

# Ardisia Crenata: A New Source Of Health-Promoting Phytopharmaceuticals And Chemicals

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## Abstract

Both cell culture and preclinical animal model systems have been extensively studied to determine the effectiveness of natural plant metabolites utilized for human consumption. Some issues, including the inadequate systemic transport and bioavailability of promising medicines, contribute considerably to the divergence between these in vitro and in vivo benefits and their translation into clinical application. In the last several decades, scientists have made tremendous strides in effectively developing innovative drug delivery methods for encapsulating active plant metabolites. These systems include organic, inorganic, and hybrid nanoparticles. There are over 500 species of Ardisia (Myrsinaceae), and they may be found in both tropical and subtropical climates. Many different Ardisia species have been cultivated for their aesthetic value, culinary or medicinal properties, or both. Sometimes it is hard to tell whose species you are dealing with or where to get seeds or cuttings because of taxonomic ambiguities. The applications of Ardisia species or their phytochemical components have not been thoroughly studied. However, they are a rich source of new and physiologically powerful phytochemical substances like bergenin and artisan. This page provides an update on the clinical study into the use of Ardisia chemicals, as well as a summary of their historical use and current state of knowledge. This data also highlights the genus's potential as a source of medicinal medicines.

**Keywords:** Ardisia, nanomedicine, natural plant metabolite, biomedical application, carrier formulation, drug delivery

## I. INTRODUCTION

Herbalists employ various plants, some of which have medical properties, under the umbrella phrase "medicinal plants." The materials used to create drugs have traditionally come from medicinal plants. Furthermore, these plants are essential to the growth of human civilizations throughout the globe. Furthermore, several plants are suggested for their medicinal benefits and are considered vital sources of nourishment. Some examples of such plants include green tea, walnuts, ginger, and many more. Other plants and their derivatives are a significant source

of the active chemicals used in medicines like aspirin and dental products. [1]. Thirteen thousand plant species have been used for at least 100 years as traditional remedies in different cultures around the globe. More than 20,000 plants used for therapeutic purposes have been documented, and that figure is likely far higher.

Herbal medicine has been widely recognized as a viable alternative to conventional Western treatment. Herbal remedies have widespread social acceptance, yet only a tiny fraction of the world's medicinal plants have undergone rigorous scientific evaluation for their therapeutic efficacy. Herbal medications are seldom recognized or regulated by national health agencies, and this is the case in most nations. There is still significant worry about the security of herbal remedies. "The Food and Drug Administration (F.D.A.) estimates that approximately 50,000 adverse events are induced by botanical and other dietary supplements annually in the United States." [1] Additionally, the effectiveness and quality of most herbal medications are not proven. Expanding the knowledge base and giving advice on regulatory and quality assurance requirements are essential tenets of the WHO's Traditional Medicine (T.M.) Strategy 2014-2023 aims to increase T.M.'s reliability, effectiveness, and acceptability worldwide [2]. In 2012, 119 of the 195 countries that make up the World Health Organization had laws to control the sale and distribution of herbal supplements. Herbs, herbal materials, preparations, and completed herbal goods are all considered herbal medicine items since they include either plant parts, other plant components, or a mix of the two. [3] "Leaves, blooms, fruit, seeds, and stalks are all examples of herbs. Herbal materials include plants and fresh juices, gums, fixed oils, essential oils, resins, and dry powders of herbs. Comminuted or powdered herbal materials, or extracts, tinctures, or fatty oil of herbal materials are all examples of herbal preparations that provide

the foundation for completed herbal medicines.” Herbal preparations containing one or more plants are considered finished herbal goods.

*Ardisia* is a genus of flowering plants in the family Myrsinaceae. Its members may naturally occur in the tropics of America, Australasia, the Indian subcontinent, East and South Asia, and a small percentage of Oceania. About 300 species belong to this genus; 68 may be found in China, where they are grown extensively and often in the south Yangtze River region. In China, *Ardisia* species are used for both their medicinal and aesthetic value. The therapeutic value of several of them has made them renowned. *Ardisia crenata* is often used to treat asthma, whereas *Ardisia japonica* (Horst.) Blume is typically used to treat chronic bronchitis. The oxytocic and anti-pregnancy effects of *Sims* var. *crenata* are well-documented. For severe injuries, doctors prescribe *Ardisia pusilla* A. de Candolle. [4] Since the species within the genus are so morphologically similar, numerous individuals belonging to various species within the genus are sometimes mistaken for members of the same genus. To this end, correctly identifying these *Ardisia* medicinal herbs is crucial.

Hebert et al.[5] initially introduced D.N.A. barcoding, a novel methodology that employs a short and standardized piece of D.N.A. sequences to identify species; this method has since been a focus of biodiversity studies.[6] Subsequent studies[7, 8, 9] by Hebert et al. showed that the CO1 gene functions as a universal animal D.N.A. barcode. However, due to hybridization and reticulate evolution, investigations on plant barcodes are far more challenging than those of mammals. [10, 11] There has been no agreement on a universal D.N.A. barcode for all plant species. However, many single loci and combinations of loci have been proposed as candidates for plant identification in recent years (see [12,13,14]). It is necessary to research and choose appropriate loci for each species group, mainly if the group includes multiple closely related species. D.N.A. barcoding research has been done on closely related species and genera, but its applicability to *Ardisia* plants has not yet been assessed.

There are now 70 species of *Ardisia* in the Philippines, with three more being discovered since Merrill's [15] original list was published. Pelsner et al. [16] revised this, reducing the number to 56 species, of which 45 are endemic and four are endangered. Some of the species names listed by Merrill [15] turned out to only correspond to a single specimen; thus, Hu [17] suggested synonyms, explaining that such inaccuracies resulted from investigations based on defective materials from insufficient sampling locations. *Ardisia* is a taxonomically complicated genus due to the large number of names used for it. Because of this, it has slowed down efforts to rewrite the whole genus [17] and produced severe taxonomic uncertainty. Correctly identifying plant species is essential in the scientific discipline of systematics and in the fields of ethnobotany and medicine, where various plants are used for various purposes and have various medicinal benefits. Pharmacological studies that rely on references to medicinal plants published before the nomenclatural modifications may not provide an accurate picture of the plants because of the names they used [18]. It is an issue for the genus *Ardisia* since certain species are used for food and medicine, and there is growing interest in their potential chemotherapeutic and chemopreventive properties [19].

Herbal supplements are subject to varying degrees of regulation across the world.

Several different types of regulation are now in use across the world:

- All items must adhere to the same regulations; however, proof of a specific kind is not necessary for herbal remedies.
- Herbal medications are exempt from any registration or marketing restrictions.
- Herbal medications must comply with all applicable regulations, including registration and marketing approval.

Herbal remedies are separated into three groups in Europe to receive marketing approval [20]:

- Traditional medical practices (or "traditional usage") that have been adopted based on adequate safety evidence and probable effectiveness
- It must be shown that the active ingredients in the medical goods have been in well-established medicinal use inside the European Union for at least 10 years, with acknowledged effectiveness and an acceptable degree of safety (referred to as "well-established usage").
- Stand-alone (company-developed) or mixed-application (company-developed plus external research) safety and effectiveness data.

The AYUSH Department in India is responsible for A.S.U. Pharmaceuticals. By contrast, the Central Drugs Standards Control Organization is responsible for determining what phytopharmaceuticals must do to comply with regulations in 2015. (CDSCO). [21] In order to analyze and allow the commercialization of herbal medication along the same lines as synthetic chemical compounds, this gazette notice establishes regulatory procedures for phytopharmaceuticals and regulatory submission requirements for scientific evidence on quality, safety, and effectiveness.

A natural medicinal drug is defined as[22] a purified and standardized fraction with minimum acceptable four bio-active or phytochemical compounds (qualitatively and quantitatively assessed) of an extract of a medicinal plant or its part used for diagnosis, treatment, mitigation, or prevention of any disease or disorder in humans or animals, except for administration via the parenteral route.

The newly added Appendix I B to Schedule Y details the information required to accompany an application to import or produce a phytopharmaceutical medicine in the nation or to undertake a clinical study using such a drug.

Lots of effort is put towards ensuring that phytopharmaceutical drugs:

- Available data on the plant, formulation, and route of administration, dosages; suggested therapeutic class, and claims made for the phytopharmaceutical; and supporting evidence from the published literature on safety and efficacy and human or clinical pharmacology.
- Insights gathered from:
  - Details about the formulation of the phytopharmaceutical medicine;
  - the manufacturing process of the formulation;
  - stability data;
  - identification and authentication of the plant used for extraction and fractionation;
  - the extraction process;
  - fractionation and purification.

Advances in solvent extraction, fractionation, potentiating procedures, current formulation development, etc., are all fair game under the new phytopharmaceuticals rule. [23] Once the CDSCO has approved the N.D.A., the new phytopharmaceutical medicine will have the same marketing status as a new chemical entity drug. [4] The new phytopharmaceutical rule is consistent with laws requiring scientific examination and data creation in the United States, China, and other nations. [24] The usage of herbal products is projected to become more mainstream as a result of this new rule, which will facilitate the scientific exploration and development of novel medications derived from botanicals. The advancement of academic and industrial research into phytopharmaceutical medication development would be stimulated.

In recognition of her work isolating artemisinin from *Artemisia annua* to treat malaria, Dr. Tu Youyou was awarded the Nobel Prize in Medicine last year. With the new phytopharmaceutical rule, we can only hope that Indian researchers will be inspired to find solutions to unmet medical needs via phytopharmaceutical medications.

## II. REVIEW OF LITERATURE

The little evergreen shrub known as *Ardisia crenata* Sims, also known as the coral bush, coralberry, hen's eyes, and spiceberry, is native to the Yangzi River valley in China [25]. Diseases including pulmonary T.B., hepatitis, chronic bronchitis, and irregular menstruation are treated using traditional medicines from the genus *Ardisia* [26]. As a consequence, several *Ardisia*-derived compounds have been extracted and characterized, such as cyclic depsipeptide [27], peptide [28], alkylphenol [29], and triterpenoid saponins [30]. The biological peptide Fr900359 may block platelet aggregation. This peptide was identified by Fujioka [31] and has structural similarities with ardisicrenosides C and D, which have an inhibitory effect on cAMP phosphodiesterase. Ardupisilioside, discovered by Zheng and his team, also inhibits tumor growth. After identifying ardisiacrispin A and B, Jansakul and Piacente found that these proteins inhibit H.I.V. replication, induce apoptosis, and disassemble microtubules in human hepatoma Bel-7402 cells. Dimeric lactone has been shown to have HIV-inhibiting action, according to a 2007 study published by Dat.

The Kirby-Bauer disc diffusion technique, as described by Carbonnelle, was used to test the extracts for antimicrobial activity. Each bacterial strain had its overnight broth culture adjusted to a concentration of 10<sup>6</sup> CFU/mL before being used to inoculate agar plates. To recap, we autoclaved the Nutrient Agar (N.A.) at 121 °C for 20 minutes and dissolved the corresponding extracts (0.1 g/mL) in 100% dimethyl sulfoxide (DMSO, Merck, Germany). Finally, a millipore disposable filter of 0.20 microns was used to filter the extract (Minisart, Sartorius Biotech, Germany). Each extract was soaked onto a sterile filter paper disc (6 mm in diameter) and then deposited onto the surface of the agar plate (nutrient agar), which had been contaminated with bacteria. We used a disc saturated with only 50 L of DMSO as a negative control. One disc had 10 mg of streptomycin (the standard antibiotic), while the other contained 20 mg. After inverting the samples, they were left to ferment for 18 hours at 37 degrees Celsius. Measurements of the diameters of the inhibitory zones were made and analyzed for each bacterial strain tested in triplicate.

Multiple imaging modalities are required to ascertain the tumor's location, size, and shape in order to estimate the viability and risk of surgical therapy for patients with lung cancer. CT, MRI, and PET/SPECT are just a few of the imaging modalities often employed in actual medical settings. Patient care before, during, and after surgery may be improved with the use of various imaging modalities. [32]. The examination of residual regions and surgical problems after surgery to foretell the likelihood of recurrence is the most important of them. Still fall short of enabling real-time precision image-guided surgery, even in the modern era of precision medicine (IGS). Therefore, the tumor location cannot be exhibited to its fullest potential, preventing removal of 80% of the tumor. At the time of surgery, the surgeon relies more on his or her own expertise and spatial imagination to determine an accurate estimate of the resection margin. Consequently, there is a high probability of recurrence after surgery, and complications during surgery may be devastating, resulting in organ malfunction, failure, or even death. Thankfully, molecular imaging technology is constantly evolving in response to clinical needs; more and more researchers are committing to developing IGS technology; and more and more IGS technology is applied in clinical practice, all of which helps advance biomedical therapeutic diagnosis and application. The benefits of nanotechnology in cancer treatment have been brought to light by the creation of nanomaterials (NMs) for IGS [33]. The excellent

resolution and deep tissue penetration capabilities of NM are what make it a viable option for use in clinical surgery, making up for the limitations of currently available instruments. In addition, NMs with many functions may coordinate with.

Nanotechnology in medicine, specifically advancing NM for use in treating multimodal imaging guided surgery. Due to the increased permeability and retention (EPR) effect, all nanoformulation contrast agents may passively accumulate inside the tumor site during precision image-guided surgery. Nanocontrast compounds have an additional benefit in that they may be expressed to target the receptors that are particularly abundant in lung cancer and other malignancies. The nanodeveloping agent is then equipped with receptors that bind to their corresponding ligands, allowing for precise targeting and accumulation at the tumor location. The buildup of the contrast agent in normal tissues may be minimized while the concentration at the tumor location is enhanced. Moreover, the size of nanoparticles can be flexibly adjusted, from large size to small size, with various design methods, increasing the penetration ability inside solid tumors and allowing more contrast agents to be dispersed to the tumor edge area, which greatly improves the Accuracy of preoperative tumor detection and intraoperative tumor margin delineation. To assist patients in successfully eliminating cancer, nanoparticles may be made into multifunctional therapeutic and diagnostic nanoplatforms that integrate imaging and navigation capabilities with other therapies to produce diagnostic-therapeutic-integrated nanoplatforms [34, 35]. The integration of nanotechnology into surgical procedures represents a new and exciting direction in cancer treatment.

To analyze [37], transfer [38], sense [39], and act [40], [41] inside a live creature are all examples of the many uses of nanoscale materials in nanomedicine, which is a subfield of medicine. Problems with oral bioaccessibility, substantially lower diffusion potential into the outer membrane, and unwanted side effects before the conventionally designed immunization method demand increased IV infusion when extremely low solubility capsules are used for biopharmaceutical transport [41]. Nonetheless, using nanotechnology techniques into the drug transport system has the potential to overcome most of these obstacles. Improved accessibility means reduced toxicity, fewer adverse effects, improved biodistribution, and a longer medication life cycle [42], [43], [44]. In order to ensure the safe and effective delivery of therapeutic medications, engineered medication transport systems are strategically located at key online destinations or in the heart of physical communities. One of the ways they are generated is by self-meeting, when well-described processes or styles spontaneously develop building blocks [95]. The mononuclear phagocyte system presents additional challenges, such as opsonization/sequestration, which must be surmounted [45].

According to current data, surgery, radiation therapy, and chemotherapy are all viable conventional therapeutic choices for cancer patients. Damage to healthy cells from chemotherapeutic drugs reduces the drugs' effectiveness. Despite the clear dangers associated with their employment, these tactics are becoming more commonplace. However, in the case of oncological illness therapy, the primary purpose of the Nanoparticle is to selectively convey the drug only to cancer affected cells, which may influence both the efficacy and the undesirable toxicity. Although doxorubicin, a potent anticancer medication, may have serious adverse effects with prolonged usage, [45]report that encapsulating it in pegylated PLGA-NPs dramatically reduces the risk of cardiomyopathies developing.

### III. CHARACTERISTICS OF MEDICINAL PLANTS

Synergistic medicine relies on the fact that plants' constituent parts work together in concert to either amplify or mitigate the effects of one another. The components of plants have shown to be particularly efficient in treating complicated illnesses, such as cancer disorders, and therefore have gained the support of conventional medicine.

Effective preventative medicine relies on the plants' naturally occurring components, which have been shown to inhibit the onset of some illnesses. Reduced reliance on potentially harmful synthetic treatments (those used after the illness has already manifested) is a positive outcome of this research.

### IV. CLASSIFICATION OF MEDICINAL PLANTS

Depending on the parameters used, medicinal plants may be categorized in various ways. Roots, leaves, petals, seeds, and other plant parts are often used as storage organs for medicinal plants, and these components are typically organized according to the active principles they contain. In the fight against sickness, these ideas are invaluable. There are seldom or no reports on the taxonomy of many plant species that produce vegetable oils used in cosmetics and body and skin care treatments.

**Classification To paraphrase the Usage.**

**There are four herbs: Herbs for medicine, food, fragrance, and decoration.**

- Medicinal herbs, such as marigold, lemon balm, lavender, johnny-jump-up, feverfew, etc., have medicinal capabilities and are used to make medications due to their healing characteristics.
- Culinary Herbs, such as oregano, parsley, sweet basil, horseradish, thyme, etc., are perhaps the most often used as culinary herbs due to their robust flavors.

- The aromatic properties of aromatic herbs, such as the fragrance of their blooms or leaves, make them useful in various contexts. Essential oils from aromatic plants have many uses, including cosmetics, cleaning, and scented products like perfumes and scented bath waters. Examples include a wide variety of herbs.
- Ornamental herbs like lavender, chives, bee balm, lemongrass, etc., are used for decorating because of their vividly colored blossoms and leaves[46].

### **Separation Based On Their Dynamic Components**

There are five main groups of herbs based on their active ingredients: "The five categories are: aromatic (volatile oils), astringent (tannins), bitter (phenol compounds, saponins, and alkaloids), mucilaginous (polysaccharides), and nutritive (food stuffs)."

#### **Fragrant plants**

As the name suggests, many of these plants have a pleasant aroma, which inspired the label. They have several applications in medicine, culinary arts, and fragrance. Stimulants and nervines are the two types of aromatic plants.

The respiratory, digestive, and circulatory systems are often affected by stimulant herbs since they are responsible for increasing energy and activity. Fennel, ginger, garlic, and lemongrass are all examples.

#### **Drying Herbs**

Protein precipitation by tannins in astringent herbs "tightens," contracts, or tones living tissue and aids in stopping discharges. They may harm the liver and cause gastrointestinal, urinary, and cardiovascular side effects when used in excessive quantities. They may be a pain reliever, disinfectant, ant abortive, astringent, emmenagogue, hemostatic, or styptic.

#### **Venomous Plants**

Bitter herbs, so called due to the presence of phenols and phenol glycosides, alkaloids, and saponins, are broken down into four classes:

Herbs used as diuretics cause water to be excreted in the urine. The discharged fluids aid in the cleaning of the blood vessels, kidneys, and liver. They have properties like a blood purifier, lithotripter, antiseptic, antipyretic, anti-allergic, anti-caustic, and antibiotic. "The following [33] plants are considered medicinal: asparagus, blessed thistle, burdock, butcher's broom, buchu, chaparral, chickweed, corn silk, dandelion, dog grass, grapevine, and parsley."

#### **Herbs High in Mucilage**

Due to the polysaccharides they contain, mucilaginous herbs are slick and mild in flavor, and they become sweet in water. Mucilage, in one form or another, is produced by every plant species to store water and glucose for later use. They assist regulate the digestive tract and shorten the time it takes for waste to pass through the system. They have medicinal properties such as antibiotic, antacid, demulcent, emollient, vulnerary, or detoxifier. "Herbs include althea, aloe, burdock, comfrey, dandelion, Echinacea, fenugreek, kelp, psyllium, slippery elm, dulse, glucomannan from Konjac root, Irish moss, and mullein are all examples [48]."

#### **Herbs for Their Nutritious Effects**

Sprouting wheat The nutritional benefits of these plants were the inspiration for their names and categories. They are nutritious natural foods with medical properties like a laxative impact, a laxative effect, and a diuretic effect.

However, their primary value lies in the fact that they provide not only the vitamins and minerals essential for good health but also the protein, carbs, and fats that our bodies need to function. Fruits and vegetables such as rosehips, acerola, apples, asparagus, bananas, barley grass, bee pollen, bilberries, cabbage, carrots, cauliflower, grapefruit, hibiscus, lemons, oat straw, onions, oranges, papayas, pineapples, red clover, spirulina, and stevia are all excellent examples.

#### **Classification based on Their Medicinal Herbs**

Annuals, biennials, and perennials are the broad categories into which herbs fall. Annuals have a single growing season before they perish. There are two growing seasons for biennials, and only the second produces flowers. Perennials survive the winter and continue to thrive year after year after they have been established. For a long time if you take care of them. Grown from seed, the life cycle of annual herbs takes just one year to complete. Unless the garden's circumstances are ideal, the annuals need to be planted yearly.

## **V. ETHNOBOTANICAL USES AND MEDICINAL PROPERTIES OF PHILIPPINE ARDISIA SPECIES**

Notes on the plant's ethnobotanical applications were included in several herbarium collections. *Ardisia crispa* (PNH 150522), *A. elliptica* (PNH 39168, as *A. squamulose*), and *A. postictal* (PNH 166599, PNH 35570) all have edible fruits when they reach full ripeness. While the stems of *A. elliptica* are used for firewood and house posts, the fruits are utilized for flavoring (LBC 3979, like *A. squamulose*) (PNH 41728). Similarly, *A. pyramidalis* is grown for its decorative value and valuable stems, which are used for fuel and lumber (CAHUP 10638, CAHUP 19802). (CAHUP 51747, CAHUP 10526, CAHUP 5637, CAHUP 10549, LBC 6248). Asthma patients have also benefitted from drinking tea from boiled *A. diffuse* roots (PNH 38100). *Ardisia* species were mentioned in a few ethnobotanical works because of their Usage in the Philippines. While the ash from its leaves combined with coconut oil is used to treat skin eruptions, *Ardisia confertiflora* also has promise as a garden plant. It has been said that *Ardisia elliptica* may heal

wounds. While there are several species of *Ardisia* in the nation, only a few have been examined for their potential pharmaceutical uses; these include *A. iwahigensis*, *A. elliptical* (as *A. squamulose*), and *A. pyramidalis*.

Given *Ardisia*'s potential as a food source and beneficial chemicals, the genus and species must be accurately identified and named. One of the most investigated species for its medicinal characteristics, *Ardisia elliptical* (as *A. squamulose*), is known by many different vernacular names throughout the nation, including katagpo (Tagalog), bahagion (Bisaya), and Kolen (Iloko). This leads to taxonomic confusion.

**Table 1. Pharmacological properties of *Ardisia* species that are recorded in the Philippines**

Species	Part used	Pharmacological Property	Reference
<i>Ardisia crenata</i>	Root	cAMP phosphodiesterase inhibition	ilia et al. (L994)
		Cytotoxic	Meng et al. (2008)
	Whole plant	Vasorelaxant	Zaima et al. (2013)
	Leaf	Cytotoxic and topoisomerase catalytic inhibition	Newell et al. (2010)
<i>Ardisia crispa</i>	Root	Anti-inflammatory and anti-Hyperalgesic	Roslida & Kim (2008)
		Antitumor	Roslida et al. (2011)
		Chemopreventive	Roslida et al. (2013)
<i>Ardisia elliptica</i>	Leaf	Sperm count reduction	Raga et al. (2011a)
		Platelet aggregation inhibition	Ching et al. (2010)
	Stem and leaf	Anti-adenovirus (as <i>A. squaniuksa</i> )	Chiang et al. (2003)
	fruit	Anti-Salmonella	Phadungkit & Luanratana (2006)
		Anti-proliferative effect against HCT-116 cells	Ondee et al. (2020)
<i>A. iwahigensis</i>	Stem and leaf	Cytotoxic	Horgen et al. (1997)
<i>A. pusilla</i>	Whole plant	Cytotoxic	Tang et al. (2009)
<i>A. pyramidalis</i>	Leaf	Anti-angiogenic	Raga et al. (2011h)
		Anti-angiogenic	Herrera & Amor (2011)

## VI. CONCLUSION

Many therapeutic agents are derived from natural products, which have played an important role in the field of drug discovery. Many pharmaceuticals used today were first isolated from compounds found in nature over the past 75 years. Treatments for cancer, bacterial and viral infections, and autoimmune disorders like multiple sclerosis are all benefiting from research into these natural products. Sixty percent and seventy five percent of novel medications, respectively, come from natural sources in the cancer and infectious illness fields.

Cancer is a terrible illness, and the therapies that are now accessible to patients sometimes come with unpleasant side effects. In addition to conventional drug therapy, the use of medicinal plants for cancer management or prevention is a viable option. Researchers are looking into the tumoricidal properties of many plant-derived bioactive compounds for a wide range of cancers, as these compounds have shown promising results in clinical studies. They were classified as either extracts, pure compounds, nanoparticles containing extracts, or chemotherapeutic agents containing extracts, and their possible mechanisms of action were described. More research is needed to elucidate their specific mechanisms of action, and to determine their potential for cancer prevention and treatment, despite the fact that all of the studies found the extracts to demonstrate strong in vitro and in vivo anticancer activity in cancer cell lines and animal models.

Medicinal uses have been found for many *Ardisia* species due to the diversity of bioactive phytochemicals, including bergenin and artisan. While it is possible to find some of these substances in other plant species, the unique combinations of phytochemical elements in *Ardisia* species make this plant material an exciting prospect as a source of prospective phytotherapeutic medicines.

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