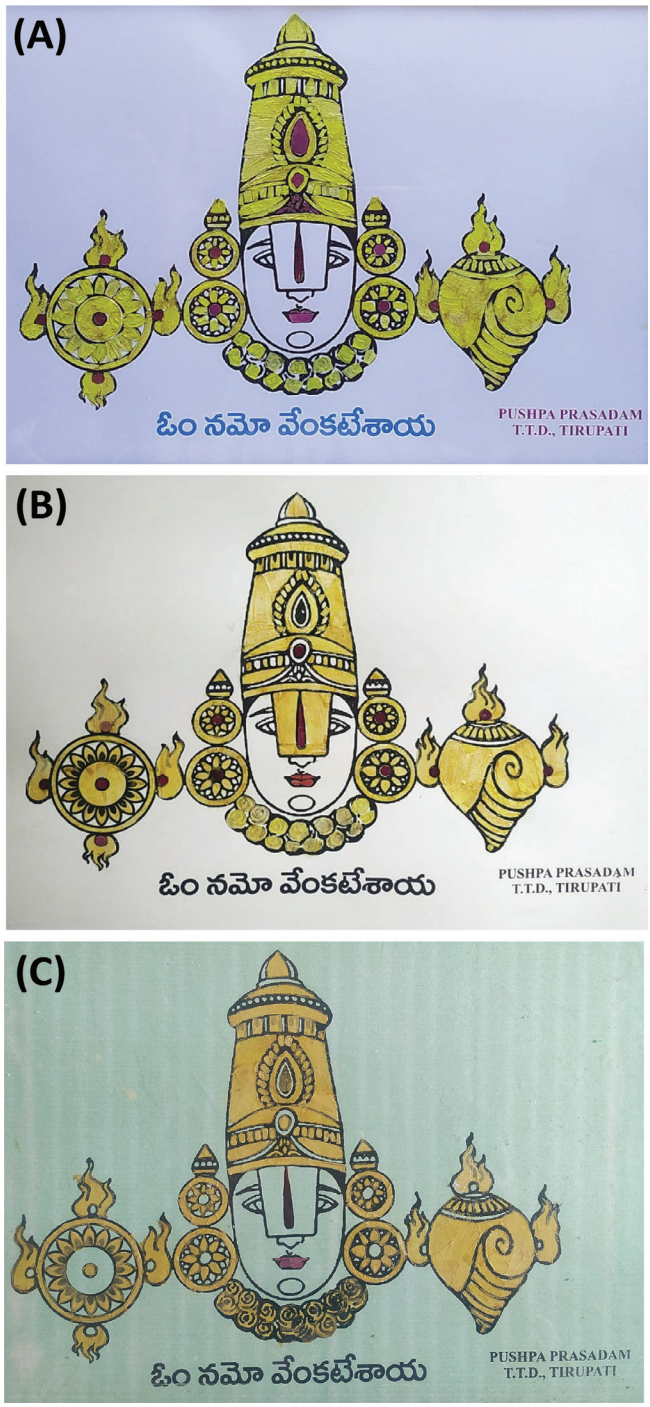


Fig. 12.1. Chrysanthemum petals pasted on various backdrop materials: ivory paper (A), canvas paper (B), and corrugated paper (C). (Photo courtesy of Vikas Kumar Galipothu.)

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12.2.3 Handling, packing, and storing of dry chrysanthemums

Handling, packing, and storing dried chrysanthemums require careful attention to maintain their delicate structure and visual appeal. During handling, it is crucial to be gentle and minimize direct contact, using tools such as soft brushes to adjust their position in a clean, dust-free environment. After the drying process, each flower or bunch of flowers should be carefully wrapped in soft tissue paper to provide cushioning and protection from physical damage. For packing, it is important to use supportive and moisture-proof materials, such as rigid boxes with soft internal padding, and to seal the flowers in airtight containers with silica gel packets to avoid humidity. These wrapped flowers should then be stored in cardboard boxes or cupboard drawers, which help maintain a cool, dry environment essential for their preservation. This setup not only absorbs any residual moisture but also ensures the flowers are kept in a state that prevents degradation. Moreover, it is crucial to store dried flowers away from direct sunlight in a dark, well-ventilated area to maintain their color and structure.

12.2.4 Designs and arrangements made from dried chrysanthemums

Dried flower arrangement is an art form that significantly enhances the beauty of interior spaces, emphasizing the quality of the products used. Dried flowers can be arranged in vases similar to fresh-cut flowers, either alone or combined with fresh blooms to create diverse floral arrangements. Here are some popular uses and designs made from dried chrysanthemums (Fig. 12.3):

12.2.4.1 Potpourri

Potpourri is a mixture of dried, naturally fragrant plant materials, often arranged in decorative bowls or sachets to make room smell fresh.

12.2.4.2 Bouquets

Dried flowers can be arranged into bouquets that maintain their beauty over time, without the need for water.

12.2.4.3 Frames and wall hangings

Pressed flowers and leaves are often used to create beautiful, framed art pieces or wall hangings that serve as permanent decorations.

12.2.4.4 Wreaths

Crafting wreaths from dried flowers and foliage is a popular way to create seasonal or year-round decorations for doors and walls.

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Fig. 12.2. Chrysanthemum flowers embedded in resin as paperweights. (Photo courtesy of Vikas Kumar Galipothu.)

12.2.4.5 Craft applications

Chrysanthemums offer unique potential for creative crafts. Pressed flowers can embellish greeting cards and bookmarks, adding a personal touch. Dried flowers embedded in resin create decorative paperweights, while laminated petals enhance table mats, blending functionality with aesthetic appeal (Fig. 12.2).

12.3 Tinting of Chrysanthemums

Tinting is a value-adding technique that involves the artificial addition of colors using food-grade dyes or color agents, particularly useful for species where natural color pigmentation is weak or absent. For chrysanthemums, globally recognized for their vivid and attractive colors, tinting offers a way to introduce a broader variety of hues, which can be specifically tailored to fit various decorative needs. Tinted flowers often command a premium on the market because they meet specific aesthetic requirements that natural colors cannot achieve (Fig. 12.4). Using dual colors in tinting allows the creation of two hues in a single bloom, adding a unique touch to bouquets, stage decorations, or general floral arrangements. Tinting chrysanthemums allows for creativity and innovation in floral design, making it possible to tailor the flowers to meet diverse and evolving consumer preferences. When opting for tinting in chrysanthemums, several factors must be considered. Color fastness is crucial, as some dyes may fade or leach when exposed to sunlight or water, affecting the flower's aesthetic appeal. Additionally, the health of the flower is important; tinting can reduce the longevity of the flowers as heavily dyed petals may clog the xylem, impairing the flower's ability to uptake water and sustain its freshness. Furthermore, while tinted chrysanthemums can command higher prices in the market, especially for

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Fig. 12.3. The versatility of dried chrysanthemum flowers for creative expression in home décor: bunch of dried chrysanthemums (A), small dried whitish-pink chrysanthemum flowers for floral ornaments (B), and hairpins adorned with chrysanthemum flowers (C). (From https://www.etsy.com)

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special events or in markets that value unique and vibrant colors, it is essential to balance the potential gains with the costs associated with the tinting process.

12.3.1 Dyes, methods of tinting, and considerations

Chrysanthemum flower stems treated with blue dye for 7.5 hour exhibited the highest vase life. Those treated with yellow dye for the same duration showed the maximum moisture content. Additionally, flowers tinted with blue, orange, or green dyes and placed in the dye for 10 hour received the highest consumer preference compared to quick dyeing due to their vibrant color and even distribution (Pavan *et al.*, 2022). Food-grade dyes are commonly used because they are safe and come in a variety of colors. The dyes are dissolved in water, sometimes with the addition of other chemicals to improve uptake and color fastness. Additionally, some florists use natural dyes derived from other plants or minerals, which can offer unique hues and are marketed as an eco-friendly option. The two primary methods of tinting involve, stem absorption and flower dipping. Both approaches allow for customizable hues, ranging from single colors to intricate combinations, creating unique and visually striking floral products.

12.3.1.1 Tinting via stem absorption

This is the most common method used for tinting chrysanthemums, particularly effective with primarily white or light-colored flowers. This technique involves



Fig. 12.4. Tinting of white spray chrysanthemums (top left) to achieve a diversified variety of hues, ranging from single to dual and multiple rainbow-colored chrysanthemums. (Photo courtesy of Malleshaiah SharathKumar.)

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cutting the flower stems and placing them into a container with a warm solution of dye mixed with specific chemicals. To facilitate a higher uptake rate of the dye, the flowers are preconditioned by stressing them overnight at around 18°C to enhance the uptake of the dye solution. As the plants draw up the colored solution through the stems, the dye disperses uniformly throughout the petals, allowing for vibrant, even colors or intriguing gradient effects. It is essential to halt the dyeing process before the color reaches its peak intensity to prevent oversaturation, as residual dye in the stems continues to tint the flower when placed in vase solutions. This careful control ensures a precise and desirable tinting effect. Additionally, extended duration of tinting may result in discoloration of leaves, deteriorating the leaf quality of chrysanthemums.

12.3.1.2 Dipping flowers

This method is often employed for daisies and involves submerging the flower heads directly into a tinting solution made from aniline dyes dissolved in isopropanol. After dipping, the flowers are shaken to remove excess solution and then left to dry on a rack before they can be packed or stored. This method is quicker than tinting via stem absorption; however, it results in less uniformity but a strong coloration on the outer petals.

12.4 Edible Chrysanthemums

Edible chrysanthemums, known as "garland chrysanthemum" (*C. coronaria* or *Glebionis coronaria*) or "shungiku" in Japanese, involve various parts of the plant such as leaves, young shoots, flower buds, or petals. These are a versatile ingredient in Asian cuisines and have been cultivated for tea and functional foods because of their health-promoting properties (Fig. 12.5). Modern studies highlight chrysanthemum's pharmacological effects, including antibacterial, anti-inflammatory, antioxidant, antiviral, and antitumor properties, attributed to active ingredients such as flavonoids, phenolic acids, terpenoids, volatile oils, and polysaccharides (Yuan *et al.*, 2020; Liu *et al.*, 2024).

Edible chrysanthemums are among the most popular edible flowers globally (Zhang *et al.*, 2019) and exhibit a diversity in phytochemical profiles, which significantly contribute to their nutritional and medicinal functions (Yuan *et al.*, 2020; Lu *et al.*, 2022). The typical method of consuming chrysanthemums involves steeping the flowers in hot water (chrysanthemum tea) to directly extract phytochemicals. However, the phytochemical profiles vary significantly among different chrysanthemum varieties, which may influence their specific health benefits (Yang *et al.*, 2017; Chen *et al.*, 2021). Research highlights the inhibitory effects of chrysanthemum flowers on the formation of advanced glycation end-products (AGEs), which are linked to various chronic conditions such as diabetes, atherosclerosis, aging, and chronic inflammation (Tsuji-Naito *et al.*, 2009; Khan *et al.*, 2020; Sun *et al.*, 2020).

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Particularly, the edible variety *Chrysanthemum* × *morifolium* Ramat. *forma esculentum* Makino, "Kotobuki," has been studied for its health-promoting flavonoids. These compounds, notably luteolin 7-O-(6″-O-malonyl)-glucoside, have shown significant potential in reducing key markers of liver injury, such as plasma aspartate aminotransferase and alanine aminotransferase, and exhibit strong radical scavenging activities, underscoring their effectiveness in mitigating liver damage (Suguwara and Igarashi, 2009).

12.4.1 Shungiku, Japanese-style

C. coronarium, known in Japan as shungiku, is renowned in Japanese cuisine for its distinctive flavor, which is slightly bitter, grassy, and herbal, with a tangy undertone and a succulent texture. The flavor of young shungiku leaves is mild,

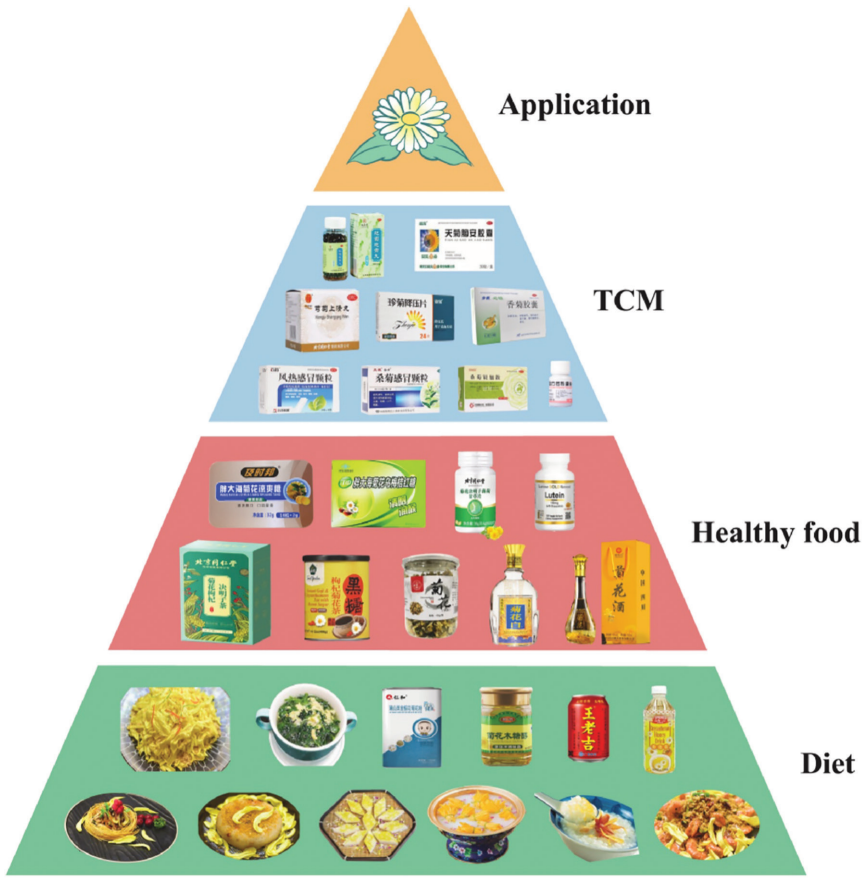


Fig. 12.5. Modern applications of chrysanthemum in TCM, healthy food, and diet. Note: TCM = traditional Chinese medicine. (Photo courtesy of Liu *et al.*, 2024.)

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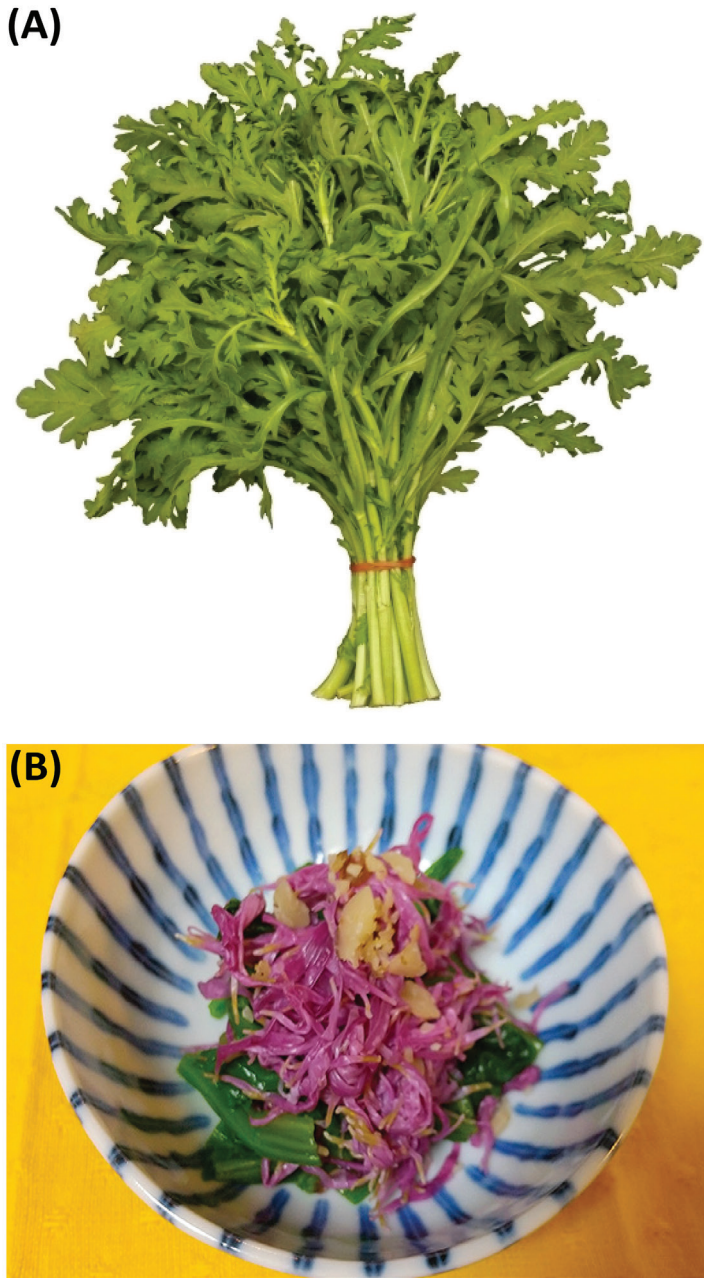


Fig. 12.6. *Chrysanthemum coronarium* used as a leafy vegetable (A), featuring Ohitashi, a dish made with edible chrysanthemums in Japanese cuisine (B). (Photo courtesy of (A) © State of New South Wales, CC BY 4.0—www.nsw.gov.au; (B) Ministry of Agriculture, Forestry and Fisheries website, CC BY 4.0—https://www.maff.go.jp)

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but it becomes stronger and distinctly bitter as the plant matures and flowers, a taste reminiscent of coriander, making it a polarizing choice among diners. When young and tender, both the leaves and stalks of shungiku can be enjoyed raw in salads, with the ideal stalk diameter being no wider than 0.3 cm to avoid an overpowering bitterness. More mature greens, typically found in markets, are better suited for cooking, which mellows their flavor into a mildly grassy and herbaceous profile, with stalks that turn sweet and slightly crunchy when cooked. In Japanese dishes such as sukiyaki and shabu-shabu, shungiku is a praised addition and also enhances soups. The greens should be boiled briefly, no longer than 30 s to remain firm and vibrant. A popular way to serve them is blanched, cooled to room temperature, and dressed with a traditional sesame dressing. The versatility of shungiku extends to its preparation methods; it can be steamed, blanched, lightly boiled, stir-fried, or used in tempura. Visually, shungiku leaves resemble those from a florist, varying from slightly to deeply indented.

Shungiku thrives as a winter vegetable due to its hardiness and nutritional content. It is rich in vitamins A and B and a significant source of antioxidants, containing more potassium than an equivalent serving of bananas that are known for high potassium content. Its ability to tolerate light frosts allows it to be grown in open fields or unheated greenhouses from late autumn to early spring in mild climates. This adaptability, combined with its health benefits, makes shungiku a valuable addition to diets during the cooler months, offering a unique and healthful option for those seeking to enrich their culinary experiences.

12.4.2 Mottenohoka and Ohitashi: celebrating edible chrysanthemums in Yamagata cuisine

In Yamagata Prefecture of Japan, the culinary tradition of using edible chrysanthemums showcases a deep-rooted cultural appreciation and innovative applications in regional cuisine. This custom, dating back to the Edo period (1603–1868) and famously enjoyed by poet Matsuo Basho, remains robust today. One of the most cherished dishes is "Ohitashi of edible chrysanthemums," where chrysanthemum leaves and petals are boiled, chilled, and served with a soy sauce dressing, highlighting their delicate texture and natural flavors (Fig.12.6). The "Mottenohoka" variety, also known as "Enmeiraku," is particularly esteemed. This late-blooming, purple-colored chrysanthemum is noted for its fragrant aroma and exceptional flavor, described as almost outrageously delicious, hence its name "Mottenohoka," meaning "out of the question." Unique for its tubular, crunchy petals, this variety contrasts with the flatter petals of other chrysanthemums. Edible chrysanthemums from Yamagata are also used in "sunomono" (pickled vegetable dishes) and tempura, illustrating their seamless integration into local cuisine. These diverse applications highlight the distinctive qualities of different chrysanthemum varieties, affirming their status as celebrated ingredients in Yamagata's gastronomy (MAFF—https://www.maff.go.jp/e/policies/market/k_ryouri/search_menu/526/index.html).

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12.4.3 Chrysanthemum tea

Chrysanthemum tea, a fragrant herbal infusion primarily made from the flowers of *C. morifolium* and *C. indicum*, is valued for both its culinary and medicinal properties. Renowned for its antioxidant, anticancer, anti-diabetic, and anti-inflammatory activities (Chen *et al.*, 2019; Li *et al.*, 2019), chrysanthemum tea has been consumed for its health benefits for millennia, with its use dating back over 3000 years to the Xia Dynasty in China (Hao *et al.*, 2022). Chrysanthemum is classified into medicinal, tea, edible, and ornamental types, with its medicinal forms recognized in the Chinese Pharmacopoeia as Gongju, Hangju, Huaiju, Qiju, and Chuju. Among the 28 flower medicines listed in the Chinese Pharmacopoeia, eight are used for health-care purposes, including Juhua, the flower head of *C. morifolium*. Renowned for its traditional efficacies of "scattering cold," "clearing heat and toxins," and "brightening eyes," Juhua is used to treat conditions such as the common cold, eye pain, and dim-sightedness. It is effective against fever, headache, sore throat, and hypertension (Yuan *et al.*, 2020). Beyond its dietary and medicinal uses, Juhua symbolizes Chinese culture and spirit, featuring prominently in poems and cultural works. Chrysanthemum tea is particularly popular in East Asian countries such as China, Korea, and Japan, where it is also used in various functional foods such as chrysanthemum wine, cake, and hot pot (Yang *et al.*, 2019). Today, the medicinal and edible values of chrysanthemum are increasingly integrated, playing a significant role in daily life and health practices.

12.5 Conclusions and Future Prospects

The exploration of value addition in chrysanthemums highlights their multifaceted applications and significant potential in both traditional and innovative markets. Beyond ornamental value, chrysanthemums serve as a versatile crop used in traditional Chinese medicine, healthy foods, and diets. Technologies such as dry flower processing, tinting, and culinary uses have enhanced their economic value and practical applications. Innovations in drying techniques can further expand their use in pharmaceuticals, nutraceuticals, and functional foods. With growing interest in natural and sustainable products, chrysanthemums align well with eco-friendly consumer trends.

To advance the potential of value addition of chrysanthemums, future efforts should focus on developing advanced drying technologies to preserve their bioactive compounds, color, and structural integrity, thereby enhancing their applications in pharmaceuticals and nutraceuticals. Expanding market development strategies to promote chrysanthemum-based products in regions with a growing interest in natural health products is crucial, emphasizing their multifunctional benefits. Sustainability should be a priority, promoting eco-friendly farming practices and production methods. Comprehensive research on the health benefits of chrysanthemums can support the creation of new health supplements and functional foods. Culinary innovations should be explored to

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expand their presence in the food industry, creating novel products incorporating chrysanthemum petals, extracts, or flavors. Integrating chrysanthemums into modern health practices, especially within traditional Chinese medicine, can enhance their credibility and acceptance in contemporary health care. Finally, consumer education campaigns can increase awareness and drive demand, ensuring continued growth and innovation in the chrysanthemum industry.

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