

Anatomical and morphological study of flowers of common tansy
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The anatomical and morphological study of *Tanacetum vulgare* L. flowers
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SUMMARY

Investigated anatomical and morphological signs flowers tansy ordinary (*Tanacetum vulgare* L.). The microscopic and histological structure of the inflorescence receptacle (basket) of common tansy has been studied for the first time, its diagnostic features have been identified. In particular, lysigenic receptacles were found containing a dark brown secret, insoluble in water, slightly soluble in alcohol, and highly soluble in chloroform. Additional signs of the structure of the inflorescence envelope (basket) were revealed, in particular, the presence of a layer of sclerenchyma in the mesophyll of the envelope. For the first time, the morphological and anatomical features of the structure of the fertile part of a tubular flower, peduncles and leaves that make up the corymbose inflorescence of baskets are described.

Key words: common tansy, *Tanacetum vulgare* L., flowers, morphological, microscopic and histological signs.

RESUME

The comparative morphological, histological and microscopical investigations of *Tanacetum vulgare* L. flowers were carried out. For the first time the microscopic and histological structures of the inflorescence (the basket) of *Tanacetum vulgare* L. flowers were studied and its diagnostic signs were revealed. In particular, the lysigenic conceptacles were discovered, which contain the secret of dark brown color not dissolved in the water, relatively insoluble in alcohol and readily soluble in the chloroform. There the additional signs of the structure of the inflorescence (the basket), in particular, the presence of the layer of sclerenchym in the mesophyll of the spathe were observed. For the first time the morphological and anatomical characteristics of the structure of the fertile part of the tubular flower, flower stalk and leaflets,

Keywords: *Tanacetum vulgare* L., flowers, morphological, microscopical, histological characteristics.

Introduction

Flowers of common tansy (*Tanacetum vulgare* L.) serve as a source of antihelminthic and choleric agents, among which the infusion, tanacehol and choleric collection No. 3 are the most famous [1–6]. Previously, we have developed new

approaches to standardization of flowers of common tansy, consisting in determining the amount of flavonoids in terms of cinaroside [7], however, the anatomical and morphological characteristics of the raw material of this plant, set out in the State Pharmacopoeia of the USSR XI edition (Art. 11) [8], require additional research. So, in the section "Microscopy" of the pharmacopoeial article "Tansy flowers" of the USSR GF XI edition, the diagnosis of this raw material is described in sufficient detail [8], however, in this method, the diagnosis of raw material is carried out only by the structure of the inflorescence wrapper (basket) and the structure of the tubular flower. When assessing the authenticity of raw materials, the available microscopic signs may be insufficient due to the fact that the raw materials are baskets and parts of complex corymbose inflorescences with a common peduncle no more than 4 cm long, counting from the upper baskets [8, 9].

In our opinion, when diagnosing an inflorescence as a morphologically complexly organized structure, it is advisable to consider it in separate parts.

The aim of this work is to study anatomical and morphological signs of common tansy flowers (*Tanacetum vulgare* L.).

Material and methods

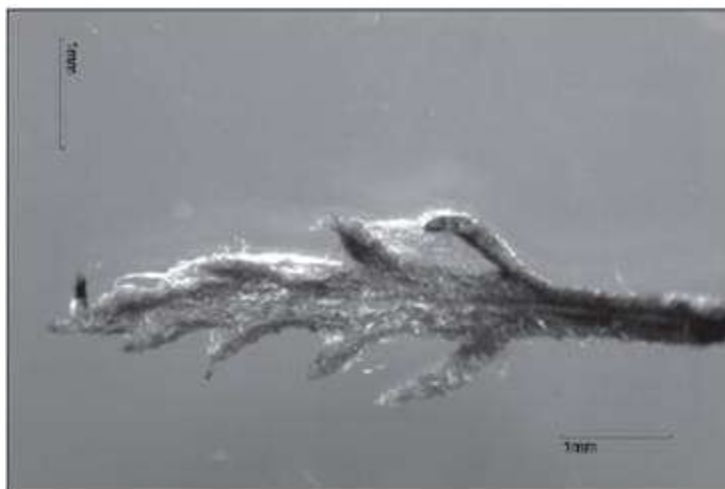
Investigated the flowers of common tansy, collected in env. Togliatti, the village of Nizhnee Sanchelevo, Samara Region (July 2008), at the pharmacopoeial site of the Samara Botanical Garden (Samara, July 2009), as well as industrial samples of raw materials (OJSC Krasnogorskleksredstva). In this study, we used light microscopes of the following brands: digital microscope Motic DM111 (the possibility of magnification of this device is represented by four eyepieces: 4x10; 10x10; 40x10; 100x10), digital stereoscopic microscope Motic DM-39C-N9GO-A (the possibility of magnification of this device is represented by two eyepieces: x 20; x 40). Micropreparations were prepared in accordance with the pharmacopoeial methodology of the State Pharmacopoeia of the USSR XI edition [8]. Their coloring was carried out: with Lugol's solution (detection of starch), Sudan III solution (detection of essential oil) and aniline sulfate (detection of lignification of shells). At the same time, the histological features of the structure of the following parts of the raw material were studied: receptacle, peduncles and leaves within 4 cm from the top of the basket. In addition, the structural features of the tubular flower (both fertile and sterile parts of it) and the inflorescence wrapper were additionally studied.

Results and discussion

Common tansy is a perennial herb of the Asteraceae family, or Asteraceae (Asteraceae) tall 50–150 cm. Flowers as a medicinal plant material (MPR) are hemispherical flower baskets, almost flat from above, 5–8 mm in diameter, collected in dense apical scutes [8, 9]. The morphologically expressed part of the tansy inflorescence is the leaves on the shoots (Fig. 1), which form the corymbose inflorescence.

These leaflets are simple, sessile, pinnatipartite, from 0.5 to 1.0 cm long, visibly pubescent upon detailed examination (Fig. 1). They are green in color, and on the outside it is darker than on the inside.

When examining the leaflet, the epidermis is visible from the surface, which is a collection of cells of an irregular, isodiametric shape with strongly thickened walls (Fig. 2). The epidermis of the underside of the leaflet has an anomocytic stomatal apparatus.



Rice. 1. Leaf of inflorescence of common tansy (on shoots) (xtwenty).

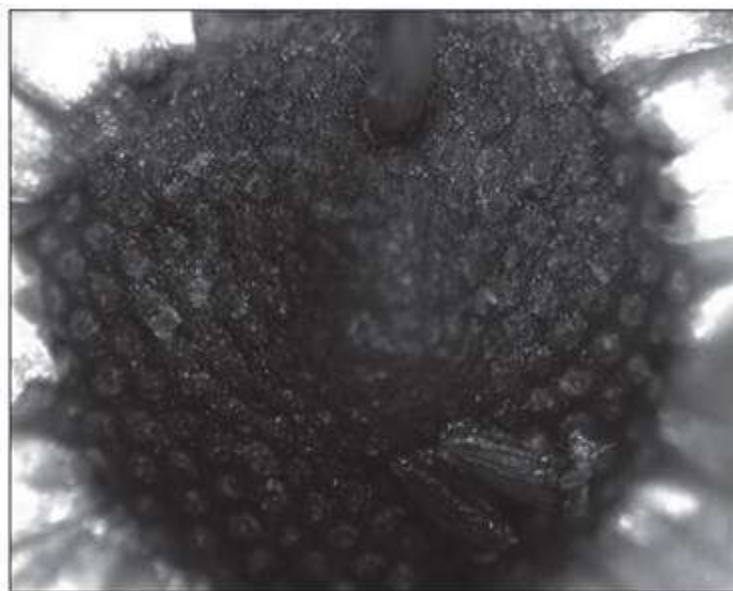


Rice. 2. Epidermis of the leaf of the inflorescence of common tansy (x400).

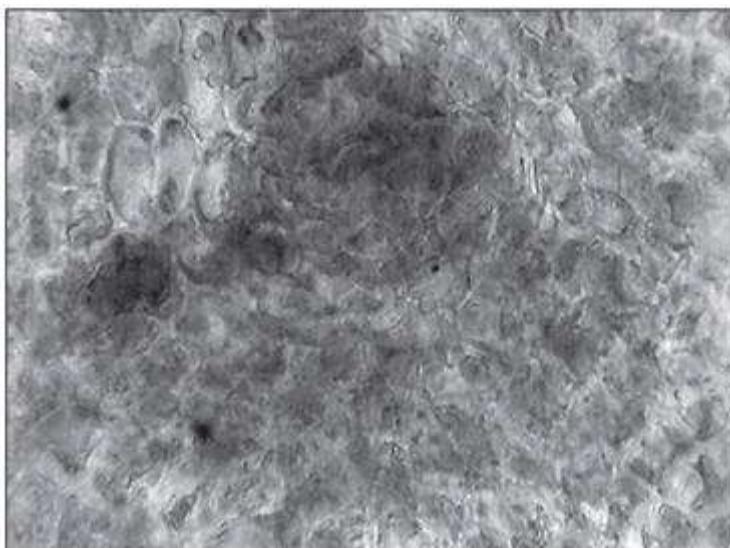
On the entire surface of the leaflet, there are trichomes similar to those on the peduncle and on the envelope. In addition, occasionally there are two-row, multi-tiered essential oil glands similar to those found on tubular flowers.

In our opinion, leaflets can serve as a diagnostic sign, and in this regard, both the morphological structure of the leaf plate and its anatomical and histological features are informative. An important morphological component of the inflorescence (basket) is also its receptacle. From taxonomy

It is known that the morphological features of the anatomical structure of the receptacle can be a diagnostic feature of plant species of the Asteraceae family. After removing the flowers from the surface of the receptacle, it can be seen that it is matte dark brown, almost black. The surface of the receptacle is uneven, with noticeable rounded, symmetrically located points of attachment of flower ovaries (Fig. 3). On close examination, the epidermis from the surface of the receptacle is represented by rounded isodiametric cells with dark contents (Fig. 4).



Rice. 3. Receptacle of inflorescences of common tansy: top view (x40).



Rice. 4. Epidermis of the surface of the receptacle of the inflorescence of tansy (xone hundred).

The longitudinal section of the inflorescence (Fig. 5) shows that the receptacle of the tansy has an elongated shape. It is made by spongy parenchyma with a large number of intercellular spaces. The cells of the spongy parenchyma are of a rounded isodiametric shape.

They are practically colorless, occasionally contain yellow chromoplasts. The surface of the receptacle is organized by a denser tissue with noticeable receptacles symmetrically located in it (Figs. 5 and 6).

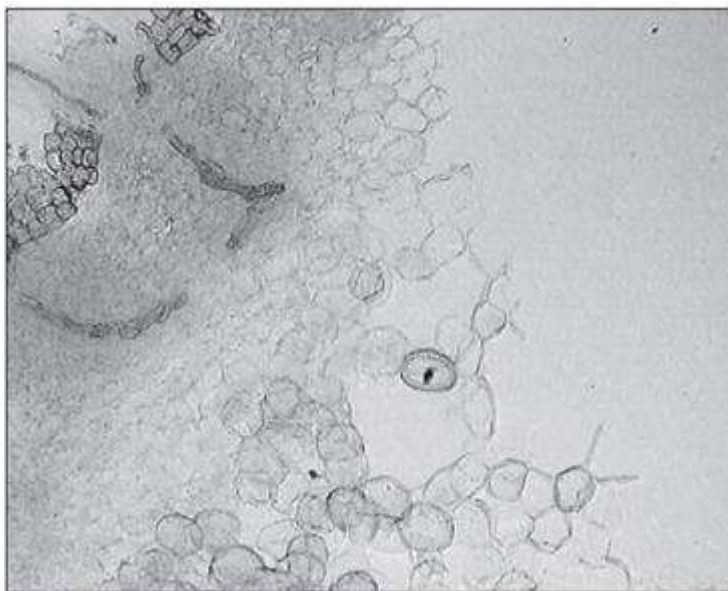
The outer layer of the receptacle parenchyma contains a large number of small vascular bundles, symmetrically alternating with the receptacles of secretions (Fig. 5 and 6). A detailed examination of the containers revealed that they are probably of lysigenic origin. No epithelium was found around the perimeter. The secret is a dark brown resinous substance that does not dissolve in water, slightly dissolves in ethyl alcohol 95% and is highly soluble in chloroform. It is important to note that other researchers have not previously described the presence of containers in the receptacle of tansy inflorescences. This feature can be used in the diagnosis of this medicinal product.

The study of the wrapper of the inflorescence of common tansy showed that the basket is surrounded by a wrapper of 2, less often 3 rows of leaflets (Fig. 7).

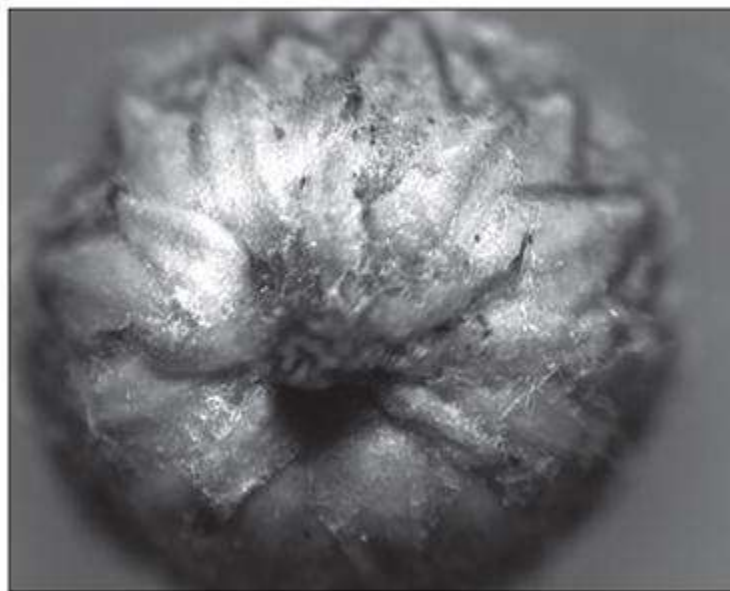
The envelopes are lanceolate-ovoid; inner leaves are more elongated, oblong-ovate, with a narrow light or brownish border at the apex and along the edges (Fig. 8). When examining the leaflets of the envelope from the surface, the central vein accompanying the secretory passages is clearly visible in them. The epidermis on the outside of the leaflet consists of large cells with straight or slightly sinuous walls, with a pronounced fold of the cuticle. The cells of the epidermis on the inner side of the leaflet are narrow and strongly elongated (Fig. 9).



Rice. 5. Longitudinal section of the inflorescence of common tansy (x40).



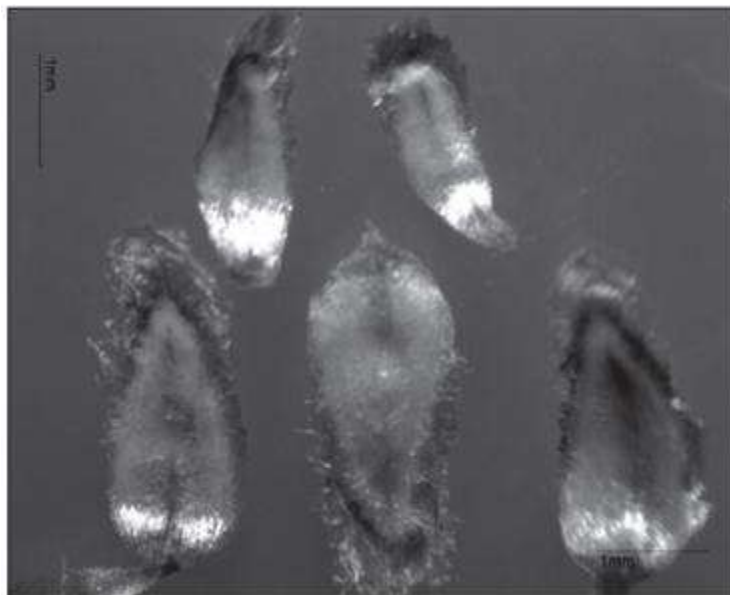
Rice. 6. Parenchyma of the receptacle of the inflorescence of common tansy (xone hundred).



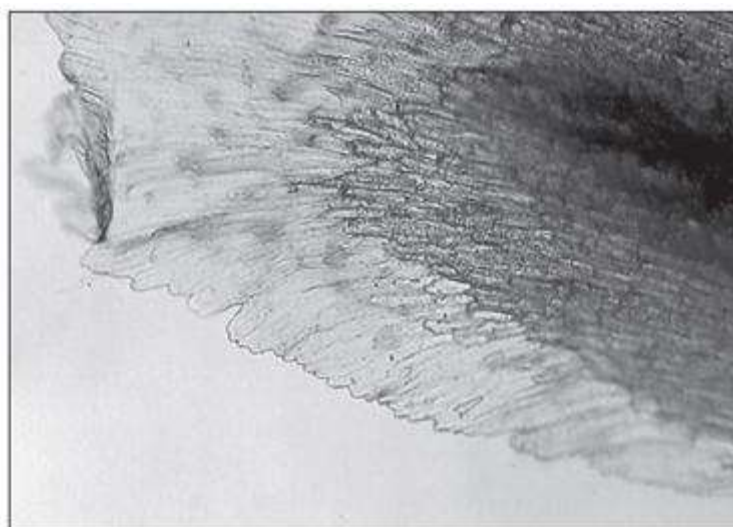
Rice. 7. Inflorescence (basket) of common tansy: bottom view (xtwenty).

The stomata and hairs are found only in the epidermis on the outer side of the envelope leaflet and are concentrated mainly along the central vein of the leaflet and along the edge. The stomata are surrounded by 4–6 peri-stomatal cells with cuticular folding clearly visible from the surface. The epidermis hairs are multicellular, scourge-shaped in shape, the terminal cell of the hair is very long, twisted and often broken off. When examining the leaves of the envelope, internal tissues are clearly visible from the surface under the transparent epidermis. Some of them are represented by elongated prosenchymal cells with strongly thickened membranes, in which pore channels are clearly visible. On the transverse section of the wrapper, it can be seen that this tissue is an aggregate of sclerified fibers that perform a reinforcing function, which

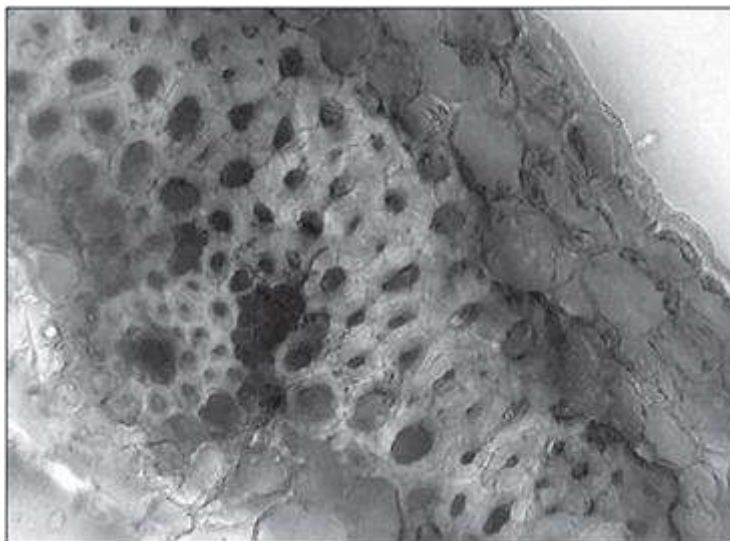
confirmed by staining with aniline sulfate solution and the appearance as a result of lemon-yellow coloration (Fig. 10). In the center of the envelope, a small conducting bundle is visible, reinforced with small sclerified cells (Fig. 10).



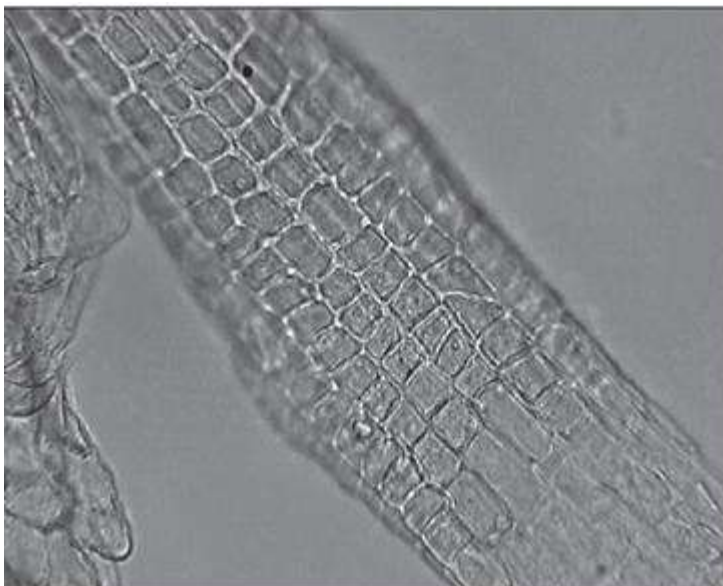
Rice. 8. Wrapping a basket of common tansy (x40).



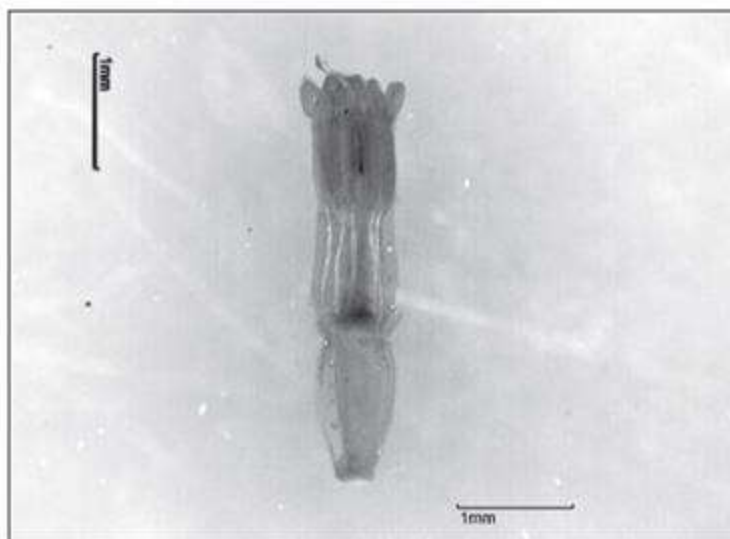
Rice. 9. A leaf of a wrapper of an inflorescence of common tansy (xone hundred).



Rice. 10. Cross-section of the envelope of the common tansy inflorescence: coloring with aniline sulfate solution (x 400).



Rice. 11. Tubular flower of the inflorescence of common tansy (x40).



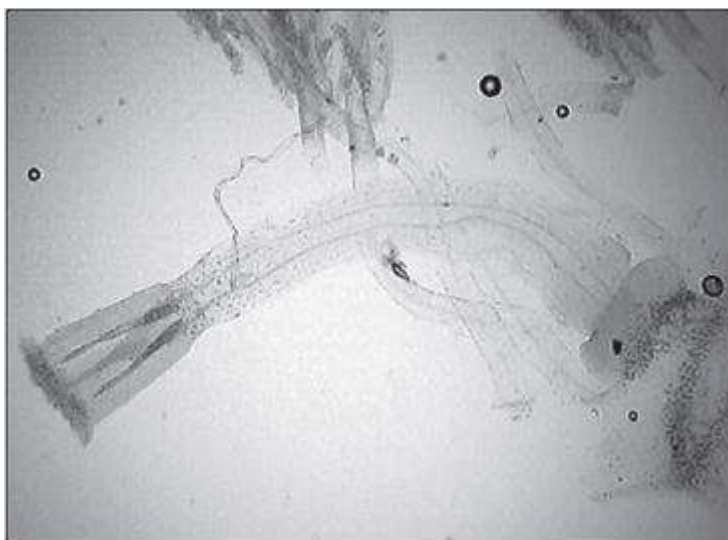
Rice. 12. Filament of the tubular flower of the inflorescence of common tansy (x400).

Some structural features of the epidermis of the outer and inner sides of the envelope on the transverse section of the leaflets were revealed. In particular, the inner epidermis is represented by large cells with a thin membrane. Under it is the parenchyma in one or two layers of large thin-walled cells. The inner epidermis is covered with a pronounced cuticle. The epidermis of the outer side of the envelope is distinguished by smaller cell sizes, a more pronounced cuticle. The parenchyma of two or three layers of cells is also localized under the outer epidermis, but their size is much smaller than that of the cells on the inner side of the envelope.

It should be noted that the presence of sclerenchyma, previously not described in the literature, is an essential diagnostic feature and can be introduced into the new edition of the "Microscopy" section of the draft pharmacopoeial monograph for the studied type of raw material.

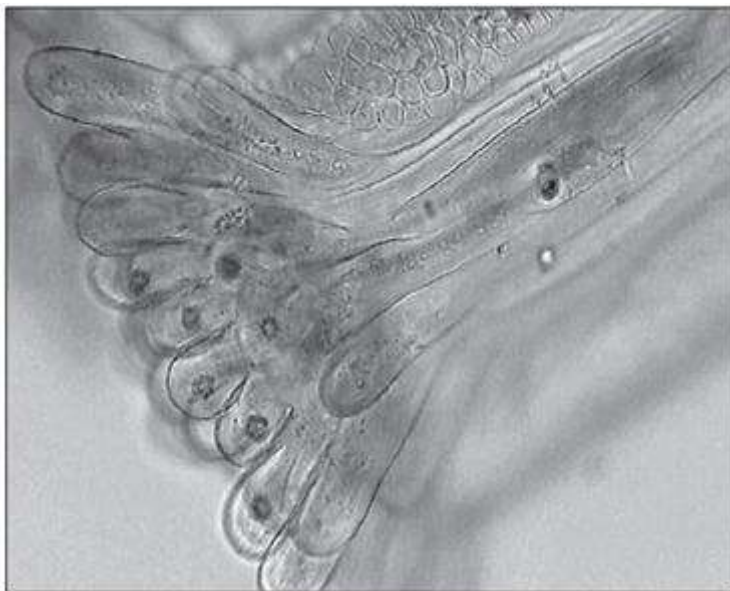
From the point of view of raw material diagnostics, it is important to study the tubular flower of common tansy (Fig. 11). Morphologically, the tubular flower can be divided into a fertile part (gynoecium, androeum) and a sterile part, represented by the perianth. Tubular flowers of bisexual tansy. Androeium in a flower is represented by five fused anthers of stamens. The anthers of the stamens fused together are large, elongated, with pointed tops. Anther theca is two-celled, filled with yellow pollen. Filaments are long, colorless, with a noticeable conducting bundle, from two spiral vessels. The epidermis of filaments is represented by weakly elongated, thin-walled cells (Fig. 12).

At their ends, at the base of the anthers, there is a binder, the cells of which are thickened, lignified, which is confirmed by staining with aniline sulfate solution. Gynoecium is represented by a pistil with a lower ovary (Fig. 13).



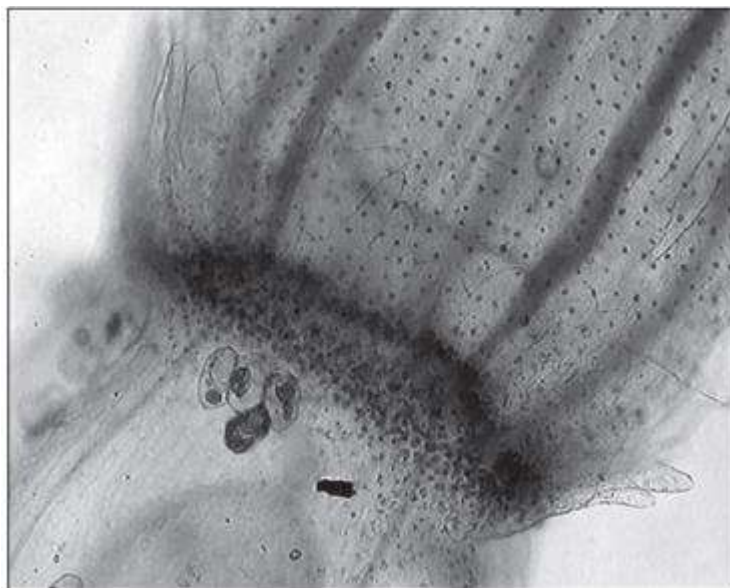
Rice. 13. Gynoecium of the tubular flower of the inflorescence of common tansy. General view (x one hundred).

Directly in the corolla tube, the pistil column is localized, bifurcating by one third of its length. It has two stigmas, the surface of which is uneven, villous. The pistil column is rather large, colorless. At its base, there is a large ring of native yellow nectaries. The bifurcated parts of the column and stigma are also bright orange in color (Fig. 14). The parenchyma of the ovary at the base of the column contains a large amount of calcium oxalate drusen. The peculiarity of the localization of drusen in the tissues of the corolla may be a diagnostic sign. It consists in the fact that druses are very numerous precisely at the border at the place of coalescence of the ovary and corolla and form a noticeable ring (Fig. 15). On the surface of the flowers there are essential oil glands, most densely located on the ovary and at the base of the corolla tubule. The glands are four-six-celled, two-row, two-three-tiered. In the integral part of the column, two conducting bundles are clearly visible, each of which consists of only two vessels. On the outer surface of the rim, three parts can be visually distinguished, differing from each other in structure (Fig. 16).



Rice. 14. The stigma of the pistil of the tubular flower of the inflorescence of tansy (x400).

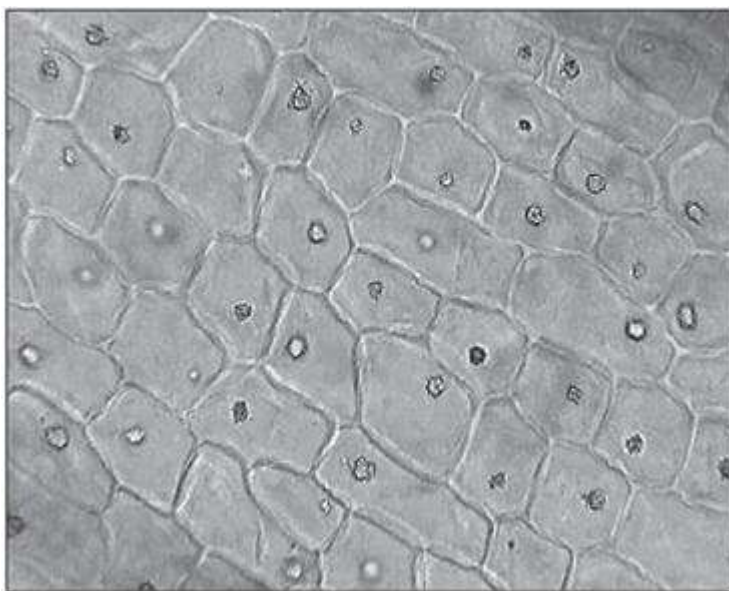
The epidermis of the lower part of the corolla tube, closer to the ovary, consists of thin-walled, more or less isodiametric cells (Fig. 17 and 18). Almost in each of them small druses (Fig. 17), essential oil glands (Fig. 18) are visible, at low magnification, conductive elements are clearly visible, which are not visualized in other parts of the rim.



Rice. 15. Place of fusion of the corolla with the ovary of the tubular flower of the inflorescence of tansy ordinary (x 400).



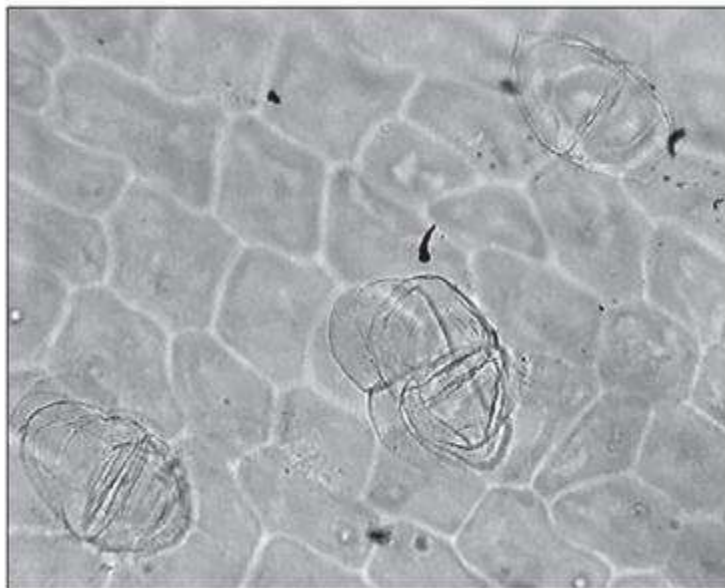
Rice. 16. Corolla of a tubular flower. inflorescences of common tansy. General view (x 400).



Rice. 17. Druses of the epidermis of the corolla tube of the tubular flower of the inflorescence of tansy ordinary (close to the ovary) (x 400).

The middle part of the tube is the corolla (the area immediately close to the bend) differs in that here the epidermal cells have a prosenchymal shape. Their walls are more thickened, pores are clearly visible in them. The third part - bend of the corolla - represented by five elongated teeth with rounded tops. They are permeated with conductive elements (spiral vessels) in the amount of five, according to the number of fused corolla members. Epidermal cells at the limb are intensely colored yellow. The pigment of these cells looks like crystals and does not have a clear granular expression. It is almost absent in the corolla tube epidermis. The edge of the fold is framed by cells with a noticeably thickened folded

cuticle. Numerous glandular trichomes are found along the outer epidermal surface of the corolla tube. These are two-row, multi-tiered hairs with a powerful cuticular sheath. There are much more of them at the bend, mainly in the corners between the teeth of the rim.



Rice. 18. Glands of the epidermis of the corolla tube of the tubular flower of the inflorescence of tansy ordinary (close to the ovary) (x 400).

In fig. 19 and 20 show morphological and histological features of the structure of the ovary. The lower ovary of the flower, which forms the achene, has a finely toothed margin, visible at high magnification - the corydalis of the reduced calyx. The epidermis of the ovary from the surface is covered with a noticeably larger number of glandular, two-row, multi-tiered trichomes compared to the corolla (Fig. 19).

The cells of the epidermis of the ovary are parenchymal, isodiametric in shape (Fig. twenty). The base of the ovary is framed by three to four rows of sclerified cells (Fig.

twenty).

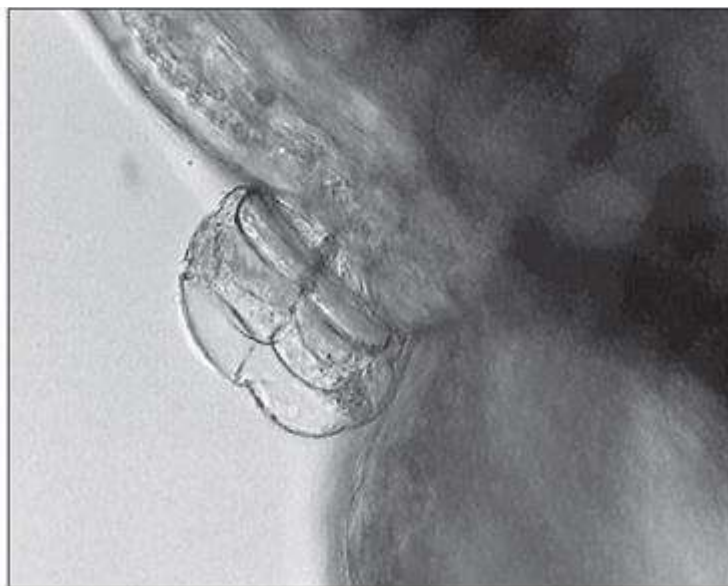
Compared to the usual epidermal cells of the ovary, they are smaller and more thickened membranes with clearly visible pore canals. These layers of sclerified cells are stained with aniline sulfate solution in lemon-yellow color.

In the course of these studies, an anatomical study of the peduncle of the inflorescence of common tansy was also carried out, since this part of the raw material has its own structural features, which can also be diagnostic for this plant species. In the existing section "Microscopy" FS 11 GF XI edition, these features are not used. The literature review revealed the interest of other researchers in this problem. In particular, there are data on the structure of epidermal cells, the presence of stomata and trichomes on the surface of the peduncle epidermis [8]. In this experiment, we have confirmed the data of scientists, and also carried out additional research to analyze the features of the anatomical structure.

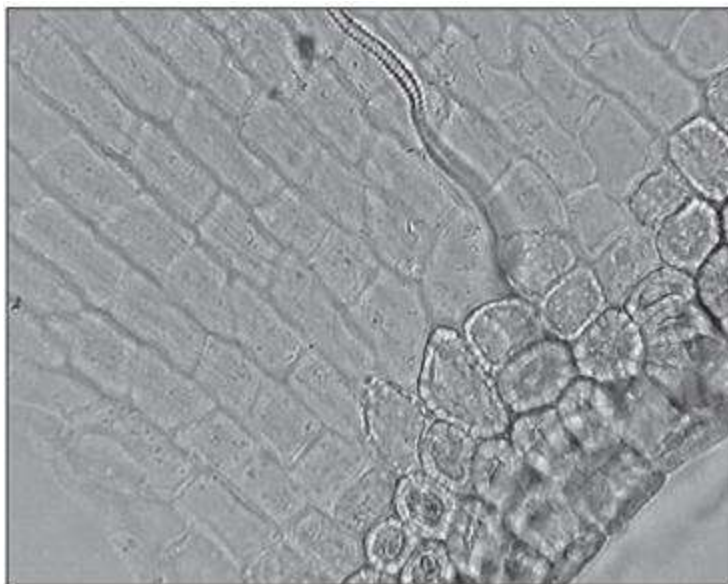
peduncle as an axial organ of the shoot.

The peduncle is a hollow stem of the beam structure. The bundles in the ring are closed collateral with a strongly pronounced layer of sclerenchyma, stained in lemon-yellow color with aniline sulfate solution (Fig. 21).

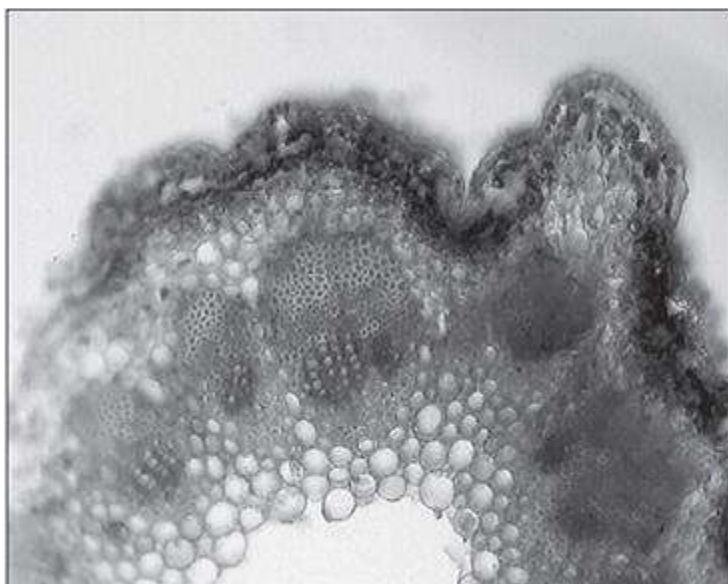
The cross section of the peduncle shows the presence of ribs with pronounced angular collenchyma. Peduncle epidermis is represented by small rounded cells with a thick cuticle layer. On the surface of the epidermis, the remains of multicellular scourge-shaped hairs, represented by 4–5 sequentially connected cells of a rounded shape, are occasionally found (Fig. 22). Similar trichomes are also found on the envelope of the inflorescence basket and on the leaves of the peduncle. The terminal cell of the scourge hair is long, twisted and often falls off.



Rice. 19. Trichomes of the epidermis of the ovary of the inflorescence of tansy (x400).



Rice. 20. The place of attachment of the inflorescence to the receptacle of common tansy (x400).

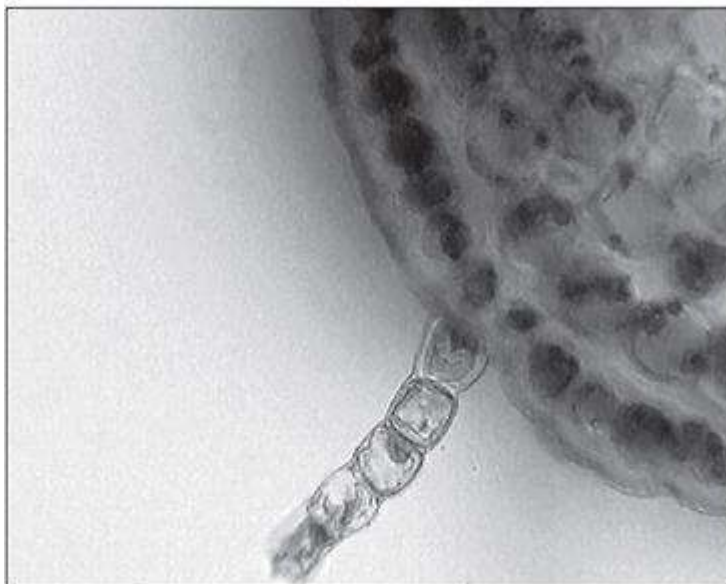


Rice. 21. Cross section of the peduncle of the inflorescence of common tansy (xone hundred).

Directly under epidermis situated chlorophyll-bearing stem parenchyma, represented by 4–5 rows of large thin-walled elongated cells. The cells lining the peduncle cavity are large, prosenchymal in shape with noticeable simple pores. Conductive elements are represented by spiral and annular vessels.

Thus, the results of microscopic studies make it possible to reveal the main diagnostic features of the flowers of common tansy. The given video sequence of illustrations is part of the conducted microscopic analysis, which gives an idea of the new technical possibilities of digital microscopy.

The obtained data are planned by us for inclusion in the new edition of the section "Microscopy" in the FS on the medicinal plant "Tansy flowers", which creates the preconditions for increasing the objectivity of the morphological and anatomical analysis of this raw material and will improve its quality.



Rice. 22. Hair of the peduncle of the inflorescence of common tansy (cross section) (x 400).

Conclusions:

1. The microscopic (histological) structure of the receptacle was studied for the first time inflorescences (basket) of common tansy, its diagnostic signs were revealed. In particular, lysigenic receptacles were found containing a dark brown secret, insoluble in water, slightly soluble in alcohol, and highly soluble in chloroform.

2. Confirmed literature data on histological features the structure of the inflorescence envelope (basket), as well as additional signs, in particular, the presence of a layer of sclerenchyma in the mesophyll of the envelope.

3. The features of the structure of the fertile part of the tubular flower are described. V As possible additional signs in diagnostics during further study, it is possible to distinguish: structural features of the stigma and column of the pistil, the presence of nectaries at the base of the column of the pistil and the features of their structure, a sclerified ring of cells at the base of the achene.

4. The morphological and anatomical features of the structure are described for the first time. peduncles and leaves that make up the corymbose inflorescence of the baskets.

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