

THE ALLERGENICITY OF ORNAMENTAL PLANTS IN THE *ASTERACEAE* FAMILY

ALERGENITATEA SPECIILOR FLORICOLE DIN FAMILIA *ASTERACEAE*

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Abstract. This paper aims to synthesise data regarding the allergenic potential of ornamental plants from the Asteraceae family, both from spontaneous and cultivated flora in Romania. The groups of allergenic substances, their presence in plants and the factors influencing them were analysed. Methods used were: bibliographical study, analysis and synthesis of data. The information was provided by national and international scientific literature from various fields (botany, plant physiology, phytochemistry, floriculture, dermatology, public health). Ornamental plants from the Asteraceae family can contain allergenic substances. These compounds present variability depending on the species, soil, climate or part of the plant. The most important allergens belong to the sesquiterpene lactones. The risk to health imposes health and safety regulations, the need to inform the general population and the evaluation of natural remedies and cosmetic products from plants from an allergenic perspective.

Key words: Asteraceae, allergenicity, sesquiterpene lactones

Rezumat. Lucrarea își propune să sintetizeze datele referitoare la potențialul alergic al plantelor floricole din familia Asteraceae, atât din flora spontană cât și cultivată din România. Sunt analizate: clasele de substanțe alergene, prezența acestora în plante și factorii care le influențează. Metodele utilizate au fost: studiul bibliografic, analiza și sinteza datelor. Informațiile au fost furnizate de date din literatura de specialitate națională și internațională, din domenii multiple (botanică, fiziologică plantelor, fitochimie, floricultură, dermatologie, sănătate publică). Plantele floricole din familia Asteraceae pot conține substanțe alergene. Acești compuși prezintă variabilitate în funcție de specie, sol, condiții climatice sau părți din plantă. Alergenii cei mai importanți aparțin sesquiterpenlactonelor. Riscul pentru sănătate impune măsuri de protecția muncii, necesitatea informării populației și evaluarea remediilor naturiste și a produselor cosmetice din plante prin prisma alergenității.

Cuvinte cheie: Asteraceae, alergenitate, lactone sesquiterpenice

INTRODUCTION

Asteraceae family represents more than 10% of floral species (Crosby, 2004). Asteraceae are notorious for producing skin allergies. In Europe, the former “*Compositae*” allergy (now *Asteraceae*) is among the top ten contact sensitivities. Jovanovic and Poljacki (2003) concluded that among cultivated Asteraceae plants, *Chrysanthemum* is considered to be a major sensitizer (60% in Europe). Human

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susceptibility varies with occupation, age and lifestyle. Cross-reactions add to the problem (Crosby, 2004).

The most important allergenic compounds in Asteraceae plants are present in different parts of the plants, especially the leaf, the stem, the flower, in seeds and even in the pollen (Gordon, 1999). Plant allergens are remarkably widespread and exposure is possible both directly by contact and indirectly through contaminated clothing, tools, pets. Skin exposure to plants or topical application of products like herbal medicines or cosmetics may cause sensitization to allergenic compounds resulting in allergic contact dermatitis – ACD (Crosby, 2004; Gordon, 1999). Exposure via the skin is the most prevalent, but exposure via eyes (ocular), mouth (oral) and lungs (respiratory) are all possible.

Sesquiterpene lactones from Asteraceae plants appear to be a resource of many biologically active compounds. Some of them are already used for insecticidal activity. Others may give new therapeutic and agricultural products of commercial importance (Kumar et al, 2005).

This study presents a brief overview of the most common allergenic ornamental plants belonging to the Asteraceae.

MATERIAL AND METHOD

The study was based on literature data collection, analysis and synthesis. Ornamental plants from Asteraceae families (spontaneous and cultivated flora) were investigated in relation to their allergenic compounds. Basic data were centralized. Very allergenic weeds were not included (*Ambrosia*, *Artemisia*, *Taraxacum*).

RESULTS AND DISCUSSIONS

Allergic contact dermatitis (ACD) is more common than most people realize. Typical symptoms include inflammation (redness), pruritus (itching) and eruptions (blisters). Asteraceae allergens and their relatives are found worldwide in flowers, herbs and vegetable gardens, urban and rural weed population and native vegetation. “*Compositae*” (redefined as Asteraceae) plant extracts are present in many cosmetics, massage oils, shampoos, herbal creams, herbal remedies and tonics, aroma lamps (Gordon, 1999). Paulsen (2002) emphasized that the risk of elicitation of dermatitis by using Asteraceae-containing products is by-and-large unknown.

Exposure to plants and plant products is commonly by direct contact, via skin. Allergens are able to become airborne – as particles of dry leaf materials, fine sawdust and smoke from burning plant material. The airborne particles can settle on unprotected skin or, worse, be inhaled. *Chrysanthemum*, *Dahlia*, *Parthenium* and *Achillea* are some plant sources of airborne allergens. Also, pollen is a possible carrier of airborne allergens (typically for *Ambrosia* sp. and *Parthenium* sp.).

Certain members of the Asteraceae are notorious for producing allergies other than ACD. The pollen of the ragweed (*Ambrosia* sp.), golden rod (*Solidago*)

and sneeze weeds (*Helenium*) is responsible for the widespread sneezing, coughing and congestion of hay fever and related respiratory maladies (Crosby, 2004).

The most important allergens in the Asteraceae family are sesquiterpene lactones with a α -methylene group (circled) on the γ -lactone ring (fig. 1); without it, there is no allergenicity (Crosby, 2004).

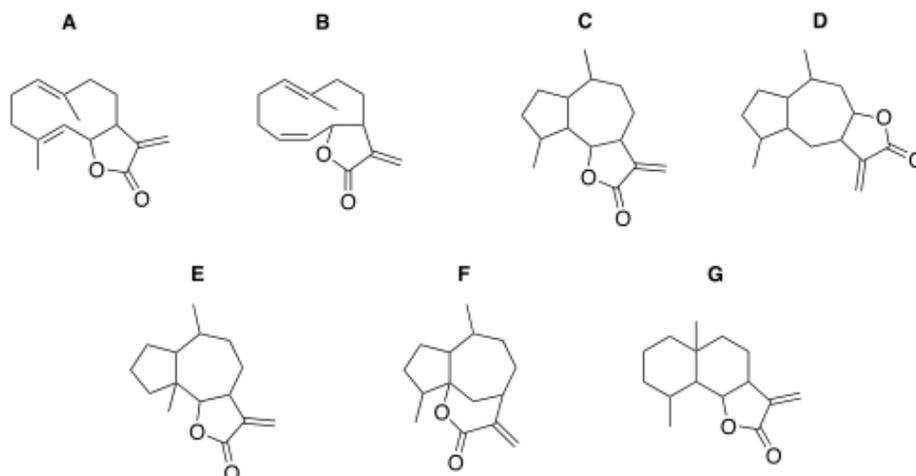


Fig. 1 - Chemical structures of some sesquiterpene lactones:
A: Germacranolides, **B:** Heliangolides, **C+D:** Guaianolides, **E:** Pseudoguaianolides,
F: Hypocretenolides, **G:** Eudesmanolides.
(http://en.wikipedia.org/wiki/Sesquiterpene_lactone)

Sesquiterpene lactones (SQL) constitute a “large and diverse group of biologically active plant chemicals which have been identified in several plant families. However, the greatest number are found in Asteraceae family with over 3,000 reported different structures” (Moufid and Eddouks, 2012). The SQL are usually stored in different plant parts. The diversity and distribution of SQL in different tissues are genetically related (Ramirez et al, 2013). It was proven by different research studies that SQL often display potent bioactivities and are sequestered in special organs such as lactifers, resin ducts and trichomes (Göpfert et al, 2009). They are mostly found in leaves and flowering heads of plants. Chadwick et al (2013) emphasized that SQL are functional compounds and are therefore liable to change in concentration during plant development according to the plant’s needs. This means significant changes occur in the plant in a spatial, temporal and species-dependent manner.

Interestingly, there are large differences in chemotypes of sesquiterpene lactone constitution between countries and regions according to the properties of geographical location, soil and climate (Foster et al, 2006; Mohamed et al, 2010). The phytochemical studies have clearly demonstrated that there is “an intraspecific variability of these constituents depending on the geographical area” (Moufid and Edolouks, 2012).

Sesquiterpene lactones are natural compounds which have a broad range of biological activities: antimicrobial effects, antihelminthic properties, analgesic and anti-inflammatory actions, antihyperlipidic activity, effects on plant growth, insecticidal, insect antifeedant properties, mammalian antifeedant properties, acute mammalian toxicity, cytotoxic and antitumor properties. The level of efficacy cannot be generalized. Each compound has individual properties and therapeutic and economical significance.

The main Asteraceae ornamental plants which contain SQL are listed in table 1. Representative chemical compounds were tabulated.

Table 1

Ornamental Asteraceae with allergenic sesquiterpene lactones

Scientific name	Common name	Allergens
<i>Aster</i> sp.	Daisy	dihydrogriesenin ivalin
<i>Arnica montana</i>	Hillside arnica	dihydrohelinalin, helenalin, acetydihydrohelinalin
<i>Arnica longifolia</i>	Deep-spring arnica	carabron
<i>Anthemis cotula</i>	Mayweed	anthocotulidae
<i>Anthemis nobilis</i>	Camomile	nobilin
<i>Achillea millefolium</i>	Yarrow	germacren D, azulena
<i>Chrysanthemum cinerariaefolium</i>	Pyrethrum daisy	pyrethrosin
<i>Calendula officinalis</i>	Marigold	calendin
<i>Centaurea cyanus</i>	Corn flower, basket flower	salograviolide A
<i>Cosmos bipinnatus</i>	Garden cosmos	costunolide, germacrene D, sabinene, farnesene
<i>Coreopsis grandiflora</i>	large-flowered tickseed	perezone, parvifoline
<i>Dahlia variabilis</i>	Dahlia	difensin
<i>Dendranthema grandiflorum (Chrysanthema morifolium)</i>	Chrysanthemum, florists' chrysanthemum	arteglasin A
<i>Echinacea purpurea</i>	Purple coneflower	α -humulene α -copaene, allo-aromadendrene
<i>Gaillardia</i> sp.	Fireweed	pulchellin, neopulchellin, gailla
<i>Helianthus annuus</i>	Sunflower	Niveusin A
<i>Helenium autumnale</i>	Sneezeweed	helenin, helenalin, flexuosin A, B, sulferalin, carolenalone
<i>Inula helenium</i>	Elecampane	helenalin, helenin

<i>Matricaria/ Chamomilla recutita</i> (<i>German chamomile</i>)	Chamomile	desacetylmatricarin, matricarin
<i>Parthenium hysterophorus</i>	Wild feverfew	parthenin, ambrosin, coronopilin, lymenin
<i>Rudbeckia hirta</i>	Black Eyed Susan	pulchelin, rudmolin, dihydrorudmolin
<i>Senecio</i> sp.	Ragworts, groundsel	6-hydroxy- eremophilinolide, eremophilane
<i>Solidago</i> sp.	Goldenrod	germacrene A, D
<i>Tagetes</i> sp.	French marigold	patuletin, patulitrin
<i>Tanacetum vulgare</i>	Tansy	arbusculin A
<i>Tanacetum parthenium</i>	Feverfew	parthenolide

Most exposure and its consequences are highly individual and rely on age, occupation, location and many other variables. Occupation is a prime factor, especially for gardeners, florists, outdoors men (Crosby, 2004).

Table 2

Occupational dermatitis from ornamental Asteraceae plants

Occupation	Plants or plant products involved
Horticulturists, florists, nurserymen, floriculturists, flower handlers	<i>Chrysanthemum, Dahlia, Helenium</i>
Gardeners and groundskeepers	<i>Chrysanthemum, Tagetes</i>
Plant/plant product handlers (cosmetician, masseur, pharmacists)	<i>Parthenium, Echinacea, Matricaria, Arnica, Calendula</i>
Farmers	<i>Helianthus</i>
Herbal medicine users	<i>Chamomile, Arnica</i>

Composites and other lactone-bearing plants likewise tend to stand in for each other's allergenicity. Cross-reaction is a real problem. It can occur between flowers, weeds, herbs and vegetables.

CONCLUSIONS

1. Ornamental plants from the Asteraceae family have a great allergenicity potential in humans. Cross-reactions between ornamentals, weeds and even vegetables are frequent and often underestimated.
2. The most important allergenic compounds from Asteraceae plants are sesquiterpene lactones (sesquiterpenoids). SQL structures and levels are species and local-related.
3. Many sesquiterpene lactones are highly biologically active compounds and could have different economic uses (medical, industrial, agricultural).
4. Florists and horticulturists are highly exposed to Asteraceae ornamentals contact and could develop occupational contact dermatitis.

5. The risk to health imposes health and safety regulations at work, the need to inform population and the evaluation of natural remedies and cosmetic products from plants from an allergenic perspective.

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