Review article

Content analysis, development and standardisation of choleretic agents based on medicinal herbal raw materials of *Tanacetum* and *Achillea*

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ABSTRACT

The purpose of the study was to collect data on Achillea and Tanacetum species common in Kyrgyzstan, their active components, and therapeutic characteristics. A review of scientific papers and other sources of information on the Internet, including databases and national resources, on the subject of pyzhma and yarrow, with an emphasis on their chemical composition, prevalence, biological activity, and traditional use, was conducted. A search was performed for keywords and plant species with data analysis in Microsoft Excel for systematisation and validation. The study covered the distribution, chemical composition and therapeutic properties of pyzhma and yarrow in Kyrgyzstan. The chemical composition of plants contains essential oils, flavonoids, and sesquiterpenes, causing their choleretic, antispasmodic and hepatoprotective properties. The content of active ingredients in wild forms of pyzhma is higher, making them more valuable for medical use. The study shows that the Asteraceae family is widespread in Kyrgyzstan and thrives in diverse conditions, with different chemical components having hepatoprotective, choleretic, and anti-inflammatory effects, useful in medical practice.

Keywords: *Achillea*, biological activity, chemical composition, choleretic property, plant extracts, *Tanacetum*,

INTRODUCTION

More than half of modern medicinal products are synthesised from herbal remedies (Khatib *et al.*, 2023). Their wide range of biological activity and a variety of phytochemical compounds make them suitable for the creation of new drugs. Various species of pyzhma (*Tanacetum*) and yarrow (*Achillea*) grow in Kyrgyzstan, which are traditionally used in folk medicine. The chemical

composition and biological activity may vary depending on the species, plant organ, place of growth, and environmental conditions (Lechkova *et al.*, 2023). One of the main problems is the lack of information about the chemical composition and active ingredients of plants growing in Kyrgyzstan. Current scientific evidence supporting the efficacy and safety of these plants is also limited. The examination of the chemical composition and pharmacological properties of pyzhma and yarrow will expand the understanding of the mechanisms of their action and the potential of their choleretic properties for therapeutic use. In addition, the exploration and use of local plant resources can be of substantial economic importance. This will not only expand scientific knowledge but may also lead to the creation of new medicines.

At the moment, studies on the variation of the chemical composition of pyzhma and yarrow, the mechanisms of their action on the biliary system, methods of standardisation of extracts, and their safety, toxicity, pharmacokinetics, and clinical efficacy remain relevant. The purpose of the study was to systematise and analyse existing data on pyzhma and yarrow species in Kyrgyzstan, their chemical composition and biological properties, and to evaluate their use in medical practice.

PROCEDURE ADAPTED FOR COLLECTION OF INFORMATION

A comprehensive review of information resources on the Internet was performed to conduct this study, including papers, databases such as PubMed, Scopus, Semantic Scholar, Google Scholar, and the sites of the National Academy of Science of Kyrgyz Republic, I.K. Akhunbaev Kyrgyz State Medical Academy, Kyrgyz-Turkish Manas University, Kyrgyz National University named after Jusup Balasagyn. National botanical resources, reports, and other publications related to the species, chemical composition, and biological properties of pyzhma and yarrow were also used.

After determining the plant species growing on the territory of the republic, the search additionally included such species as *Achillea millefolium, Achillea Setacea, Achillea asiatica, Achillea filipendulina*, *Achillea collina*, *Tanacetum vulgare, Tanacetum parthenium*. The selection of relevant publications was conducted according to the following inclusion criteria: works published in peer-reviewed journals, books, monographs, reports, conference materials, and clinical trials describing studies on the use of samples of various types of medicinal plants *Tanacetum* and *Achillea* collected from different territories of Kyrgyzstan. Specific gathering sites included regions with diverse ecosystems such as pastures, steppes, mountain slopes, and river valleys. Studies on the growth of pyzhma and yarrow in Central Asia and Kyrgyzstan, as well as data on the active components of these plants, their therapeutic properties, and active substances, were also included. Special attention was paid to studies of choleretic activity, namely experiments on laboratory animals using liver perfusion techniques to measure bile flow and a comparative analysis of the choleretic effect of extracts with known hepatoprotectors. The content analysis of the collected information included the systematisation of data on the species, chemical composition, and biological properties of pyzhma and yarrow.

Special attention was paid to papers describing research in Kyrgyzstan over the past 5 years, however, due to insufficient data, the search was expanded

to publications issued more than 5 years ago. The object of the study included various types of yarrow and pyzhma common in Kyrgyzstan, regions and places of their growth, active components of plants, therapeutic properties, extraction methods, and features of plant raw materials.

The biological activity of plants was analysed in the context of their therapeutic effects, with an emphasis on choleretic function and general effects on the hepatobiliary system. The information obtained was entered into Microsoft Excel spreadsheets to facilitate the structuring of the data. The tables were systematised by plant species and included information on the chemical composition and distribution, features of the growing landscape, and research materials.

The data were analysed by two researchers to increase the reliability of the results. The units of analysis included a plant species with choleretic properties that grows on the territory of the Kyrgyz Republic, the region of growth, chemical composition (content of active substances), collection and storage of plant raw materials, methods of synthesis of nanoparticles of plant raw materials, author and date of publication, forms of medicines, safety issues of medicines, experimental data (research results on animals or people).

FINDINGS

The prevalence of pyzhma and yarrow in Kyrgyzstan

One of the leading families in the Kyrgyz Republic is *Asteraceae Dumortier*. According to Zhailybayeva *et al.* (2023), the *Asteraceae Dumortier* family, which includes plants such as pyzhma and yarrow, accounts for 16.9% of the total number of species in the country and includes 141 species. It is shown that each *Achillea* species has its own preferences in terms of landscape types and growth conditions, from meadows and steppes to mountain slopes and shores. Most *Achillea* species prefer open and semi-mountainous landscapes such as pastures, steppes, grasslands, and slopes, which indicates their ability to adapt to diverse ecosystems.

Pyzhma grows in various conditions, from reclaimed lands to ruderal sites, which can affect the chemical composition and quality of plant materials. Nurzyńska-Wierdak *et al.* (2022) established that different harvesting sites can affect the morphological parameters of pyzhma, such as plant height and inflorescence mass. The highest content of flavonoids and phenolic acids was identified in raw materials from ruderal and reclaimed sites.

The examination of *Achillea filipendulina*, conducted in the northern foothills of the Alai range in the Kara-Suu and Nookat regions, focused on the vegetation cover and its floral composition. It was determined that the association of gundelia milkweed yarrow is located in the Kichik tract at an altitude of 1800-1900 m. The projective vegetation was 55-60%, while the yarrow was 15-20%. The study showed that the natural reserves of yarrow and other medicinal plants vary depending on the height and composition of plant communities. Information about the condition of these plants is important for their rational use and protection (Mero *et al*., 2023). It was established that *Tanacetum vulgare* is widespread in Central Asia and Kyrgyzstan, inhabiting various landscapes.

The chemical composition of pyzhma and yarrow, which are found on the territory of Kyrgyzstan

The active components of *Achillea* species are presented in detail in Table 1.

Table 1: Active substances of *Achillea* (yarrow) species

Achillea species	**Chemical composition**	**Source**
Achillea millefolium/ Yarrow ordinary/ kadimki kaz tandai	Dicaffeoylkine acids, luteolin-7-O-β-D-glucuronide, sesquiterpenes (hamazulene), monoterpenes (camphor, thujol), flavone glycosides (apigenin, luteolin), alkaloids (achillein, betaine, choline, trigonellin), sesquiterpenoids (acetoxyartabsin, acetylbalkanolide, achillicin, achillin, austricin, balkhanid, dihydroacetoxitamacin, hydroxyachylin, leucodine, millefin, millefolid), vitamin K, flavonoids (artemethin, vitexin, vicenin, isovitoxin, isoramnetin, isoerentin, casticin, cosmosin, quercetin, orientin, certisin), essential oils (furfural, isobutyl acetate, kadinen, humulene, copaene, caryophyllene, isoartemisiacetone, limonene, alpha-thujone, eucalyptol, pinene, camphene, farnesene, borneol, myrcene, sabinene, terpineol, cumin aldehyde, bornyl acetate, terpinol-4, cymol, γ-terpinene, azulene, menthol, terpinolene, aljoyen, α-terpinene), carbohydrates (inositol, glucose, arabinose, galactose), organic acids (aconite, amber), phenolic carboxylic acids (salicylic, caffeic).	Liu *et al.* (2020), Berdigulova *et al.* (2022)
Achillea Setacea/ Yarrow bristly/ Katuu tuktuu kaz tandai	Alkaloids (betaine, choline, trigonellin, achillein), glycosides, sesquiterpenes, sesquiterpenoids (acetoxyartabsin, acetylbalkanolide, achillicin, achillin, austricin, balhanide, dihydroacetoxitamacin, hydroxyachilin, leucodine, millefin, millefolide), flavonoids (artemethin, vitexin, vicenin, isovitoxin, isoramnetin, isoerentin, casticin, cosmosin, quercetin, luteolin, orientin, certisin, apigenin), essential oils (furfural, isobutyl acetate, kadinen, humulene, copaene, caryophyllene, isoartemisiacetone, limonene, alpha thujone, eucalyptol, pinene, camphene, farnesene, borneol, myrcene, sabinene, terpineol, cumin aldehyde, bornyl acetate, terpinol-4, cymol, γ-terpinene, azulene, menthol, terpinolene, aljoyen, α-terpinene), resins, tannins, vitamins C and K, organic acids (aconite, amber), phenolic carboxylic acids (salicylic, caffeic), 1,8-cineol, carbohydrates (inositol, glucose, arabinose, galactose).	Eisenman *et al.* (2013), Liu *et al.* (2020)
Achillea asiatica/ Yarrow Asian/	Essential oils (furfural, isobutyl acetate, kadinen, humulene, copaene, caryophyllene, isoartemisiacetone, limonene, alpha thujone, eucalyptol, pinene, camphene, farnesene, borneol, myrcene, sabinene, terpineol, cumin aldehyde,	Eisenman *et al.* (2013), Liu *et al.*

Chinese/ Golian/ Asia kaz tandayy	bornyl acetate, terpinol-4, cymol, γ-terpinene, azulene, menthol, terpinolene, aljoyen, α-terpinene, limonene), sesquiterpene lactones, sesquiterpenoids (acetoxyartabsin, acetylbalkanolide, achillicin, achillin, austricin, balhanide, dihydroacetoxitamacin, hydroxyachylin, leucodine, millefin, millefolide), alkaloids (betaine, choline, trigonellin, achillein), flavonoids (artemetin, vitexin, vicenin, isovitoxin, isoramnetin, isoerentin, casticin, cosmosin, quercetin, luteolin, orientin, certisin, apigenin), phytoncides, bitter and astringent substances, resins, vitamins C and K, carotene, carbohydrates (inositol, glucose, arabinose, galactose), organic acids (aconite, amber), phenolcarboxylic acids (salicylic, caffeic).	(2020)
Achillea filipendulina / Yarrow meadowsweet/ fern-like/ Tabylgylbyr actu kaz tandai	Contains 0.07-0.26% oil (furfural, isobutyl acetate, kadinen, humulene, copaene, caryophyllene, isoartemisiacetone, limonene, alpha thujone, eucalyptol, pinene, camphene, farnesene, borneol, myrcene, sabinene, terpineol, cumin aldehyde, bornyl acetate, terpinol-4, cymol, y-terpinene, azulene, menthol, terpinolene, aljoyen, a-terpinene), sesquiterpenoids (acetoxyartabsin, acetylbalkanolide, achillicin, achillin, austricin, balhanide, dihydroacetoxitamacin, hydroxyachylin, leucodine, millefin, millefolide), flavonoids (quercetagetine, kentaureidine, artemethin, vitexin, vicenin, isovitoxin, isoramnetin, isoerentin, casticin, cosmosin, quercetin, luteolin, orientin, certisin, apigenin), traces of alkaloids, asparagine, amino acids and nitrogen-containing substances, carbohydrates (inositol, glucose, arabinose, galactose), organic acids (aconite, amber), phenolic carboxylic acids (salicylic, caffeic).	Sharopov (2015), Liu *et al.* (2020)
Achillea collina/ Yarrow of the hill.	No data available	Botanical Garden named after E.Z. Gareev of the National Academy of Sciences of the Kyrgyz Republic (2022)

The identified active components of *Tanacetum* (pyzhma) species are presented in Table 2.

Table 2: Active substances of *Tanacetum* (pyzhma)

Species	Chemical composition	Study
Tanacetum vulgare/ Chrysanthemum vulgare/ Common pyzhma	Alkaloids, glycosides, essential oils (including α-thujone, β-thujone, L-camphor, thujol, borneol, pinene, γ-terpinene, artemisium ketone, chrysanthenyl acetate, chrysanthenol, chrysanthenone, umbellone, sabinene and 1,8-cineol), terpenoids (a-amyrin), flavonoids (such as luteolin quercetin, apigenin, diosmetin), tannins, phenolic acids, sesquiterpene lactones (arbusculin-A, thanacetin, germacrene D, crispolide), flavonoid derivatives, caffeic acid, sterols (j3-sitosterol cholesterol, stigmasterin, taraxasterin and campesterin), and triterpenes.	Bussmann *et al.* (2020), Sharopov (2015), Medical Economics Company (2000)
Tanacetum partheniu m/ Feverfew	Parthenolide, thanetine, camphor, chrysanthenyl acetate, chrysanthenol, chrysanthenone, artemisia ketone, artemisia alcohol and 1,8-cineol.	Sharopov (2015)

The main part of the active components of *Tanacetum* and *Achillea* species are essential oils, flavonoids, and glycosides, which have choleretic, hepatoprotective, and antispasmodic effects. In addition, the hepatobiliary system is also influenced by phytosterols, tannins, resins, and other components present in pyzhma and yarrow (Raudone *et al.*, 2024; Eisenman *et al.*, 2013; Makhovska *et al.*, 2020). The inclusion of local plant species in pharmacopoeias and the development of standards will enhance their use in medical practice.

Therapeutic properties of yarrow *(Achillea)*

It was established that all *Achillea* species growing on the territory of the Kyrgyz Republic have a similar chemical composition and traditional use. *Achillea millefolium*, one of the most famous and widely used plants of the genus *Achillea*, is distinguished by its numerous medicinal properties. In particular, mono- and dicofeoylquinic acids contained in this plant play a key role in the manifestation of its hepatoprotective and choleretic effects. These components also substantially increase the overall antioxidant activity of *Achillea millefolium* extracts (Raudone *et al.*, 2024). In the study by Benedek *et al.* (2006), an analysis of *Achillea* extract by HPLC (high performance liquid chromatography) showed that it contains 48.8% dicofeylquinic acids (DCCA) with certain percentages for 3.4-DCCA, 3.5-DCCA, and 4.5-DCCA, 3.4% luteolin-7-bDO-glucuronide. The extract showed a dose-dependent increase in bile flow in liver perfusion experiments, with the *Achillea* fraction showing a two to three-times higher increase compared to cinarin alone. The DCCA in the *Achillea* fraction is likely responsible for this choleretic effect. The study suggested that the traditional use of yarrow in the treatment of hepatobiliary disorders is justified by the content of DCCA in it and their substantial effect on the flow of bile. In addition, yarrow tea containing DCCA can have a substantial choleretic effect. *Achillea millefolium* extracts reduce contractions of various smooth muscles, including the ileum, gallbladder ducts, pulmonary artery, trachea, uterus, and vas deferens. The aqueous alcohol extract

reduces contractions caused by acetylcholine and potassium chloride (Zubtsova *et al.*, 2019).

The plant exhibits pronounced hemostatic, analgesic, diuretic, antipyretic, and anti-inflammatory properties, which makes it a valuable tool in the treatment of various diseases. In medical practice, inflorescences and shoots of yarrow are used to obtain a therapeutic effect (Berdigulova *et al.*, 2022; Barda *et al.*, 2021). A decoction of inflorescences is used for hepatitis, angiocholitis, gallbladder diseases, acute disorders of the gastrointestinal tract, to regulate the menstrual cycle, and gynaecological pathologies (Eisenman *et al.*, 2013). Infusions of herbs without flowers are used in the treatment of rheumatism (Zubtsova and Skliar, 2023).

Achillea filipendulina decoctions have traditionally been used to treat a wide range of diseases, including gastrointestinal disorders, gout, sciatica, nasal congestion, cardiovascular diseases, abdominal pain, cough, arthritis, and malaria. In addition, this plant has been used as a laxative, diuretic, antipyretic, expectorant, antitussive, and anthelmintic agent. Externally, *Achillea filipendulina* was used to treat wounds and scabies.

Examining essential oils and lipids of two *Achillea* species grown in Uzbekistan, Asilbekova *et al.* (2019) identified that the essential oil from *Achillea filipendulina* flowers had a yield of 1.2% by dry weight and included 84 components, among which santolin alcohol (50.1%) and (Z)-chrysanthenyl acetate (13.8%) prevailed. The total lipid yield from this plant was 4.4% of the dry weight. The essential oil from the aboveground part of *Achillea millefolium* had a yield of 1.0% and included 82 components, the most substantial of which were 1,8-cineol (14.3%) and bornyl acetate (4.4%). The total lipid yield was 3.6% of the dry weight. The study showed that environmental conditions substantially affect the composition of essential oils.

The antibacterial properties of the plant manifest against both gram-positive and gram-negative bacteria. The flavonoid quercetagetin demonstrates anti-HIV activity by acting as an inhibitor of HIV reverse transcriptase and integrase. Therewith, kentaureidine exhibits cytotoxicity by inhibiting tubulin polymerisation (Sharopov, 2015).

Achillea Setacea has a wide range of medicinal properties, including antimicrobial, anti-inflammatory, and hemostatic effects. Studies have shown that essential oil is released from the aboveground parts of this plant, which is a carrier of many bioactive components. In particular, 51 active components were found in the composition of this oil, among which sesquiterpenes are especially prominent. These compounds demonstrate substantial anti-inflammatory activity, which makes *Achillea Setacea a* promising agent for use in traditional and modern medicine (Eisenman *et al.*, 2013).

A similar study was conducted by Barda *et al.* (2021), reviewing the current state of knowledge about the phytochemistry of the genus *Achillea* and comparing traditional applications with modern pharmacological data. Over the past decade, 31 species of *Achillea* have been examined, 141 chemical compounds have been identified, including flavonoids, phenolic and quinic acids, sesquiterpenoid lactones, etc. The traditional uses of 24 types are discussed, including the treatment of spasms, gastrointestinal and hepatobiliary disorders, haemorrhages, pneumonia, rheumatism pain, wound healing, and diuretic, anti-inflammatory, antipyretic, and the treatment of menstrual and gynaecological disorders.

Therapeutic properties of pyzhma *(Tanacetum)*

Tanacetum vulgare (common name pyzhma) has many useful properties due to the content of phenolic acids, flavonoids, terpenoids, and fatty acids, which make its extracts especially valuable in medical and pharmacological practice. These extracts exhibit strong antioxidant activity, effectively inhibit enzymes such as tyrosinase and amylase, and have neuromodulatory effects by stimulating the dopamine transporter and the release of norepinephrine. However, at high concentrations (50-100 micrograms/ml), the extracts exhibit cytotoxicity, which requires caution when using them (Ak *et al.*, 2021; Berganayeva *et al.*, 2023). The main components of pyzhma essential oil include camphor and trans-chrysanthenyl acetate, which contribute to its biological activity (Ivanović *et al.*, 2022). *Tanacetum vulgare* is known for its antioxidant, antimicrobial, attractant, and insecticidal properties, which makes it useful in various fields of medicine (Sharopov, 2015). Herbs and inflorescences of wild yarrow have a substantially higher concentration of essential oil compared to cultivated varieties. According to various sources, the essential oil content in a wild plant ranges from 0.07% to 0.5%, whereas in cultivated species, this indicator is about 0.3% (Sodombekov *et al.*, 2023; Sytnik *et al.*, 2023). Thus, wild yarrow is more valuable for medical and pharmacological applications due to its higher content of essential oils.

Dried pyzhma flowers (30 g-50 g) are taken as an infusion or liquid extract, as an anthelmintic, carminative, and choleretic agent (Toktonaliev, 2019). In a study conducted by Abdurakhmanova *et al.* (2019), clinical trials of the anthelmintic drug Gelrem, developed on the basis of medicinal plants of Uzbekistan, were reviewed. This preparation included extracts of pyzhma pseudocyst, wormwood, and flower buds of cloves. The tests were conducted at the Tashkent Pediatric Medical Institute on 20 patients suffering from enterobiosis, ascariasis, and giardiasis. The results showed that Gelrem has high therapeutic efficacy and good tolerability. Clinical improvement was observed in all patients: appetite improved in 100% of patients, abdominal pain decreased in 79%, and itching in the anus disappeared in 93%. Laboratory tests confirmed the complete disappearance of intestinal parasites: pinworm, ascaris, and dwarf tapeworm eggs were not found in any patient after the course of treatment. Giardia disappeared in 9 out of 11 patients.

In vitro and animal studies have shown that pyzhma extracts have antispasmodic effects on rabbit intestines and choleretic activity in dogs. It is assumed that these effects may be related to the presence of caffeic acid, which is known for its ability to stimulate bile production (Medical Economics Company, 2000; Far *et al.*, 2023).

The choleretic and cholekinetic activity of new pharmaceutical compositions containing a thick extract of pyzhma flowers (GECPO) and essential oils of lavender, mint, and cloves was thoroughly examined in 2022 under the guidance of Yurchenko and Mishchenko (2022). During experiments on healthy animals, it was established that all tested compositions substantially increased bile secretion, and their effectiveness was substantially higher compared to the drug “Holelesan”. The greatest choleretic effect was demonstrated by the composition of GECPO in combination with lavender essential oil, which indicates its particularly high effectiveness.

A Decoction from the leaves of *Tanacetum parthenium* is used in gynaecology for dysmenorrhea, infections, abdominal pain, as an

abortifacient. The litholytic properties of pyrethrum have also been observed (Khatib *et al.*, 2023). *Tanacetum parthenium*, which is part of the drug "Feverfew", contains sesquiterpene lactones, among which the main active component is parthenolide. Flavonoids and volatile oils are also present in the composition of the plant. Parthenolide is found in the surface leaf glands in concentrations from 0.2% to 0.5%. This component has a multifaceted effect, including anti-inflammatory, analgesic, antioxidant, cytotoxic, and antispasmodic. Such properties make it effective in the treatment of fever, migraines, toothache, stomach aches, infertility, and rheumatoid arthritis. In the experiments conducted by Lechkova *et al.* (2023) on rats, it was determined that *Tanacetum parthenium* essential oil is safe at doses up to 1 g/kg of body weight for no more than one month. The antispasmodic effect of parthenolide helps to relax the smooth muscles of the biliary tract and improve the outflow of bile. In addition to parthenolide, flavonoids such as luteolin, quercetin, apigenin, and diosmetin and terpenoids, including L-camphor and thujol, have a substantial effect on the walls of the bile ducts. These substances exhibit pronounced antispasmodic properties, which help to relax and improve the patency of the biliary tract.

Drug safety and plant extraction

Although herbal medicines are usually made from plant materials, this does not make them absolutely safe. The development and standardisation of such medicines require careful and accurate analysis of the content of active substances and their standard concentrations. This is critically important to ensure both the effectiveness and safety of these drugs. For example, the *Asteraceae* family is characterised by a high concentration of thujones in essential oils. This concentration can vary substantially depending on the organ of the plant and the stage of its development. Studies show that thujones have dose-dependent genotoxic and carcinogenic properties (Corvino *et al.*, 2023).

In addition, an important aspect is the quality control of raw materials, including analysis of the content of harmful elements. Thus, in the study by Chekirov *et al.* (2018), soil and *Achillea millefolium* samples collected every 3 km at seven stations along the Alamedin River were analysed. The use of inductively coupled plasma mass spectrometry (ICP-MS) allowed determining the content of heavy metals and mineral elements. The results of the study showed differences in the concentrations of calcium (Ca), copper (Cu), potassium (K), magnesium (Mg), and nickel (Ni) in different plant organs and soil. High levels of heavy metals have been recorded in urbanised areas, indicating a substantial anthropogenic impact.

Both dry and fresh parts of the plant can be used for the synthesis of active components. The leaves, flowers, and stems of pyzhma and yarrow are suitable for extracting active substances (Zaychenko *et al.*, 2019). The dry vegetable raw materials are pre-ground to the desired size, which increases its surface area and contributes to more efficient extraction of active substances. After that, sieving and cleaning are conducted to remove unnecessary impurities (Maharramova, 2021). Extraction occurs when the solvent interacts with plant tissue, resulting in the dissolution of phytochemicals having a similar polarity to the solvent. In the plant extract, phytochemicals can also act as biocatalysts.

The active components of plants can be extracted by various methods, including maceration, reflux extraction,

ultrasonic, and microwave treatment, percolation, hydrodistillation, Soxlet extraction, and boiling. Distilled water, ethanol, and methanol are most often used in the extraction of *Tanacetum* and *Achillea* (Nizhenkovska *et al.*, 2018). For the analysis of essential oils and lipids of two types of *Achillea*, Asilbekova *et al.* (2019) applied the method of hydrodistillation using the Clevenger apparatus. Neutral lipids were extracted using hexane, whereas polar lipids – a mixture of chloroform and methanol. The obtained extracts were analysed by thin-layer chromatography (TLC), column chromatography (CC), and gas chromatography with a mass spectrum detector (GC-FID).

Farajpour *et al.* (2024) used the method of hydrodistillation using the Clevenger apparatus (by vapour condensation) to obtain essential oil from the aboveground parts of thirty-five samples of three *Achillea* species. Ground to a fine powder and dried above ground parts of plants (100 grammes each) were subjected to hydrodistillation for three hours.

The study conducted by Al-Rimawi *et al.* (2024) consisted of obtaining an extract from the dried powder of *A. fragrantissima* by multistage extraction. In this case, 2 grammes of powder prepared from the leaves, stems, and flowers of *A. fragrantissima* were soaked in 150 ml of distilled water, ethanol, and 1% sodium bicarbonate solution. The extraction process was conducted for 20 minutes. The mixture was left at room temperature for 12 hours to improve the extraction of active substances from plant material. The extracts were then filtered to remove plant particles and concentrated using an IKA WEREKRV06-ML rotary evaporator. The concentrated extracts were freeze-dried in a Labconco dryer until a constant weight was achieved. The finished dried extracts were stored in the refrigerator until use.

The highest concentration of tannins in *Achillea millefolium* was recorded during budding, amounting to 7.1-2.6%. The peak content of flavonoids was noted during the flowering period (0.186-0.028%), which makes this period optimal for the collection of the *Herba Millefolii* drug. In *Tanacetum vulgare*, the highest content of tannins (8.75-4.3%) and flavonoids (0.160-0.063%) was also identified during budding. The content of tannins of at least 4% and flavonoids of at least 0.02% is recommended for Herba Tanaceti (Ivancheva *et al.*, 2000).

The stages of collecting flowers of feverfew substantially influenced the content and composition of the essential oil. Omidbaigi *et al.* (2007) established that the highest average essential oil content (0.55%) was obtained from plants harvested at the stage of fruit formation, while the lowest average content (0.35%) was extracted from flowers harvested at the budding stage.

CONCLUSIONS

The results of the study showed that for the Kyrgyz Republic, the characteristic species of the *Asteraceae* family are *Achillea millefolium, Achillea setacea, Achillea asiatica, Achillea filipendulina, Achillea collina, Tanacetum vulgare, and Tanacetum parthenium*. Species of the genus *Achillea* are found in Turkestan-Alai province, Kyrgyz Ala-Too, Tien Shan, Pamir-Alai, Alai ranges, and other regions. The characteristic landscapes were steppe, meadow, shrubs, adyr zones, river valleys, and roadsides.

Essential oils such as thujol, thujone, camphor, borneol, humulene, furfural, azulene, limonene, chrysanthemol, 1,8-cineol, etc., were responsible for the choleretic properties of plants. In large quantities, pyzhma and yarrow contain flavonoids quercetin,

casticin, certisin, apigenin, diosmetin, cosmosin, etc., which are also characterised by choleretic, hepatoprotective, and antispasmodic properties. Sesquierpenes (achillin, austricin, balhanide, dihydroacetoxitamacin, hydroxyachilin, leucodine) with a powerful anti-inflammatory effect also have a huge therapeutic potential. *Achillea* has hemostatic, antipyretic, diuretic, antibacterial, anthelmintic, and laxative properties. The *Tanacetum* species is characterised by antioxidant, antimicrobial, anthelmintic, choleretic, litholytic, anti-inflammatory, and analgesic properties. The extraction of pyzhma and yarrow can be done with fresh or dried plant organs. Flowers, leaves, and stems of pyzhma and yarrow are used. After grinding and filtration, the process of synthesis of nanoparticles from plants occurs by maceration, boiling, percolation, and other methods.

In the future, it is necessary to continue research aimed at systematising this knowledge and confirming it through clinical trials. It is advisable to collect and analyse plant samples from different regions and environmental conditions to identify possible differences in chemical composition and biological activity.

CONFLICT OF INTEREST STATEMENT

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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