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Analysis of Tannins in the Aboveground Part of Hyssop (Hyssopus Officinalis L.)

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Annotations: Most essential-oil–containing plants of the Lamiaceae family are currently used as expectorants, anti-inflammatory agents, wound-healing remedies, sedatives, and for other purposes. In this regard, hyssop — a representative of this family — holds particular importance.

Studying the chemical composition of the aboveground part of the medicinal hyssop plant is considered relevant for its application in scientific medicine.

This article presents information related to the analysis of tannins in the aboveground part of Hyssopus officinalis L., a medicinal plant widely used in folk and scientific medicine.

Keywords: medicinal hyssop, chemical composition, pharmacological activity, tannins, permanganatometry.

It is known that phytopreparations have a number of advantages over synthetic drugs - a wide selection of therapeutic active ingredients in medicinal plants, the possibility of their joint use, the low incidence of side effects and contraindications, and so on. These specificities contribute to the widespread use of phytopreparations in clinical practice for the treatment of a number of diseases, as well as their use in addition to the main treatment in the form of prophylactic therapy. However, the anthropogenic impact on nature and the complexity of the ecological situation in a number of regions have led to a sharp decline in the natural reserves of many medicinal plants. The growing need of the health sector for herbal medicines gives priority to the provision of the raw material base at the expense of additional plant sources and their integrated use. In this regard, the complex of biologically active substances (essential oils, iridoids, triterpenoids, polysaccharides, phenolic compounds, etc.) in most essential oil plants of the jasmine family is of particular interest due to its versatile pharmacological activity and low toxicity. Most of the essential oil plants belonging to the family Yasnotkadosh are now used as expectorants, anti-inflammatory, wound healing, sedative and other means. Of particular importance in this regard is the medicinal hyssop plant, which is representative of this family [1-4].

Medicinal hyssop (Hussopus officinalis L.) grows naturally in Tashkent, Andijan, Samarkand and Surkhandarya regions, as well as in the Tashkent Botanical Garden named after Academician F.N.Rusanov. Research by scientists of the Institute of Botany has shown that in favorable environmental conditions it is possible to obtain the required amount of seeds and planting material for the creation of industrial plantations of medicinal hyssop.

Medicinal hyssop is widely used in medicine in many countries around the world and is included in the pharmacopoeias of a number of European countries, but medicinal hyssop grown in Uzbekistan has not been sufficiently studied chemically.

It is important to study the chemical composition of the medicinal hyssop plant in order to apply it in scientific science.

Research Objective.

Analysis of tannins in the aboveground part of medicinal hyssop (Hyssopus officinalis L.).

Methods.

The object of the study was the aboveground part of medicinal hyssop grown in the Tashkent Botanical Garden named after academician F. N. Rusanov. The plant material was collected during the flowering period and dried in the open air in a shaded area protected from direct sunlight.

To perform qualitative reactions, a 10% aqueous extract of the test raw material was prepared in a 1:10 ratio. Then, 3 ml of this extract was poured into five test tubes, and to each tube, 1% solutions of iron–ammonium alum, iron chlorides, alkaloids, mucilage substances, and gelatin were added [5–7]. Additionally, the classification reaction described in the pharmacopeia was carried out. For this reaction, 50 ml of the 10% extract was placed into a flat-bottomed flask (200–250 ml), followed by the addition of 10 ml of concentrated hydrochloric acid (1:1) and 15 ml of a 40% formalin solution. The flask was then connected to a vertical glass tube and heated gently on an electric plate until a brick-red precipitate formed (a precipitate resulting from the condensation of the condensed group of tannins). After filtration of the precipitate, the filtrate contained the decomposition products of the hydrolyzable group. To determine the presence of this group, 5 ml of the filtrate was taken, and with gentle addition (without shaking), 1 g of crystalline sodium acetate was added, followed by 10 drops of a 1% iron–ammonium alum solution [8–12].

Quantitative analysis was performed using the permanganatometry method. The tannin content was determined by the permanganometric method [5, 13–14].

Results.

The results of the qualitative reactions conducted on the test extract are presented in Table 1.

Table 1 Results of the qualitative reactions performed on the tannins found in the aboveground part of medicinal hyssop

Biologically Active Compounds	Qualitative Reactions	Result
	Reaction with 1% gelatin solution	+
Tannins	Reaction with iron–ammonium alum	+
	Reaction with iron (III) chloride solution	+
	Reaction with plant mucilage substances	+
	Reaction with alkaloids	+
	Classification reaction	+

As can be seen from the data in Table 1, the qualitative reactions performed on the test extract yielded positive results.

The results of the quantitative analysis of tannins in the aboveground part of medicinal hyssop are presented below.

T=0.004157 g K=1.007 V_0 =0.6 ml

a_1=1.0132 g V_1=12.4 ml

a_2=1.0136 g V_2=12.46 ml

a_3=1.0130 g V_3=12.39 ml

a_4=1.0135 g V_4=12.45 ml

a_5=1.0133 g V_5=12.43 ml

1) $X = \frac{(V_n - V_0) \cdot K \cdot T \cdot 100}{a}$

$X_1 = \frac{(12.4-0.6)\cdot 1.007\cdot 0.004157\cdot 100}{1.0132} = 4.88\ \%$

$X_2 = \frac{(12.46-0.6)\cdot 1.007\cdot 0.004157\cdot 100}{1.0136} = 4.89\ \%$

$X_3 = \frac{(12.39-0.6)\cdot 1.007\cdot 0.004157\cdot 100}{1.0130} = 4.87\ \%$

$X_4 = \frac{(12.45-0.6)\cdot 1.007\cdot 0.004157\cdot 100}{1.0135} = 4.89\ \%$

$X_5 = \frac{(12.43-0.6)\cdot 1.007\cdot 0.004157\cdot 100}{1.0133} = 4.88\ \%$

2) Calculation of the arithmetic mean

$X_{average.} = \frac{x1+x2+x3+x4+x5}{5} = \frac{4.88+4.89+4.87+4.89+4.88}{5} = 4.88\ \%$

3) Individual measured values

$d_n = |X_n - X_{average}| = |X_n - 4.88|$

$d_1 = |4.88-4.88| = 0$

$d_2 = |4.89-4.88| = 0.01$

$d_3 = |4.87-4.88| = 0.01$

$d_4 = |4.89-4.88| = 0.01$

$d_5 = |4.88-4.88| = 0$

4) Range of deviations from the mean

$f = n-1 = 5-1 = 4$

$S^2 = \frac{\varepsilon^2\cdot d^2}{f} = \frac{(0.01)^2+(0.01)^2+(0.01)^2}{4} = 0.000075$

5) Standard deviation

$S = \sqrt{S^2} = \sqrt{0.000075} = 0.0087$

6) Standard error of the mean (standard deviation of the mean)

$S_{Xaverage} = \frac{S}{\sqrt{n}} = \frac{0.0087}{\sqrt{5}} = 0.0039$

7) Practical value of the control criterion (range and related values)

$a = \frac{|X_n - X_{n-1}|}{R}$ R- value range

$R = |X_{max} - X_{min}| = |4.89-4.87| = 0.02$

$a_1 = \frac{|X1-X2|}{R} = \frac{|4.88-4.89|}{0.02} = 0.5$

$a_2 = \frac{|X2-X3|}{R} = \frac{|4.89-4.87|}{0.02} = 1$

$a_3 = \frac{|X3-X4|}{R} = \frac{|4.87-4.89|}{0.02} = 1$

$a_4 = \frac{|X4-X5|}{R} = \frac{|4.89-4.88|}{0.02} = 0.5$

$a_5 = \frac{|X5-X1|}{R} = \frac{|4.88-4.88|}{0.02} = 0$

8) Half width of the confidence interval

$\Delta x = R \cdot S = 0.02 \cdot 0.0087 = 0.000174$ **(3.8)**

$\Delta x_{average} = \frac{0.000174}{\sqrt{5}} = 0.000078$

9) Confidence interval

$\left| X_{average} - \Delta X_{average} \right| \le \mu \le \left| X_{average} + \Delta X_{average} \right|$

$\left| 4.88 - 0.000078 \right| \le \mu \le \left| 4.88 + 0.000078 \right|$

10) Relative error

$\varepsilon = \frac{\Delta X}{X} \cdot 100 = \frac{0.000174}{4.88} \cdot 100 = 0.0036\%$

11) Mean relative error

$E_{average} = \frac{\Delta X_{average}}{X_{average}} \cdot 100 = \frac{0.000078}{4.88} \cdot 100 = 0.0016\%$

DISCUSSION.

During the study, the presence of tannins in the aboveground part of medicinal hyssop was confirmed using both qualitative and quantitative methods. The reactions performed with iron salts, gelatin, alkaloids, and mucilage substances produced characteristic colors and precipitates, indicating that the tannins belong to the hydrolyzable group. The blue ring that appeared on the crystal during the classification reaction further demonstrated the release of tannin decomposition products.

According to the quantitative determination results, the average tannin content in hyssop raw material was 4.88%. To assess the reliability of the results, the calculated average relative error was 0.0016%, which indicates a high level of analytical accuracy. The small error value confirms that the obtained data are statistically stable and reliable.

Thus, the accumulation of tannins in significant amounts within the hyssop plant and their sufficient quantitative content highlight the pharmacognostic and medicinal importance of this species. The findings expand the potential for using hyssop as a source of biologically active compounds.

CONCLUSION

The qualitative and quantitative analyses conducted confirmed the presence of tannins in the aboveground part of medicinal hyssop. The qualitative reactions with iron salts, gelatin, alkaloids, and mucilage substances indicated that the tannins belong to the hydrolyzable type. The blue ring formed in the classification reaction further verified the presence of tannin decomposition products.

According to the quantitative analysis, the raw material contained an average of 4.88% tannins, confirming that hyssop is rich in these compounds and holds significant medicinal value. The results suggest that hyssop is a valuable source of biologically active components and that its potential as a medicinal agent may be further expanded.

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