CONTRIBUTIONS TO THE
PHARMACOGNOSTICAL AND
PHYTOBIOLOGICAL STUDY ON
TARAXACUM OFFICINALE (L.) WEBER

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Abstract
The objective of this study was the comparative pharmacognostical analysis of
The microscopic examination showed the following specific anatomical elements: pappus,
laticiferous tubes, epidermal cells with irregularly thickened walls and inulin as deposit substance.
The chemical analysis established the presence of flavonoids (rutin, hyperoside, quercetin),
hydroxycinnamic acid derivatives (caffeic acid, chlorogenic acid), catechic tannins, sterols,
triterpenes, carotenoids, coumarins and mucilages. Flowers and leaves have a higher
amount of polyphenols compared to stems and roots. The Triticum bioassay
(Constantinescu method) revealed for dandelion aqueous extracts two types of effects on
cell division (mitoinhibitory or stimulative), depending on extract concentration.

Keywords: Taraxacum officinale, polyphenols, mitoinhibitory action.

Introduction
Taraxacum is a large genus of flowering plants in the Asteraceae
family. Taraxacum officinale (L.) Weber, commonly called dandelion, is
a herbaceous perennial plant considered a weedy species, especially in
lawns and along roadsides, and it is sometimes used as a medicinal herb
and in food preparations. Dandelion has been extensively employed in
traditional folk medicine and in modern phytotherapy as a diuretic (the saluretic effect being demonstrated experimentally) and a cholangog. In Chinese, Arabian and Native American traditional medicine it is used to treat a variety of diseases including cancer [3, 8]. This plant has anti-angiogenic, anti-inflammatory and anti-nociceptive activities through its inhibition of NO production and cyclooxigenase-2 (COX-2) expression and/or its antioxidative activity [7].

The aim of the present study was to determine the morpho-anatomical characteristics, the flavonoids and polyphenolcarboxilic acid content and the specific action of the extracts obtained from *Taraxacum officinale* on the plant cell division.

**Materials and methods**

The raw material consisted of the roots, stems, leaves and flowers of *Taraxacum officinale*. These products were harvested in May (flowers and stems), June (leaves) and September (roots) 2008, from Arges County (Romania), naturally dried in the shadow and conserved in laboratory conditions. For the microscopic study clarified preparations with a chloral hydrate solution 800 g/L and a Zeiss. Imager D1 microscope (ob. 10x and 40x) were used. For the qualitative analysis the raw material was successively extracted with different solvents (ethyl ether, methanol, water). Half of the above alcoholic and aqueous solutions were hydrolyzed. Specific reactions were carried out on the initial and hydrolyzed solutions, aiming to identify the active principles [5, 6]. For polyphenols (flavonoids and polyphenolcarboxilic acid) thin-layer chromatography (TLC) was applied [5].

**TLC parameters for polyphenols**

- test solution: 1g of powdered herbal material was extracted with 10 mL methanol R under a reflux condenser for 10–15 min., filtered and concentrated to 1 mL;
- silica gel F Merck TLC plates;
- mobile phase: ethyl acetate : formic acid (conc.): water/ 80:8:12 (V/V/V);
- reference solution (0.1% in methanol): rutin (Fluka), quercetin (Merck), hiperoside (Merck), caffeic acid (Merck), chlorogenic acid (Merck);
- detection: successive spraying with a 0.1% methanolic solution of diphenylboryoxyethylamine and 0.1% methanolic solution of propylene glycol and UV light (366 nm).
The quality of the herbal drug was estimated by the following tests:
- loss on drying (drying in an oven at 105°C, according to Romanian Pharmacopoeia 10th edition);
- the swelling index (the standard method according to Romanian Pharmacopoeia, 10th edition);
- the assay for flavonoids (using a spectrophotometric method based on the reaction with AlCl₃/CH₃COONa, according to Romanian Pharmacopoeia 10th edition, Cynarae folium monograph) and total hydroxycinnamic acid derivatives (using a spectrophotometric method based on the formation of oxymes in the presence of sodium nitrite and sodium molybdate). The standard calibration curves were obtained using rutin and respectively caffeic acid [5, 6, 10]. For the spectrophotometric assay a UV-VIS Cecil Series 2000 spectrophotometer was used. The results of the quantitative chemical analyses were calculated on a dry basis.

The plant bioassay (Constantinescu method, Triticum bioassay) used embryonic roots from Triticum vulgare Mill. as a biological reagent [1]. The wheat karyopses were germinated and treated in laboratory conditions. The aqueous extracts from the herbal products were tested. Four series of samples were prepared for each product (concentration is expressed as g of plant product per mL of water): sample 1 - 2.00%; sample 2 - 1.00%; sample 3 - 0.66% and sample 4 - 0.133%. The solutions to be tested were brought in Petri dishes having a diameter of 15 cm, and then the germinated wheat karyopses were introduced in solutions (the main root had to be 1 cm length). The dishes were covered with a lid and then the karyopses were left in contact with the solutions for 5 days. In parallel, a control sample (M) was prepared, in which the test solution was replaced by distilled water. The root elongation was evaluated at the same time of the day, for 5 days. For the microscopic study the embryonic root of two karyopses from each Petri dish was sectioned at a distance of 5 mm from the tip and it was stained with diluted acetic orcein, a dye with great affinity for chromatin in acid medium. Then, the stained sections were examined by immersion in cedar oil (ob. 100 x).
Results and discussion

The macroscopic examination (figure 1) confirmed the identity of the raw material.

![Image](image1.png)

Figure 1. The products obtained from *Taraxacum officinale*

a) *Taraxaci radix*; b) *Taraxaci caulis*; c) *Taraxaci folium*; d) *Taraxaci flos*

At the microscopic examination we observed: ladder like xylem vessels, latex tubes and fragments of parenchyma with deposit substances (inulin) for root; pappus, endothecium, papillae and pollen grains for flower; epidermal cells with irregularly thickened walls, stomata of the anomocytic type and spirally and annularly thickened vessels associated with latex tubes for leaf and for stem (figure 2).
Sterols, triterpenes, hydroxycinnamic acid derivatives, flavonoids (aglycones and glycosides) and mucilages were identified in these products by specific chemical reactions; beside these classes of active principles, the leaves and flowers also contain catechic tannins and carotenoids. These compounds are mentioned in the scientific literature about *Taraxacum officinale* [2, 4, 9, 11].

By analyzing the TLC chromatogram of polyphenols (fig. 3) one can note the presence of several spots corresponding to compounds with flavonoid behaviour (yellow or yellow-brown fluorescence after spraying with diphenylboryloxyethylamine) or de hydroxycinnamic acid derivatives (blue or green-blue fluorescence, after spraying with the mentioned reagent). Among these spots, caffeic acid (Rf = 0.48) and chlorogenic acid (Rf = 0.93) have been identified in all the analyzed plant products, hiperoside (Rf = 0.49) in roots, leaves and flowers, quercetin (Rf = 0.92) and rutin (Rf = 0.31) only in leaves and flowers. The consulted scientific literature mentions the
The presence of caffeic acid and chlorogenic acid in *Taraxaci radix* cum *herba*, and of apigenin, luteolin, quercetin and isorhamnetin glycosides in *Taraxaci herba* [2, 9, 11].

![TLC chromatogram of polyphenols in methanolic extracts prepared from *Taraxacum officinale* (viewed with a UV lamp at 366 nm)](image)

A - stem extract; B - leaf extract; C - reference substances (from top downwards: quercetin, caffeic acid, hiperoside, chlorogenic acid and rutin); D - flower extract; E - root extract.

The results of the quantitative chemical analysis, calculated on a dry basis, are shown in table I. It may be seen that the swelling index has relatively high values, which can be correlated with the presence of water-soluble polysaccharides (mucilages).

*Taraxaci flos* and *Taraxaci folium* have a high content of polyphenols (flavonoids and hydroxycinnamic acid derivatives). The results showed that these values are lower than the ones mentioned in the literature for other *Asteraceae*, characterized in the same experimental conditions. By instance, in the case of the artichoke leaf (*Cynarae folium*), Romanian Pharmacopoeia 10th edition, stipulates not less than 0.35 % flavonoids expressed as rutin [10].
Table I. Results of the comparative quantitative chemical analysis

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Taraxacum officinale</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>roots</td>
</tr>
<tr>
<td>Loss on drying (g%)</td>
<td>8.8 - 9.7</td>
</tr>
<tr>
<td>Swelling index (mL/g)</td>
<td>9.2 – 10.1</td>
</tr>
<tr>
<td>Total hydroxycinnamic acid derivatives (g%, expressed as caffeic acid)</td>
<td>0.875 -0.914</td>
</tr>
<tr>
<td>Flavonoids (g%, expressed as rutin)</td>
<td>0.029 -0.035</td>
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The results of the Triticum bioassay - Constantinescu method (the root elongation values for each sample tested, in the 5th day) are presented in figure 4. For the aqueous extracts obtained from Taraxacum officinale this bioassay revealed a concentration-dependent mitoinhibitory effect on cell division for the 0.66 - 2.00 % concentrations (for leaves, flowers and stems) and 1.00 - 2.00 % (for roots); at the lowest concentration (0.133%) a small stimulative effect was observed.

The microscopic examination of the embryonic wheat roots confirmed the mitodepressive effect of the higher concentrations extracts of Taraxacum officinale. These extracts were not cytotoxic (the statmokinetic effect consists of karyokinesis inhibition and of nuclei with 1-2 hypertrophied nucleols). At the lowest concentration numerous cells with normal division phases were observed.

Figure 4. Influence of Taraxaci extracts on embryonic Triticum root elongation in the 5th day of the experiment
This mitoinhibitory effect is mentioned in the scientific literature about *Taraxacum officinale* (few studies have been reported on the anticarcinogenic activity of dandelion) [8].

**Conclusions**

The pharmacognostical screening of root, stem, leaf and flower of dandelion has been performed. The specific anatomical elements are the pappus, latex tubes, epidermal cells with irregularly thickened walls and inulin as deposit substance. The main classes of active principles are flavonoids (quercetin, rutin, hiperoside), hydroxycinnamic acid derivatives (caffeic acid, chlorogenic acid), catechic tannins, sterols/triterpenes and mucilages. *Taraxaci flos* and *Taraxaci folium* can be considered as polyphenol sources. These products were not cytotoxic, but a mitoinhibitory effect was observed in the higher concentration extracts.

**References**


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