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Study of Aqueous Extraction of a New Anti-Inflammatory Agent Based on Aerva Lanata

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Abstract

Herbal teas in filter bags form a significant segment due to their convenience and safety. Diuretic compositions are in demand for those prone to microlithiasis (the formation of small salt crystals) and recurrent urinary tract inflammation. Pol-pala is traditionally used as a mild diuretic with litholytic and anti-inflammatory effects, while corn silk additionally provides osmotic diuresis. This paper presents experimental results on the development of a filter bag composition for a mixture of the aforementioned medicinal plants. It was found that increasing the temperature and infusion time to 30 minutes and 95-100 ° C significantly increases the extraction of extractive substances, including flavonoids. A method for quantitatively assessing the yield of total flavonoids calculated as rutin is proposed. An acceptable consumer brewing regimen for filter bags is demonstrated: one bag (2.0 g) per 200 ml of water at 95-100 ° C, infuse for 20-30 minutes.

Keywords: Aerva lanata , Stigmata maydis , extraction, filter bags, flavonoids, extractive substances, extracts, spectrophotometry, phytotherapy.

Introduction

Diseases of the urinary tract are among the most common pathologies encountered in general medical practice. In recent years, there has been a significant increase in the number of patients with chronic cystitis, pyelonephritis, and urolithiasis, necessitating the search for safe and affordable preventive and maintenance treatments.

One such approach is herbal medicine, which is characterized by its gentle action, good tolerability, and the possibility of long-term use. Unlike synthetic diuretics, herbal remedies not

only have a diuretic effect but also an anti-inflammatory and metabolic effect, helping to correct water-salt balance without a significant risk of electrolyte imbalances.

Of particular interest is the use of *Aerva lanata* (half-pala), which has proven diuretic, anti-inflammatory, and litholytic properties, facilitating the excretion of uric acid salts and preventing stone formation [1-3]. Given this, we conducted research into the development of a technology for obtaining a dry extract from the underground part of the plant to create various medicinal forms [4]. Purified water was used as the extractant when studying the influence of various factors on the extraction process.

To enhance the extract's biological activity and create a convenient dosage form, we decided to develop the composition and technology of the pol-pala filter bags. Corn silk (*Stigmata maydis*), which contains potassium salts and flavonoids, was used as the second component of the mixture. This material exhibits a mild diuretic and anti-inflammatory effect, as well as moderate anti-inflammatory properties. The combination of pol-pala and corn silk allows for the creation of a herbal mixture with a pronounced diuretic effect and good safety during long-term use.

Filter bags are a modern and convenient way to present herbal raw materials. They offer precise dosing, easy infusion preparation, and high bioavailability. However, the challenge of standardizing this herbal infusion remains unresolved, as the content of biologically active substances in infusions depends on numerous factors, such as temperature, extraction time, the process's hydromodulus, and, of course, the quality of the original medicinal herbal raw material. The lack of clear, scientifically sound recommendations limits the widespread adoption of filter bags containing corn silk and corn silk in practice.

This work is devoted to determining the amount of flavonoids and extractive substances from filter bags in the infusion during their aqueous extraction.

MATERIALS AND METHODS

The study involved herbal tea in the form of filter bags containing crushed medicinal plant materials of halmwort (*Aerva lanata*) and corn silk (*Stigmata maydis*) in a 60:40 ratio. Certified plant materials meeting requirements for authenticity, purity, and moisture were used for production.

Before packaging, the raw materials were crushed to a particle size passing through a sieve with a mesh diameter of 1.0–1.5 mm. This ensures high extraction rates of biologically active substances and prevents the loss of finely dispersed fractions of the raw materials through the filter membrane of the filter bag. Each dose of herbal tea was packaged in standard 2.0 g filter bags made of heat-resistant filter paper designed for contact with food and pharmaceutical products. The filter bags were stored in hermetically sealed containers at a temperature of (20 ± 2) $^{\circ}$C and a relative humidity of no more than 60%, in conditions excluding exposure to direct sunlight and various foreign odors.

Extract Preparation. Aqueous extracts of the above-mentioned infusion were prepared from filter bags using infusion with boiling water, simulating realistic conditions for herbal tea consumption. For the experiment, one 2.0 g filter bag was placed in a glass flask and filled with 150, 200, and 250 ml of pre-boiled water at a temperature of 95-100 $^{\circ}$C. Extraction was conducted at three time settings—10, 20, and 30 minutes—under a lid to prevent loss of volatile components

and heat. After extraction, the bag was removed with tweezers, gently squeezed into a beaker, and the extract was filtered. The resulting aqueous extracts were cooled to room temperature, and phytochemical analysis was performed after volume measurement. All samples were prepared immediately before measurements, allowing for an assessment of the influence of extraction time and process water content on extraction efficiency.

The quality of the extracts and the efficiency of the extraction process were assessed using two indicators: the content of the total extractive substances and the total flavonoids.

Quantitative determination of the total extractive substances was performed by drying the dry residue. For this, 10.00 ml of the resulting aqueous extract was collected, placed in a pre-dried and weighed porcelain dish, and evaporated in a water bath until the majority of the water was removed. The residue was then dried in a drying oven at a temperature of (105 ± 2) $^{\circ}$C until a constant weight was reached. After cooling in a desiccator, the dish was weighed again, and the extractive substance content was calculated from the difference in weights as g/L of extract, then recalculated per 1 g of absolutely dry plant material.

$$X = \frac{m_1}{m_2 * (100 - w)} * 100\ (\%)$$

m_1 – mass of dry residue of extract;
m_2 – mass of raw material in the filter bag;
W – moisture content of plant materials;
X – yield of total extractive substances, %.

A spectrophotometric complexation method with aluminum chloride was used to quantify total flavonoids. Rutin was used as a standard sample.

A 10.0 ml volumetric flask was filled with 2.0 ml of the diluted sample, 1.0 ml of aluminum chloride solution (2% in 70% ethanol), 1.0 ml of sodium acetate solution (5%), and then the volume was brought to the mark with 70% ethanol. The mixture was thoroughly mixed and kept at a temperature of 20-25 ^{0}C for 30 min. Simultaneously, a comparison solution was prepared in which ethanol was added instead of the aluminum chloride solution. The optical density was measured in a 10 mm thick quartz cuvette at a wavelength of 415 nm. The optical density of the solution was measured, the concentration of total flavonoids was calculated using the equation of the calibration graph :

$D_0 = 0.027\ c + 0.005$;

in the extract concentration $C_0 = \frac{D_0 - 0{,}005}{0{,}027}$ mg/l,

in terms of rutin. Taking into account the dilution factor (5);

$C = C_0 * 5$ mg/l

The content of the total flavonoids in one filter bag in terms of rutin:

$M = C * V$ mg/packet

in terms of routine.

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RESULTS AND DISCUSSIONS.

Results of water extraction under different brewing conditions.

Table 1.

No.	t, ^{0}C	τ, min.	V, ml	Total extract substances g/l	Total flavonoids mg/l
1	85	10	200	0.81±0.02	8.41±0.02
2	95	20	200	1.13±0.03	13.85±0.02
3	100	30	200	1.23±0.03	14.93±0.02
4	100	40	200	1.24±0.02	15.10±0.02

Thus, under brewing conditions at a temperature of 100 ^{0}C for 30-40 minutes, the extract from one filter bag contains about 15 mg of flavonoids in terms of rutin, which corresponds to 8.3 mg/g of dry raw material.

CONCLUSION

Experiments were conducted to determine the brewing conditions for filter bags containing a mixture of chamomile (*Aerva lanata)* and corn silk (*Stigmata maydis*). Experimental data were obtained reflecting the influence of extractant volume and extraction (infusion) duration on the recovery of extractive substances and flavonoids. It was established that an increase in water volume leads to a more complete dissolution of water-soluble substances. It was also established that an increase in extraction time contributes to an increase in the yield of biologically active compounds until the equilibrium stage is reached. The feasibility of using filter bags containing chamomile and corn silk as an effective source of water-soluble biologically active compounds was experimentally confirmed. The obtained results can be used in the creation of a herbal preparation and serve as a scientific basis for the development of regulatory documentation.

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