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Anticancer potential of selected plant species and their use in phytotherapy

Abstract

Returning to nature may be crucial in the fight against the harmful effects of civilization progress, which include cancer. The paper discusses selected species of medicinal plants that demonstrate anticancer activity. The main objective of the publication is to indicate, based on scientific research, the possibilities of using selected plant materials as chemopreventive agents and preparations with anticancer potential. An attempt was made to update the state of knowledge on the properties of four species selected for analysis – *Chelidonium majus*, *Hippophae rhamnoides*, *Tanacetum vulgare*, and *Syzygium aromaticum*. Their anticancer activity was described based on the cited results of numerous studies, as a thorough analysis of scientific articles available in the Google Scholar, PubMed, and Europe PMC databases was carried out. The literature on the subject, as well as specialist websites, were also used. The anticancer potential of the plants presented in the study has already been investigated to some extent and they can be used chemopreventively or as a cancer support, provided there are no contraindications to their use. However, they cannot be considered fully effective anticancer agents, much less as drugs, because in most cases the anti-carcinogenic properties attributed to plants are based only on *in vitro* or *in vivo* animal studies.

Keywords: cancer diseases, cancer prevention, selected medicinal plants

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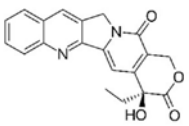
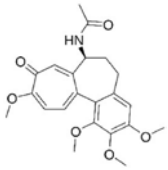
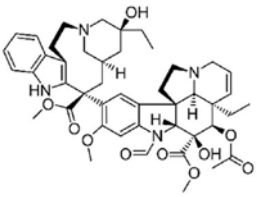
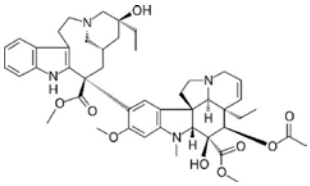
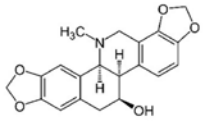
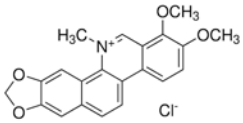
Introduction

Cancers are a great challenge for modern medicine, as there is a global increase in the incidence of oncological diseases. Conventional chemotherapy is highly invasive and is associated with numerous serious side effects. Therefore, there is currently a great need for effective therapeutic agents with anticancer activity and at the same time the lowest possible toxicity. Recently, there has been significant progress in the search for natural substances with anticancer potential, which may prove to be a good support, or even an alternative, to commonly used cytotoxic agents, due to better biological tolerance and metabolic degradation. Therefore, medicinal plants are a promising source for developing new oncological drugs (Samochowiec, 2002; Nawrot, Nowak, 2018).

Of particular interest are compounds with antiangiogenic properties (e.g. sanguinarine, genistein, paclitaxel, vincristine) and proapoptotic properties (e.g. phenolic acids, flavonoids, lectins, betulinic acid). Considering the mechanism of action, several pharmacological groups can be distinguished among plant anticancer substances (Tab. 1).

Tab. 1. Division of selected anticancer substances of plant origin into pharmacological groups according to their mode of action

Action	Name	Structural formula	Natural source
topoisomerase I inhibitors	e.g. camptothecin (CPT)		*Camptotheca acuminata* Decne (Efferth et al., 2007); *Chonemorpha fragrans* Alston (Isah, Umar, 2018)
mitosis inhibitors	e.g. colchicine		*Colchicum autumnale* L., *Gloriosa superba* L. (Hoffman et al., 2019)
	vincristine (leurocristine)		*Catharanthus roseus* (L.) G. Don (Ravina, 2011)
	vinblastine		*Catharanthus roseus* (L.) G. Don (Lee et al., 2024)
complex mechanism of action: e.g. lectins	e.g. mistletoe lectin-1	carbohydrate-binding proteins	*Viscum album* L. (Horbelt et al., 2022)
e.g. isoquinoline alkaloids	e.g. chelidonine		*Chelidonium majus* L. (Kemény-Beke et al., 2006)
	chelerythrine		*Chelidonium majus* L. (Kemény-Beke et al., 2006) *Zanthoxylum clava-herculis* L. (Gibbons et al., 2003) *Z. rhoifolium* Lam. (Tavares et al., 2014)

Currently used in oncology raw materials of plant origin or compounds obtained from them can also be divided into: oncophytotherapeutics, with proven cytostatic activity or their derivatives (e.g. alkaloids from *Catharanthus roseus* and taxol from *Taxus baccata* L.) and agents used as adjuncts to cancer therapy, the activity of which is mainly based on immunostimulation (e.g. mistletoe herb). Recently, in research on new oncostatics, there has been a tendency to learn about the effects of combining the chemotherapeutics used with natural plant compounds. Very often, it turns out that such combinations bring positive therapeutic effects, e.g. greater treatment effectiveness, broadening the spectrum of action, or minimising the side effects of chemo- and radiotherapy (Samochowiec, 2002; Nawrot, Nowak, 2018; Różański, Pietryja, 2021). For example, treatment with *Viscum album* extracts showed to reduce the side effects associated with chemotherapy, reduce the number of doses, and improve the quality of life in many different types of cancer. Recent data suggest a beneficial effect of combined treatment with mistletoe on the survival of cancer patients (Schad et al., 2018). Furthermore, a strong synergistic effect of mistletoe lectin (VCA) and the chemotherapeutic drug doxorubicin (DOX) was demonstrated, resulting in greater inhibition of human breast cancer cell growth compared to treatment with VCA or DOX alone (Hong et al., 2014). Another study found high efficacy of intravenous and oral curcumin in combination with the chemotherapeutic drug imatinib in a patient diagnosed with submandibular duct adenocarcinoma, with metastases to the lungs and previous resistance to chemotherapy (cisplatin and etoposide) (Demiray et al., 2016). Curcumin may also enhance the effect of another chemotherapeutic agent – paclitaxel (Sharifi-Rad et al., 2021).

Some plant species with multifaceted medicinal properties, known for a long time, enjoy considerable interest in the context of anticancer potential, e.g. *Chelidonium majus* L., *Hippophae rhamnoides* L., *Tanacetum vulgare* L. and *Syzygium aromaticum* (L.) Merr. & Perry. Greater celandine occurs commonly in northern Asia and throughout Europe. It is a typical ruderal weed, often found in gardens, thickets and garbage dumps, preferring shady places (Mederska, 2023). Sea-buckthorn is a Eurasian plant, rarely found in Central Europe, growing wild only on the Baltic Coast on coastal cliffs and dunes. Due to the health-promoting properties of its fruit, sea buckthorn is increasingly planted on plantations and in gardens (Krzyściak-Kosińska, Kosiński, 2009). Common tansy occurs in the temperate zone of Asia and Europe, as a common species, both in the lowlands and in lower mountainous areas. It grows in clearings, field margins, railway embankments, roadsides, on river banks, on the edges of forests, in thickets and wastelands, usually forming tufts. It prefers sunny and dry locations, and medium-fertile soils (Mederska, 2023; Senderski, 2017). Cloves are an evergreen tree originating from the Molucca Archipelago, from which they were gradually transferred to the Indian Ocean Islands, Madagascar, the Malay Peninsula, Sumatra, Ceylon, and

the Antilles. The large-scale plantations of this species are located on the islands of Zanzibar, Pemba, Madagascar, Amboina, and Indonesia. It is a plant with high habitat requirements, suitable for tropical climate, lowland or slightly hilly areas, adequately sunny, and not exposed to violent winds (Ożarowski et al., 1990; Kozłowski et al., 2019). The widely known healing properties and analysis of the biochemical composition of raw materials from the above species open a new chapter in research on anticancer drugs, which give hope for fewer side effects than previously used pharmacological agents. This study aims to present an update of the knowledge on the anticancer activity of four selected plant species (*Chelidonium majus*, *Hippophae rhamnoides*, *Tanacetum vulgare* and *Syzygium aromaticum*), as well as the possibilities of using preparations prepared on their basis as chemopreventive agents.

A brief overview of the main medicinal properties of the species analysed

Chelidonium majus or greater celandine, has been used for centuries in traditional European and Chinese medicine (Gilca et al., 2010). In medicine, the flowering herb (*Chelidonii herba*) is used, usually collected in May and June. The non-woody parts of the plant are cut off along with the basal leaves. It is recommended to dry them quickly in dryers at 30°C, or even 40–60°C, because at lower temperatures the herb turns black. Properly dried raw material should have a natural color. A less frequently used raw material is the root (*Chelidonii radix*) dug out in autumn and dried (Bełdowska, Guzewska, 1987; Gnatowska, 2022). Greater celandine can be used internally (e.g. as a water macerate or tincture) and externally (in the form of fresh pulp, decoction, tincture or ointment). External use is recommended for diseased areas (greater celandine juice is effective, among others, in combating warts). In cancer diseases, drinking an infusion of young, spring leaves of *Chelidonium* or juice of the herb and roots may be helpful (Przybylak, 2016; Wincek, 2017). Examples of preparation procedures and use of the most commonly prepared *C. majus* remedies are presented in table 2 – Appendix 1. Crude extracts of *C. majus*, as well as purified compounds derived from it, exhibit a broad spectrum of biological activities (anti-inflammatory, antispasmodic, antimicrobial – antiviral, antibacterial and antifungal, anticancer, analgesic, hepatoprotective, antiosteoporotic and radioprotective), supporting some of its traditional uses (Gilca et al., 2010).

Hippophae rhamnoides or sea-buckthorn has also long been used in medicine, especially in Asia, including Mongolia, Tibet and Siberia (Chikov, Laptev, 1983). The herbal raw material is sea buckthorn fruit (*Fructus hippophaeas*) and oil obtained from seeds (*Oleum hippophae*), which has detoxifying, nourishing, antibacterial, analgesic, antipsoriatic, antiatherosclerotic, anticancer, anti-edematous, antirheumatic, antiacne, antiviral, antiulcer, anti-infarction, regenerating and strengthening effects. It can also be used

externally to lubricate the skin, mucous membranes and as compresses on difficult-to--heal wounds, ulcers, bedsores, sores, etc. (Różański, 2007). Sea buckthorn oil is also used to protect the gastrointestinal epithelium in post-radiation cancer therapy, as an aid in radiotherapy after laryngeal cancer (Bühring, 2010), and in cancer prevention (Piłat, Zadernowski, 2019). Harvesting sea buckthorn fruit is unfortunately quite problematic because the plant has a compact shape and sharp thorns, and the fruit is soft and firmly attached to the shoots, which makes it easy to crush. Sea buckthorn fruit is easiest to obtain after the first frost, but in this instance, it will be less valuable (Senderski, 2017; Kozłowski et al., 2022).

Root (*Radix hippophae*), bark (*Cortex hippophaeas*), leaves (*Folium hippophae*), and seeds (*Semen hippophae*) can also be used as herbal raw materials. It is assumed that the fruit contains over 190 active compounds that support the treatment of many diseases (including, for example, the circulatory system, urinary system, diabetes, or scurvy). Sea buckthorn leaves are often treated as waste, but they can be used to prepare valuable tea (Guliyev et al., 2004; Bal et al., 2011; Piłat, Zadernowski, 2016; Bośko, Biel, 2017). Dried sea buckthorn fruits are available, among others, in herbal stores. They can be used to prepare vitaminizing and strengthening teas, also traditionally used for infections (Vogl et al., 2013). Fresh fruits are inured to produce wines, juices, syrups, marmalades, jams and liqueurs. Examples of fruit-based products are shown in table 2 – Appendix 1.

Tanacetum vulgare or common tansy, in traditional medicine, was used as an abortive agent (Mitich, 1992) and anthelmintic (Mazerant, 1990). It was also used for sprains, rheumatism, skin diseases such as scabies, lice, demodicosis, and to combat roundworms in the digestive system (Mazerant, 1990). Tansy preparations generally exhibit antiparasitic, antibiotic, sedative, choleretic, and immunoregulatory effects. When applied orally and to the skin, they inhibit the processes of immunological auto-aggression, thanks to which they can be successfully used in the phytotherapy of various autoimmune diseases. They also have antimycotic effects, e.g. against *Candida albicans* (C.P. Robin) Berkhout (Różański, 2004; Wincek, 2017). The herbal raw materials are tansy capitula (*Flos Athannasiae, Flos Cinnae*) without stalks and the whole herb (*Herba Tanaceti*), collected at the beginning of flowering or throughout the summer. Tansy oil (*Oleum Tanateci*) is also used. The herb is cut high, to leave the thick parts of the plant's stems without leaves. Drying should be carried out in a dry, airy, and dark place (in unsuitable conditions, capitula turn brown), at a maximum drying temperature of 35°C. Proper drying of the raw materials allows for the preservation of the natural color of the flowers and the characteristic camphoraceous smell (Gnatowska, 2022; Senderski, 2017).

Commercially available tansy preparations are available (Wincek, 2017). Examples of tansy-based products and methods of their use are presented in table 2 – Appendix 1. Studies have shown, among others, that 3,5-dicaffeoylquinic acid (3,5-DCQA) and

axillarin contained in common tansy are antiviral compounds that act on the herpes simplex virus (Onozato et al., 2009; Álvarez et al., 2011), while polysaccharides and parthenolide stimulate the immune system (Xie et al., 2007).

Syzygium aromaticum or cloves, in the European tradition, were ingredients of plague medicines (fumigations, pomanders), head and stomach diseases, and for the preservation of corpses (Smakosz, 2024). Cloves are used as a carminative, to increase the secretion of hydrochloric acid by the stomach, to improve the peristalsis of the digestive tract, and as natural anthelmintic medicines (Balch, Balch, 2000). Cloves are chewed in inflammation of the throat, mouth, and toothache (Smakosz, 2024). *S. aromaticum* is a popular spice in many cuisines in the world, with bactericidal and preservative properties, stimulating appetite and accelerating digestion. Preparations based on cloves have antiseptic, local anesthetic, and antispasmodic effects. They can be used internally or externally. Aqueous solutions of cloves are used to treat diarrhea, mycosis of the digestive tract, flatulence, and gastric and duodenal ulcers (Senderski, 2017; Wincek, 2017; Garcia-Carvajal et al., 2024).

Clove buds (collected together with the calyx) can also be used to obtain clove oil (*Eugenia caryophyllus bud oil*), which, when applied externally, has anti-inflammatory, disinfectant, anesthetic, and antispasmodic effects, as well as a tincture (taken for bronchitis, colds, coughs, or sinusitis) (Różański, 2009a). Clove oil is used as an analgesic, especially in dental practice in emergency cases of toothache. It has been proven, conductedamong other things, that it can prevent the development of *Enterococcus faecalis* (Andrewes & Horder) Schleifer & Kilpper-Bälz bacteria, which appear in unsuccessful root canal treatment (Aslan et al., 2022). This oil and the eugenol isolated from it are used as a component of temporary dental fillings (Smakosz, 2024). In contrast, an infusion of cloves can be used as an aid in cancer phytotherapy (Wincek, 2017) (Tab. 2 – Appendix 1).

Review methods

A literature review on the anticancer activity of selected plant species was conducted using online databases – Google Scholar, PubMed, and Europe PMC. An analysis of scientific articles in English and Polish published between 1956 and 2025 was performed, with particular emphasis on the most recent publications. The abstract was first analysed for each article and then reviewed the full texts of studies consistent with the designated purpose. These publications included both original and review papers. The biology and occurrence of individual species, their properties, and examples of their use in phytotherapy were described based on the bibliography of the subject and specialist websites.

Anticancer activity of the analysed species

Due to the high content of alkaloids, *Chelidonium majus* is considered by some to be a problematic plant (Tab. 3 – Appendix 1). These compounds in large quantities can be toxic, and some of them also have a narcotic effect. There are also contraindications to the use of celandine during pregnancy, in case of cataracts and glaucoma, and people taking drugs containing atropine or its derivatives (Rogala, Maciej, 2021; Machałek, 2022). However, it is precisely due to the presence of alkaloids that celandine has medicinal properties. Alkaloids such as chelidonine, chelerythrine sanguinarine, and protopine (Fig. 1) are also responsible for anti-cancer effects and preventing the formation of metastases (Wincek, 2017).

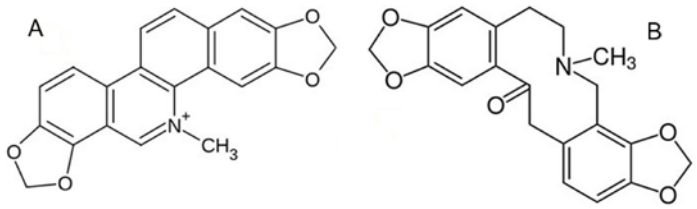


Fig. 1. Selected celandine alkaloids: sanguinarine ($C_{20}H_{14}NO_4$) – A, protopine ($C_{20}H_{19}NO_5$) – B

The anticancer activity of *C. majus* alkaloid fractions was probably first demonstrated in a 1964 paper (Sokoloff et al., 1964). Numerous studies performed later confirmed the cytotoxicity of *C. majus* extracts against many different cancers. This activity was found, for example, against human pancreatic cancer cells (PANC-1, AsPC-1 and BxPC-3), colon cancer (HT-29), breast cancer (MDA-MB-231) (Ahsan et al., 2007; Wouters et al., 2015) and epidermoid carcinoma (A431) (Park et al., 2015). Italian scientists, in light of the conducted studies, proved that sanguinarine can be effective in the treatment of melanoma (De Stefano et al., 2009). It was shown that chelidonine effectively induced apoptosis in HeLa cancer cells, by possibly changing the p38-p53 and AKT/PI3 kinase signaling pathways (Paul et al., 2012). Researchers from the Czech Republic also stated that chelerythrine and sanguinarine can be potential agents in the treatment of prostate cancer, due to their participation in apoptosis and regulation of the cell cycle (Malíková et al., 2006). Another study also demonstrated the effect of chelerythrine on Janus kinases (JAK), involved in the process of cancer development. Chelerythrine induced apoptosis and inhibited the migration of gastric cancer cells (AGS) and reduced their adhesive capacity. This study also indicated a relationship between chelerythrine and a decrease in the number of estrogen receptors in cancer cell membranes (Tian et al., 2022). H. Różański (2009b) pointed out that an important, although underestimated group of compounds in *C. majus* were peptides, remaining in the macerate, fresh juice,

and fresh herb. Therefore, he considered preparations that were not heated or cooked to be the most valuable, because they contained active celandine proteins, partially responsible for the antiviral, cytotoxic, antitumor, and oncostatic activity of this plant. It is worth mentioning that celandine is also an element of the Breuss total treatment, which has gained significant popularity in the natural treatment of cancer (Przybylak, 2016; Wincek, 2017). It should be emphasized, however, that celandine is classified as a poisonous plant, therefore, extreme caution is recommended (Ożarowski et al., 1990; Przybylak, 2016).

Hippophae rhamnoides fruits also contain valuable ingredients with high biological activity, especially vitamins (Tab. 3 – Appendix 1). Interestingly, the content of β-carotene is about 3 times higher than in carrots. In addition, sea buckthorn fruits contain numerous bioelements (as many as 24 have been counted). Therefore, it is not without reason that they are recommended as a means of improving well-being and regenerating the body (Nowak, 2018). Many biologically active substances mean that this plant has an extremely broad spectrum of effects on living organisms (Piłat, Zadernowski, 2016). It is believed that due to the antioxidant properties of sea buckthorn, it may have chemopreventive and anticancer efficacy (Chandra et al., 2018). Chinese scientists proved the positive effect of sea buckthorn juice on immune functions and inhibition of tumor growth in mice (Liping et al., 1956). It was found that intraperitoneal injections and intragastric administration of *H. rhamnoides* oil in mice inhibited the development of sarcoma (S180) and lymphocytic leukemia (P388) cancer cells. Sea buckthorn juice not only killed S180 and P388 cancer cells, but also inhibited the growth of human gastric cancer (SGC7901) and lymphocytic leukemia (L1200) cells (Mingyu, 1994; Mingyu et al., 1994).

Other studies conducted on mice showed possible mechanisms of the antimutagenic effect of sea buckthorn oil. It was reported that *Hippophae* extract (an alcoholic extract containing flavonoids) protected bone marrow from radiation damage, radiation damage and could help in faster regeneration of bone marrow cells (Agrawala, Goel, 2002). One study confirmed faster regeneration of the hematopoietic system after high doses of chemotherapy in mice fed sea buckthorn oil (Chen et al., 2003). Scientists from India showed that sea buckthorn fruit extract protected mitochondrial and genomic DNA from radiation-induced damage. They found that polyphenols and flavonoids (such as kaempferol, isorhamnetin and quercetin) present in the extract might be responsible for scavenging free radicals and protecting DNA (Shukla et al., 2006). Therefore, further research on the effectiveness of sea buckthorn-based preparation in cancer prevention is needed. These studies should better explain the activity of active compounds found in sea buckthorn and their metabolic transformations in the human body, the molecular or cellular mechanism of their action, and should also include an analysis of factors influencing the bioavailability of these substances (Piłat, Zadernowski, 2019).

In the case of *Tanacetum vulgare*, we deal with many valuable pharmacologically active substances (Tab. 3 – Appendix 1). Among them there are germacrene, parthenolide and costunolides (Fig. 2), with anti-inflammatory and anticancer properties (Mureşan, 2015; Šukele et al., 2023; Karcheva-Bahchevanska et al., 2023).

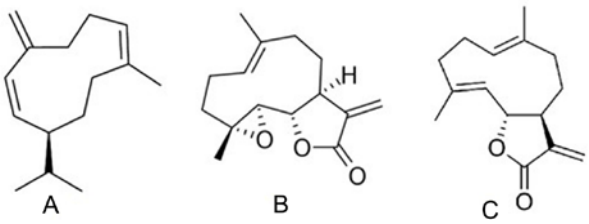


Fig. 2. Active substances from *Tanacetum vulgare* L. with anti-inflammatory and anti-cancer properties: germacrene D ($C_{15}H_{24}$) – A, parthenolide ($C_{15}H_{20}O_3$) – B, costunolide ($C_{15}H_{20}O_2$) – C

Sesquiterpene lactones, showing a broad spectrum of biological activity, may also be important for oncotherapy. Most of them have anticancer and antimicrobial effects. These compounds have been isolated from higher plants, mainly from the large, species--rich family Asteraceae Dum., which also are included in tansy (Milosavljević et al., 1999). Scientists from Bulgaria found that an aqueous-ethanolic extract of tansy *in vitro* significantly reduced the viability of breast cancer cells (Gospodinova et al., 2014). A Serbian team of scientists conducted studies that showed an *in vitro* antiproliferative effect of tansy extracts in human cervical cancer HeLa cells (Devrnja et al., 2017). The flavone found in tansy – eupatulin (Fig. 3) has anticancer properties.

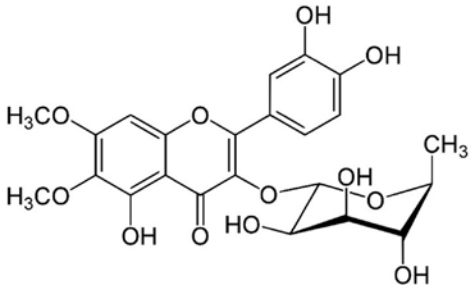


Fig. 3. Chemical structure of eupatolin ($C_{23}H_{24}O_{12}$), found in *Tanacetum vulgare* L.

Its ability to stimulate apoptosis was confirmed in various cancer cell lines, including: gastric cancer cells (AGS, MKN-1) (Kim et al., 2005; Lee et al., 2008; Park et al., 2013), leukemia cancer (HL-60) (Seo, Surh, 2001), renal cancer (786-O) (Zhong et al., 2016), liver cancer (Huh-BAT) (Park et al., 2006), osteosarcoma (U-2) (Li et al., 2015), glioma (U87MG, LN229) (Wang et al., 2016) and melanoma (A375) (Al Shawi et al., 2011).

As for *Syzygium aromaticum*, its main component is essential oil, which contains up to 90% eugenol. The composition of the raw material includes tannins, triterpenes, phytosterols, flavonoids, and mucilage compounds (Rahim et al., 2025; Brahmi et al., 2025) (Tab. 3 – Appendix 1). Clove shows anticancer activity based, among others, on its effect on estrogen receptors α. This effect is important in the case of hormone-dependent cancers, which include breast and prostate cancer (Wincek, 2017). Numerous studies confirmed that cloves were potential agents in the treatment of cancer as they increased apoptosis and inhibited cell proliferation, thus exhibiting two key properties in cancer therapy (Naik et al., 1996; Aggarwal, Shishodia, 2006; Banerjee et al., 2006).

Researchers from the United States suggested that eugenol (Fig. 5A) could be used as a melanoma treatment agent targeting E2Fs (i.e. transcription factors that provide a growth stimulus for continued melanoma cell proliferation).

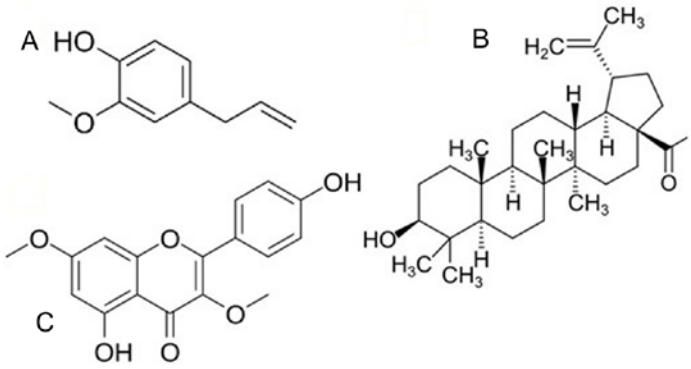


Fig. 4. Anti-cancer substances from *Syzygium aromaticum* (L.) Merr. & Perry: eugenol ($C_{10}H_{12}O_2$) – A, betulinic acid ($C_{30}H_{48}O_3$) – B, kumatakenin ($C_{17}H_{14}O_6$) – C

E2F1 dysregulation may be a key element in eugenol-mediated inhibition of melanoma growth both *in vitro* and *in vivo* (Ghosh et al., 2005). Eugenol was confirmed to be cytotoxic to promyelocytic leukemia (HL-60) and submandibular carcinoma (HSG) cells (Atsumi et al., 2005), cervical cancer (HeLa) cells (Das et al., 2018) and lung cancer (A549) cells (Azhagumeena et al., 2021). Researchers from India also showed that eugenol present in clove oil extract was an effective cytotoxic agent against various types of cancer cells, particularly esophageal cancer (TE-13), and could induce apoptosis (Dwivedi et al., 2011). It was also indicated that due to the content of betulinic acid (Fig. 5B) and other triterpenes, cloves might act as chemopreventive agents against breast cancer (Aisha et al., 2012). A team of researchers from Indonesia confirmed the clear cytotoxic effect of cloves on human breast cancer (MCF-7) (Kumar et al., 2014). In turn, a group of researchers from South Korea discovered that another compound contained in cloves – kumatakenin (Fig. 5C), also exhibited anticancer activity, inducing

apoptosis of human ovarian cancer cells (SKOV3 and A2780) (Woo et al., 2017). The results of studies conducted by Chinese scientists using various esophageal cancer cell lines suggest that kumatakenin can treat esophageal cancer and also protect against its progression by blocking TRIM65-dependent FASN ubiquitination and stability (this mechanism was further confirmed by findings using animal model tumor tissues) (Tian et al., 2022).

Summary

This study presents four selected plant species in terms of their medicinal properties and describes examples of methods of obtaining medicinal raw materials from them and using them in phytotherapy, with particular emphasis on the use of anticancer activity. This topic concerns an extremely important and current issue. "The benefits of the plant world" and their use as anticancer agents are a subject of growing interest among researchers and practitioners of oncology. In recent decades, many new oncotherapeutic agents of natural origin with selective anticancer activity have been sought. The anticancer potential of *Chelidonium majus, Hippophae rhamnoides, Tanacetum vulgare* and *Syzygium aromaticum* has only been confirmed based on the results of *in vitro* or *in vivo* animal studies. Therefore, these species can be used for cancer prevention (chemoprevention) or as supportive agents in cancer treatment, provided there are no specific contraindications to their use. However, further clinical studies are needed to demonstrate a clear justification for their use as anticancer agents. When using them in complementary therapies, a specialist should be consulted. However, in the case of poisonous species, such as tansy or celandine, it is necessary to adjust the doses and method of taking the herbal medicine and remain under constant supervision of a specialist.

Conflict of interest

The author declare no conflict of interest related to this article.

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Appendix 1

Tab. 2. Preparations based on selected species with anticancer potential

The form of the preparation	Recipe and application
Chelidonium majus L. (Source: own study based on Przybylak, 2016; Wincek, 2017)	
infusion	Pour 300 ml of boiling water over the crushed raw material, leave covered for about 0.5 hour, and strain. Drink 50 ml several times a day.
juice	The crushed raw material should be squeezed and the resulting concentrate should be poured with alcohol. After a few days, when the solution has become light in color, the liquid should be drained. This juice should be taken 5–10 drops 3–5 times a day.
tincture	Pour 1 part of washed, crushed herb with roots with 5 parts of 40% ethanol and leave for 10 days in a dark place. After this period, strain. The mixture can be used externally in the form of rinses or compresses and internally, taking 1 teaspoon dissolved in a small amount of water 2–3 times a day.
macerate	Pour 1 part of ground celandine herb with 3 parts of warm 0.9% NaCl solution and leave for 2–3 hours. Then filter and leave in a cool place. This macerate is drunk in a dose of up to 30 ml 2–3 times a day; it should be used within 3 days at most.
alcohol-glycerin macerate	Pour 1 part of fresh, crushed raw material with 1 part of glycerin and 2 parts of 40% alcohol. Set aside this mixture for 10 days in a dark place, then strain and pour into a dark bottle. It is recommended to consume 1–2 teaspoons daily dissolved in a small amount of lukewarm water or tea.
Hippophae rhamnoides L. (Source: own study based on Różański, 2007; Ma et al., 2019; Kopcekova et al., 2023; He et al., 2023; El Heddari, 2023)	
intract	Pour 1 part of fresh and crushed fruit with 5 parts of hot alcohol 40–60%. After 2 weeks, the infusion should be strained. This remedy is taken once a day, in a small glass.
juice	Prepare fruit juice using a slow juicer. Daily consumption of 50 ml of sea buckthorn juice for 8 weeks may contribute to the beneficial effects of reducing the risk of cardiovascular disease.
infusion (sea buckthorn tea)	Prepare an infusion of dried sea buckthorn leaves in the same way as with other herbs. Drinking this infusion can be a preventive element due to the antioxidant, antibacterial, antiviral, anticancer, and immunomodulatory effects of sea buckthorn leaves.
sea buckthorn oil	Pour an equal volume of oil (Provençal or sunflower) over crushed dried sea buckthorn fruit or dried pulp from squeezing the juice, mix well, and store the resulting mixture for 24 hours in a water bath at a maximum temperature of 60°C. Then squeeze the mixture through a Capron bag, and mix the resulting oil with a new portion of crushed dried fruit (or dried pomace) and heat in the same way. Repeating the procedure three times allows you to obtain high-quality sea buckthorn oil. Set aside for a week, then filter the oil.
Tanacetum vulgare L. (Source: own study based on Wincek, 2017)	
*decoction	Pour 300 ml of water over 1 tablespoon of crushed tansy herb and boil for 10 minutes, replenish evaporated water, add 5 ml of wheat germ oil, and strain. Drink several times a day for half a glass (the decoction can also be used externally, as compresses and enemas).

*infusion	Pour boiling water over 1 tablespoon of crushed tansy herb, add 5 ml of wheat germ oil, cover and leave to infuse for 20 minutes and strain. Drink half a glass several times a day.
*tincture	1 part of tansy herb pour 5 parts of 40% alcohol, leave in a dark place for 10 days, then filter. Take 3 times a day, 1 tablespoon in 50 ml of water.
Syzygium aromaticum (L.) Merr. & Perry (Source: Wincek, 2017)	
*infusion	Pour 2 teaspoons of cloves (freshly ground) into 300 ml of boiling water, and leave for 15 minutes. Drink 0.5 cups 3–4 times a day.

Note: * preparations used in cancer phytotherapy according to Wincek's recipes (2017); other recipes are used in various diseases.

Tab. 3. Basic chemical composition of the analysed species

Species/Source	Chemical composition
Chelidonium majus L. Rumińska, 1981; Ożarowski, 1987; Hahn, Nahrstedt, 1993; Rogelj et al., 1998; Cahliková et al., 2010; Frohne, 2010; Li et al., 2011; Park et al., 2011; Kędzia et al., 2013	Herb and root: isoquinoline alkaloids: benzophenanthridine derivatives (including the alkaloid chelidonine, hemochelidonine, homochelidonine, norchelidonine, also chelerythrine, chelitridine, sanguinarine, 8-hydroxydihydrosanguinarine), protopyrine derivatives (protopine, α- and β-allocryptopine), protoberberine derivatives (berberine, coptisine, stylopine), alkaloids (sparteine, coptisine, chelidonine), organic acids (chelidonic acid, as well as malic, citric, ferulic, caffeic, coumaric, gentisic acid), phenolic acid derivatives, saponins, calcium salts, proteolytic enzymes, flavonoids, biogenic amines (e.g. histamine, tyramine), traces of essential oil, carotenes, vitamin C.
Hippophae rhamnoides L. Pearson, Rogers, 1962; Czikow, Łaptiew, 1983; Yang et al., 2001; Guliyev et al., 2004; Gutzeit et al., 2008; Krejcarová et al., 2015; Bośko, Biel, 2017	Fruits: vitamin C, A (carotenoids: β-carotene, lycopene, lutein, zeaxanthin), E, B1, B2, B6, B12, F, K, P, folic acid, D, anthocyanins, flavonoids (quercetin, kaempferol, myricetin, isorhamnetin), phospholipids, tannins, unsaturated acids fatty acids, organic acids (malic, tartaric), macro and microelements, including K, Mn, Cu, Fe, B, glucose, fructose, xylose, albumins, globulins, amino acids, phytosterols (e.g. β-sitosterol); Oil: glycerides of linoleic, α-linolenic, oleic, vaccenic, palmitic and stearic acids, including: tocopherols, carotene and carotenoids, sterols, flavonoids, esters, terpenes and aromatic compounds (low concentrations); Leaves: β-carotene, vitamin E, flavonoids, triterpenes, catechins, ellagic and folic acid, chlorophylls, mineral compounds including: Na, Ca, K, Mg, Fe, Si, Al, Mn, Cr.
Tanacetum vulgare L. Mureşan, 2015; Šukele et al., 2023; Karcheva-Bahchevanska et al., 2023	Capitula and herb: sesquiterpene lactones, sesquiterpenes, flavonoids (e.g. apigenin, diosmin and quercetin), phenolic acids, camphor, phytosterols, borneol, vulgarone, mazulen, thujone, germacrene, parthenolide and costunolides. Oil: 1,8-cineole, trans-thujone, camphor and myrtenol.
Syzygium aromaticum (L.) Merr. & Perry Bao et al., 2012; Kamatou et al., 2012; Brahmi et al., 2025; Rahim et al., 2025	Oil: eugenol, acetyleugenol, β-caryophyllene, vanillin, crategolic acid, tannins (e.g. bicornin), gallotannic acid, methyl salicylate, flavonoids (eugenin, kaempferol, rhamnetin, eugenitin), triterpenoids (oleanolic acid, stigmasterol and campesterol), sesquiterpenes; Buds: tannins (e.g. ellagitannin and eugenin), triterpenes, phytosterols, flavonoids (e.g. astragalin, hyperoside, quercitin and kaempferol) and mucilage compounds.

Potencjał przeciwnowotworowy wybranych gatunków roślin i ich zastosowanie w fitoterapii

Streszczenie

Powrót do natury może być kluczowy w walce z negatywnymi skutkami postępu cywilizacyjnego, do których zaliczamy chociażby choroby nowotworowe. W pracy omówiono wybrane gatunki roślin leczniczych, które wykazują aktywność przeciwnowotworową. Głównym celem publikacji jest wskazanie na podstawie badań naukowych możliwości wykorzystania wybranych surowców roślinnych jako środki chemoprewencyjne i preparaty o potencjale antyrakowym. Podjęto próbę uaktualnienia stanu wiedzy na temat właściwości czterech wybranych do analizy gatunków – *Chelidonium majus*, *Hippophae rhamnoides*, *Tanacetum vulgare* oraz *Syzygium aromaticum*. Ich działanie przeciwnowotworowe zostało opisane w oparciu o przytoczone wyniki licznych badań, dokonano bowiem wnikliwej analizy artykułów naukowych dostępnych w bazie Google Scholar, PubMed oraz Europe PMC. Korzystano również z innych źródeł bibliograficznych, a także specjalistycznych stron internetowych. Potencjał przeciwnowotworowy roślin przedstawionych w opracowaniu został już w pewnym zakresie zbadany, dlatego mogą być one używane chemoprewencyjnie lub wspomagająco przy nowotworach, o ile nie ma przeciwwskazań do ich stosowania. Nie mniej jednak nie można uznać ich za w pełni skuteczne środki przeciwnowotworowe, a tym bardziej za leki, gdyż w większości przypadków przypisywane roślinom właściwości antykancerogenne opierają się jedynie na badaniach *in vitro* lub *in vivo* na zwierzętach. Nie można, a wręcz nie wolno, ich stosować bez specjalistycznej opieki lekarza onkologa.

Słowa kluczowe: choroby nowotworowe, profilaktyka raka, wybrane rośliny lecznicze

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