

Adult stem drugs: Epidermal Characters for Identification

Abstract

Epidermal characters of nine of the Central European Equisetum species were documented using both scanning electron and light microscopy. The arrangement of silica pilulae on the subsidiary cells of stomata as well as the type and the arrangement of papillae on the ridges of main stems and branches allow an unambiguous identification of the species even in the powdered state. A key for the identification is presented, and recommendations for an improved text for the monograph in the European Pharmacopeia are given.

Keywords: Equisetum• microscopy• SEM• anatomy• identification• adulteration

Introduction

The unambiguous identification of individuals of the genus Equisetum sometimes is a challenge even when complete herbarium specimens are on hand. Botanical keys recommend the preparation of transverse sections of the stems: the proportion of the hollows in the stem in combination with morphological characters of the nodes and leaf sheaths should allow a determination of the species. In the monograph of Equisetum arvense of the European Pharmacopoeia emphasis is laid on the paracytic stomata with typical ridges of the superimposed subsidiary cells and on U-shaped epidermal cells, which should be discernible in a transverse section. Our preliminary investigations revealed that the mentioned characters of the stomata are present in all species of the genus Equisetum. Furthermore the U-shaped epidermal cells are characters of the ridges of the branches, which are typically seen in the surface view. Therefore a revision of the monograph seemed to be appropriate. The powder of Equisetum anlense mainly consists of non typical parenchyma and vessels. Only the few fragments showing the epidermis with stomata and ridges with papillae¹ may serve for identification. Promising data are published from investigations using scanning electron microscopy (SEM) or ash preparations, which focus on silica incrustated pilulae and mamillae. These structures are poorly visible in the light microscope. An attempt for the identification of powdered material was done by Schier he presented a coarse overview of the papillae on the ridges.

Results

On larger fragments in a powder the arrangement of stomata may be discernible. Stomata in a single row or in two close rows per flank in the main stem are characteristic for E. sylvaticum and E. pratense, while in E. anlense the stomata occur in rows of Stomata in more than 4 axial rows are typical for E. palustre, particularly towards the ridges the stomata appear in horizontal rows too. All these species is common that the central part of the grooves is free of stomata. In contrast, in E. fluviatile the stomata are scattered all over the grooves. On the main stem of E. telmateia stomata are nearly absent, the branches resemble in respect to the arrangement of stomata those of E. anlense. The size of the guard cells is hardly discernible because of the superimposed subsidiary cells. Their size seems to be too variable within a species to serve as differential character. In surface view

FURUKAWA Yoichi*

Dept. of Pharmacognosy, University Vienna
Center of Pharmacy, Althanstra Be 14, A -
1090 Vienna, Austria

*Author for correspondence:

furukawa26626@ims.u-tokyo.ac.jp

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in the light microscope the area of ridges in the subsidiary cells is usually larger than the area covered with silica pilulae. The variability of the density of the ridges in the subsidiary cells seems to be too large to serve as character for differentiation.

Discussion

The genus *Equisetum* and the difficult identification of the species challenged scientists at any times, therefore many details of the anatomy of members of the genus *Equisetum* are already published [e.g. 2, 3, 41, but mostly with respect to taxonomy and relationship of the species. For pharmaceutical purposes two aspects are essential: an identification should be possible even in powdered material the methods should be simple and available to everybody involved in the proof of crude drugs. Since the characters mentioned in the monograph of the European Pharmacopoeia are too general for this purpose we initiated a search for reliable details. The method of choice is light microscopy, however, the silica pilulae, the mamillae on epidermal cells as well as the arrangement of papillae on the ridges are hardly discernible. A more complex method for detection of surface characters is SEM. Therefore we studied the epidermis of main stems and of branches of all major Central European species by SEM and tried to recover promising details in the light microscope. More emphasis in the microscopy of *Equisetum* has been laid on the papillae of the ridges, but most authors focus

on the differentiation between *E. anense* and *E. palustre* only. Schier et al. presented drawings of the papillae of nearly all relevant species, unfortunately no differentiation between main stem and branches was done. In addition the arrangement of the papillae on the ridges remained unconsidered, some drawings differ considerably from our material. The papillae in lateral longitudinal view seem to be highly characteristic, particularly when combined with their arrangement on the ridges.

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Conflict of Interest

No conflict of interest

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