

ORIGINAL ARTICLE

Contact sensitization to plants of the Compositae family: Data of the Information Network of Departments of Dermatology (IVDK) from 2007 to 2016

Andrea Bauer¹  | Johannes Geier²  | Sophie Schreiber¹ | Steffen Schubert²  | For the IVDK

¹Department of Dermatology, University Allergy Centre, University of Dresden, Dresden, Germany

²Information Network of Departments of Dermatology, University of Göttingen, Göttingen, Germany

Correspondence

Professor Andrea Bauer, Department of Dermatology, University Hospital Carl Gustav Carus, Technical University Dresden, Fetscherstraße 74, 01307 Dresden, Germany.
Email: andrea.bauer@uniklinikum-dresden.de

Background: The Compositae plant family includes many thousands of species, making it one of the most widespread group of plants worldwide. Sensitization to Compositae allergens may occur in private or in occupational settings.

Objectives: To monitor the current spectrum of sensitization to Compositae allergens, especially in cooks and florists.

Methods: We retrospectively analysed patch test results obtained with two Compositae mixes (CMs) (CM I and CM II; switch in October 2011), their individual components, and sesquiterpene lactone (SL) mix in 1492 cooks, 851 florists, and a control group (118 358 other patients) registered in the IVDK, 2007 to 2016.

Results: Florists reacted significantly more frequently to CM I and II (CM I, 8.7%; CM II, 10.6%) than did cooks (CM I, 2.1%; CM II, 0.8%) and controls (CM I, 1.3%; CM II, 1.2%). Additional testing with SL mix detected 14.3% more sensitizations than CM I or CM II alone.

Conclusions: Florists are at considerable risk of sensitization to Compositae allergens. Patch testing with both CM and SL mix is recommended.

KEYWORDS

Compositae, contact allergy, cooks, florists, occupational contact dermatitis, sesquiterpene lactones

1 | INTRODUCTION

Population-based data on the prevalence of type IV sensitization to plants are not available. However, it is estimated that approximately 5% to 10% of all contact allergies in Europeans are attributable to type IV sensitization to plants or plant constituents.¹ In Europe, the Compositae are responsible for the majority of diagnosed type IV sensitizations to phytochemicals.^{2–6} In addition to wild herbs and medicinal herbs or flowers, which are used in topical medicines or cosmetics, and ornamental flowers, the plant family also includes food plants such as various salads, seeds, and vegetables.^{2,3} Occupational allergic contact dermatitis (CD) caused by plants, fruits and vegetables is not uncommon. Gardeners and horticulturists, florists, farmers and forsters, cooks and people working in related occupations in food

processing are affected.⁷ Sensitization may occur by direct skin contact with the plants, and from plant components present in cosmetics and topical medicines. In addition to allergic CD and airborne allergic CD, photoallergic CD and chronic actinic dermatitis may occur.^{6–12} The main allergens of the Compositae are sesquiterpene lactones (SLs), which are present in different compositions and concentrations in the plants. The common basic structure is an α -methylene- γ -butyrolactone ring. SLs are low molecular weight, highly reactive substances with antimicrobial and antifeedant properties. As well as in the Compositae, SLs can be found in >17 other plant families (eg, Frulania, Lauraceae, and Magnoliaceae).^{13–15} To monitor occupational risk profiles and the current spectrum of sensitization to plants of the Compositae family in patch tested patients in general, and in cooks and florists with suspected CD or occupational CD (OCD) in particular,

we analysed data of the Information Network of Departments of Dermatology (IVDK) from 2007 to 2016 obtained with Compositae mix (CM) I and CM II in the baseline series, the corresponding breakdown tests, and the SL mix.

2 | PATIENTS AND METHODS

The IVDK is a network that is currently composed of 56 departments of dermatology in Germany, Switzerland and Austria dedicated to the epidemiology of contact allergy. Its structure and routine operating procedures are described in detail elsewhere.¹⁶ Briefly, the histories, clinical data and patch test results of all patients tested in the participating centres are recorded in local databases and, after pseudonymization, transmitted to the IVDK central office at the University of Göttingen twice yearly. Data are subjected to standardized quality control, added to the central IVDK database, and analysed according to international standards.^{17,18} For this retrospective data analysis, we selected data of the years 2007 to 2016 from the central database of the IVDK. All IVDK members are also members of the German Contact Dermatitis Research Group (DKG). Patch testing and evaluation of reactions is performed according to DKG guidelines.¹⁹ For this data analysis, patch test reactions on day (D) 3 were taken into account. In a few exceptional cases, for which a reading was performed on D4 instead of on D3, this reading was selected. Readings coded as +, ++ or +++, that is, positive reactions with erythema, infiltration, papules, and/or (coalescing) vesicles, according to scoring, were rated as positive in dichotomized analyses if not otherwise indicated. Patch test preparations were purchased from Almirall Hermal, Reinbek, Germany (until 2013), SmartPractice Europe, Reinbek, Germany (since 2014), and Chemotechnique Diagnostics, Vellinge, Sweden. The patch test exposure time was 1 day in 15.5% of patients, and 2 days in 84.5% of patients. With only a few (temporary) exceptions, Finn Chambers (SmartPractice Europe, Barsbüttel, Germany) on Scanpor tape (SmartPractice Europe, Barsbüttel, Germany) (inner diameter of 8 mm) were used as test chambers. Of the 120 701 patients patch tested during these years, 50 625 patients were tested with CM I until 30 September 2011, and 50 676 patients were tested with CM II from 1 October 2011, both at 5% pet. and as part of the DKG baseline series. The individual ingredients of CM I, namely *Tanacetum vulgare* (L.) (common tansy) 1% pet., *Arnica montana* (L.) (arnica) 0.5% pet., *Tanacetum parthenium* (L.) Sch. Bip. (feverfew) 0.1% pet., *Anthemis nobilis* (L.) (Roman chamomile) 1% pet., and *Achillea millefolium* (L.) (yarrow) 1% pet., and those of CM II, namely *T. vulgare* (L.) (common

tansy) 1% pet., *A. montana* (L.) (arnica) 0.5% pet., *T. parthenium* (L.) Sch. Bip. (feverfew; parthenolide) 0.1% pet., *Anthemis nobilis* (L.) (Roman chamomile) 1% pet., *Chamomilla recutita* (L.) Rauschert (German chamomile) 1% pet., and *Achillea millefolium* (L.) (yarrow) 1% pet., were tested in selected patients only. Moreover, SL mix 0.1% pet. (containing 33% each of allantoin, costunolide, and dehydrocostuslactone) was tested during the entire analysis period as part of the DKG plant allergen series.

Stratified analysis of OCD was performed in subsets of 1492 cooks (cooks and kitchen helpers) and 851 florists (gardeners, horticultural workers, florists and flower binders, and sellers of fruits, vegetables, and flowers) in comparison with a control group (n = 118 358). The statistical significance ($P < 0.05$) of items derived from patient histories, and differences in sensitization frequencies, were determined according to non-overlapping 95% confidence intervals (CIs). A logistic regression analysis with a dichotomized outcome, namely positive reactions to CM I or CM II, and dichotomized explanatory variables (age of ≥ 40 years, atopic dermatitis, and occupation as cook or florist) was performed. Model fit was examined with the Hosmer and Lemeshow goodness-of-fit test ($P > 0.05$). Results are presented as odds ratio (OR) estimates accompanied by profile-likelihood CIs (95%). Data were managed and analysed with the statistical analysis software SAS, version 9.4 (SAS Institute, Cary, North Carolina).

3 | RESULTS

3.1 | Characterization of the study population

The study groups as characterized by MOAHLFA indices are shown in Table 1. Cooks (n = 1492) and florists (n = 851) more often suffered from hand dermatitis, occupational dermatitis and atopic dermatitis than controls. The patients in the control group were older and were diagnosed with face and leg dermatitis more often than cooks and florists (Table 1).

3.2 | Diagnoses after patch testing

In florists, allergic CD was the most frequent current main final diagnosis (28.3%), followed by atopic dermatitis (12.3%), and chronic irritant dermatitis (11.3%). The most frequently suspected exposure sources were plants (43.8%), cosmetics (30.7%), and gloves (16.2%). In cooks, allergic CD was the most frequent current main final diagnosis (24.4%), followed by chronic irritant dermatitis (16.0%), and atopic dermatitis (11.9%). The most frequently suspected exposure sources were cosmetics (31.2%), gloves (22.0%), and food (21.7%). In controls, allergic CD was the most

TABLE 1 MOAHLFA index: Characteristics of the study population

Index	Cooks, n = 1492		Florists, n = 851		Controls, n = 118 358	
	n	%	n	%	n	%
Male (M)	659	44.2 (42.7-46.7)	269	31.6 (28.6-34.8)	42 693	36.1 (35.8-36.4)
Occupational (O)	676	45.3 (42.8-47.8)	351	41.2 (38.0-44.6)	18 068	15.3 (15.1-15.5)
Atopic eczema (A)	437	29.3 (27.0-31.7)	250	29.4 (26.4-32.5)	25 391	21.5 (21.2-21.7)
Site: Hand (H)	903	60.5 (58.0-63.0)	426	50.1 (46.7-53.4)	32 375	27.4 (27.1-27.6)
Site: Leg (L)	67	4.5 (3.6-5.7)	40	4.7 (3.5-6.3)	12 481	10.5 (10.4-10.7)
Site: Face (F)	119	8.0 (6.7-9.5)	95	11.2 (6.2-13.5)	18 893	16.0 (15.8-16.2)
Age ≥ 40 years (A)	832	55.8 (53.2-58.3)	523	61.5 (58.1-64.7)	85 716	72.4 (72.2-72.7)

TABLE 2 Prevalences of sensitization to Compositae mix (CM) I and CM II from baseline series testing

Test preparation	Cooks			Florists			Controls		
	No. tested	No. positive	Standard. % positive (95%CI) ²⁰	No. tested	No. positive	Standard. % positive (95%CI)	No. tested	No. positive	Standard. % positive (95%CI)
CM I 5% pet. Until October 30, 2011	602	14	2.1 (0.9-3.2)	349	32	8.7 (5.8-11.6)	49 674	698	1.3 (1.2-1.4)
CM II 5% pet. From October 1, 2011	696	7	0.8 (0.2-1.4)	389	44	10.6 (7.7-13.6)	49 591	689	1.2 (1.1-1.3)

frequent current main final diagnosis (24.4%), followed by atopic dermatitis (9.9%), and chronic irritant dermatitis (7.3%). The most frequently suspected exposure sources were cosmetics (38.2%), topical medicaments (16.9%), and systemic medicaments (10.4%).

3.3 | Sensitization to CM I and CM II in cooks and florists

A comparison of age-standardized frequencies of reactions to CM I and II in cooks, florists and controls is shown in Table 2. Florists reacted significantly more frequently than controls to CM I and CM II, whereas cooks showed no significant difference from the control group (Table 2).

3.4 | Sensitization to individual ingredients of CM I, CM II, and SL mix

Single components of the CMs and SL mix were tested in only a small subset of the patients, not limited to mix positives. On analysis of both

the time period when CM I was tested in the baseline series (CM I period) and the CM II baseline series test period (CM II period), the highest prevalence of sensitization to single ingredients were seen for *T. parthenium* (L.) Sch. Bip. 0.1% pet. and *T. vulgare* (L.) 1% pet. in florists as compared with controls. In contrast to observations in cooks, florists reacted to SL mix significantly more often than controls. The results for the remaining Compositae plants included in CM I and CM II, respectively, are shown in Tables 3 and 4.

3.5 | Frequencies of coupled reactions

The complete CM breakdown plus SL mix was tested in 9098 patients, and positive reactions to at least one of the substances occurred in 340 patients (3.7%). One third reacted only to one of the single CM components. Regarding coupled reactions, 50% of the patients reacted to SL mix and *T. parthenium* (L.) Sch. Bip., and approximately half of them also reacted to *T. vulgare* (L.), or *T. vulgare* (L.) and *Achillea millefolium* (L.). Positive reactions to chamomile (*C. recutita* [L.]

TABLE 3 Sensitization to individual ingredients of Compositae mix I and sesquiterpene lactone mix

Allergen	Cooks			Florists			Controls		
	No. tested	No. positive	Standard. % positive (95%CI) ²⁰	No. tested	No. positive	Standard. % positive (95%CI)	No. tested	No. positive	Standard. % positive (95%CI)
Sesquiterpene lactone mix 0.1% pet.	71	0	0.0 (0.0-4.1)	211	19	8.2 (4.7-11.8)	5140	127	1.9 (1.5-2.3)
<i>Tanacetum vulgare</i> (L.) (common tansy) 1% pet.	71	1	1.0 (0.0-3.0)	208	18	7.8 (4.4-11.1)	5081	90	1.4 (1.0-1.7)
<i>Arnica montana</i> (L.) (arnica) 0.5% pet.	71	0	0.0 (0.0-4.1)	208	1	0.4 (0.0-1.3)	5077	24	0.4 (0.2-0.6)
<i>Tanacetum parthenium</i> (L.) Sch. Bip. (feverfew allergen) 0.1% pet.	71	1	1.0 (0.0-3.0)	206	24	10.8 (6.8-14.9)	5068	102	1.6 (1.2-1.9)
<i>Anthemis nobilis</i> (L.) (Roman chamomile) 1% pet.	70	0	0.0 (0.0-4.2)	206	8	3.4 (1.1-5.7)	5011	25	0.4 (0.2-0.7)
<i>Achillea millefolium</i> (L.) (yarrow) 1% pet.	71	2	3.4 (0.0-8.3)	209	8	3.3 (1.1-5.6)	5060	58	0.9 (0.6-1.1)

TABLE 4 Sensitization to individual ingredients of Compositae mix II and sesquiterpene lactone mix

Allergen	Cooks			Florists			Controls		
	No. tested	No. positive	Standard. % positive (95%CI)	No. tested	No. positive	Standard. % positive (95%CI)	No. tested	No. positive	Standard. % positive (95%CI)
Sesquiterpene lactone mix 0.1% pet.	74	0	0.0 (0.0-4.0)	249	27	10.1 (6.4-13.8)	3706	94	2.0 (1.5-2.4)
<i>Tanacetum vulgare</i> (L.) (common tansy) 1% pet.	74	0	0.0 (0.0-4.0)	249	17	6.0 (3.2-8.7)	3683	56	1.2 (0.8-1.5)
<i>Arnica montana</i> (L.) (arnica) 0.5% pet.	74	0	0.0 (0.0-4.0)	249	1	0.5 (0.0-1.4)	3684	10	0.2 (0.1-0.4)
<i>Tanacetum parthenium</i> (L.) Sch. Bip. (feverfew) 0.1% pet.	74	0	0.0 (0.0-4.0)	247	35	13.0 (8.9-17.1)	3680	83	1.8 (1.3-2.2)
<i>Achillea millefolium</i> (L.) (yarrow) 1% pet.	74	0	0.0 (0.0-4.0)	249	13	4.6 (2.2-7.0)	3660	46	1.0 (0.7-1.4)
<i>Anthemis nobilis</i> (L.) (Roman chamomile) 1% pet.	72	0	0.0 (0.0-4.0)	229	1	0.4 (0.0-1.1)	3464	11	0.2 (0.1-0.3)
<i>Chamomilla recutita</i> (L.) Rauschert (German chamomile) 1% pet.	71	0	0.0 (0.0-4.0)	226	1	0.4 (0.0-1.1)	3448	15	0.3 (0.1-0.5)

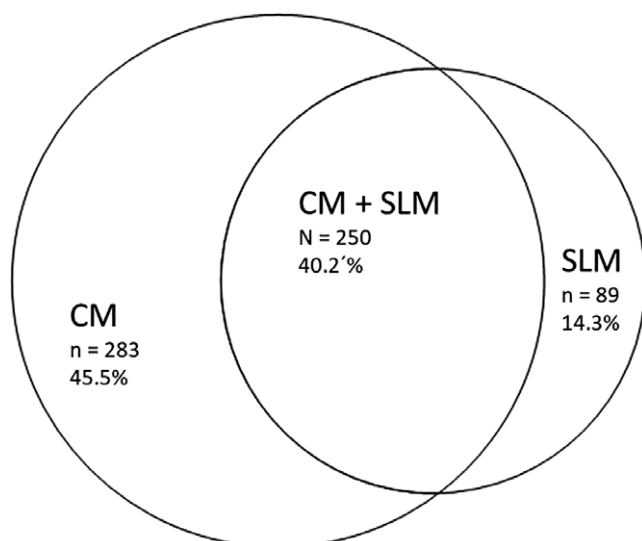


FIGURE 1 Venn diagram of frequencies of coupled reactions between sesquiterpene lactone mix (SLM) and Compositae mix (CM) I/CM II

Rauschert and *Anthemis nobilis* [L.] were documented rarely, and appeared either alone or in combination with positive reactions to another mix component. Besides single reactions (36%) to *T. parthenium* (L.) Sch. Bip., positive reactions to *T. parthenium* (L.) Sch. Bip. in combination with positive reactions to *T. vulgare* (L.) and *Achillea millefolium* (L.) (35.6%) were documented quite often (Supporting Information Tables S1 and S2).

In total, 22 180 patients had been patch tested with at least one CM and SL mix in parallel. On analysis of the test results for the three mixes, 622 patients reacted either to one of both CMs, SL mix, or two mixes (CM and SL). Eighty-nine patients reacted only to SL mix (14.3%), and 250 patients (40.2%) reacted additionally to a CM. The largest group ($n = 283$, 45.5%) reacted only to one of the two CMs (Figure 1).

During the study period, material from the patients' workplaces was tested in 616 cooks; lettuce was tested in 15 patients, and this showed no type IV sensitization. In 354 florists tested with their own material, positive reactions to plant materials ($n = 29$) were seen in 8 of 29 patients. Four patients reacted exclusively to their own plant material (gerbera extract, chicory, chrysanthemum, and yarrow), but not to the standardized patch test substances described in this article (data not shown in detail).

3.6 | Multivariate regression analysis

In a multivariate logistic regression analysis, age of ≥ 40 years (OR 2.1; 95%CI: 1.8-2.4), atopy (OR 1.8; 95%CI: 1.6-2.4) and working as a

florist (OR 8.5; 95%CI: 6.6-10.8) were associated with a significantly increased risk of CM sensitization. No significant risk increase was seen for cooks (OR 1.3; 95%CI: 0.8-1.9) (Table 5).

4 | DISCUSSION

Leisure time contact and occupational contact with plants and plant ingredients are common. Allergen sources are plants, food, cosmetics, and topical and systemically administered natural remedies and medicines. Gardeners, florists and employees in agriculture and the food industry are at risk of suffering from occupational contact dermatitis caused by plants.²¹⁻²⁴

Contact allergies to plants are often difficult to diagnose, owing to the limited number of commercially available test substances. Testing with native material may only be carried out after exact identification of the plant, and knowledge of the irritant and allergenic potential. For the preparation of test extracts, filtered acetone and ethanol extractions of dried plants or ether short extractions of fresh plants are recommended; these are then usually incorporated in pet.^{25,26} However, this procedure is only feasible in highly specialized patch test clinics. Therefore, the numbers of unreported cases of plant allergy are probably quite high. However, for diagnostic purposes in case of suspected sensitization to Compositae plants, there are commercial test substances available. Our analysis showed florists to be the most commonly affected occupational group. In 2008, Dickel et al reported comparable data from the IVDK relating to 2001 to 2006 in 115 female florists, 54 of whom were tested because of suspected occupational dermatosis (47%). The frequencies of reactions to CM were 21.5% in the entire group and 46.1% in occupation-related cases. In the latter group especially sensitization to feverfew, tansy and SL mix were more common.²⁷ The lifetime prevalence of occupation-related eczema in Danish gardeners and greenhouse workers was reported to be as high as 19.6%.²⁸ Type IV sensitization to CM was common in people working in these occupations.²⁹ In 2015, Bauer et al showed sensitization prevalences as high as 48.28% (95%CI: 29.45-67.47) in German florists, 9.38% (95%CI: 1.98-25.02) in farmers and agricultural workers, and 6.38% (95%CI: 1.34-17.54) in salespersons.²³

Our data indicate that prevalences of sensitization to Compositae plants in cooks might have decreased over the years. From 2007 to September 2011, the prevalence was 2.1% (95%CI: 0.9-3.2) for CM I, and, from October 2011 to 2016, it was even lower for CM II (0.8%; 95%CI: 0.2-1.4). IVDK data from the years 1992 to 1999 showed a frequency of sensitization to CM in the food industry of 6.2%, and a frequency of 10% in cooks.²² One could speculate that direct skin

TABLE 5 Multivariate logistic regression analysis including the independent variables age ≥ 40 years, atopy, and occupation as a florist or cook, and the dependent variables positive reaction to Compositae mix (CM) (I or II), CM I, and CM II, respectively

	Age ≥ 40 years, OR (95%CI)	Atopic dermatitis, OR (95%CI)	Florist, OR (95%CI)	Cook, OR (95%CI)	Tested	Positive
CM-positive	2.08 (1.82-2.39)	1.80 (1.61-2.02)	8.49 (6.59-10.78)	1.25 (0.79-1.89)	101 301	1484
CM I-positive	1.89 (1.58-2.28)	1.85 (1.57-2.18)	7.45 (5.03-10.66)	1.79 (1.00-2.94)	50 625	744
CM II-positive	2.32 (1.92-2.84)	1.77 (1.51-2.07)	9.47 (6.75-12.99)	0.78 (0.33-1.53)	50 676	740

contact with vegetables, fruits and spices from the Compositae family in cooking may have been reduced substantially by preventive means.

SL mix was patch tested within the plant series in parallel with the single ingredients of the CMs. Only in florists relevant amounts of positive reactions to SL-mix were seen. Including SL mix in the test panel increased the diagnostic sensitivity. Testing with SL mix showed 89 additional patients to be SL-sensitized, so testing with SL mix should be continued if ingredients of plants are suspected allergens, even if testing with CM gave negative results. The occupational relevance of SL mix was also illustrated by data from the European Surveillance System on Contact Allergies (ESSCA) registry showing an adjusted prevalence ratio for occupational sensitization to SL mix of 1.45 (1.07-1.96).³⁰ However, our data clearly indicate that CM remains a more important patch test substance than SL mix for diagnosing type IV sensitization to Compositae plants in Germany, Austria, and Switzerland. Recently, the addition of CM 2.5% to the European baseline series was proposed, after analysis of national extensions to the European baseline series.³¹ A concentration of 2.5% instead of 5% (used in patch test clinics of the ESSCA in Switzerland, Germany, Italy, and Austria) was proposed because the sensitization risk was assumed to be minimal at this concentration, as no active sensitization has been reported up to now in the United Kingdom, where CM 2.5% is regularly tested in the baseline series.³¹ Higher concentrations are considered to carry a sensitization risk in patch testing, on the basis of a case series of four patients in which active sensitization to CM 6% pet. (Trolab), especially if it was also tested with SL mix.³² In the IVDK data, no case of active sensitization to CM is documented. The DKG will continue to test CM at 5% pet.

From our data, testing of patients' own plant material can be recommended for florists and those working in related occupations. Patch testing of vegetables in cooks did not show additional sensitizations.

5 | CONCLUSION

Gardeners, horticultural workers, florists and flower binders and sellers of fruits, vegetables and flowers are at considerable risk of acquiring occupational contact allergy to Compositae plants, fruits, and vegetables. If Compositae allergy is suspected, patch testing with CM and SL mix, as well as the single Compositae allergens, is recommended. In florists and those working in related occupations, testing of patients' own plants can detect additional type IV sensitizations.

CONFLICTS OF INTEREST

The authors have no conflicts of interest to report.

ORCID

Andrea Bauer  <https://orcid.org/0000-0002-4411-3088>

Johannes Geier  <https://orcid.org/0000-0002-5047-8948>

Steffen Schubert  <https://orcid.org/0000-0002-2359-2518>

REFERENCES

1. Fregert S. Occupational dermatitis in a 10-year material. *Contact Dermatitis*. 1975;1:96-107.
2. Hausen BM, Vieluf IK. Allergiepflanzen - Pflanzenallergene. In: Hausen BM, ed. *Handbuch und Atlas der allergieinduzierenden Wild- und Kulturpflanzen*. Landsberg München: ecomed Verlagsgesellschaft mbH; 1988.
3. Menz J, Winkelmann RK. Sensitivity to wild vegetation. *Contact Dermatitis*. 1987;16:169-173.
4. Wrangsjö K, Ros AM, Wahlberg JE. Contact allergy to Compositae plants in patients with summer-exacerbated dermatitis. *Contact Dermatitis*. 1990;22:148-154.
5. Hausen BM. Kompositen-Allergie. Eine Auswertung der Testergebnisse von 1985-1990. *Akt Dermatol*. 1992;18:96-101.
6. Paulsen E. Compositae dermatitis: a survey. *Contact Dermatitis*. 1992; 26:76-86.
7. Bauer A, Uter W, Ch S. Vegetables and fruits. Textbook of Occupational Dermatology. In: Rustemeyer T, Elsner P, John SM, Maibach HI, eds. *Kanerva's Handbook of Occupational Skin Disease*. 2nd ed. Berlin, Heidelberg: Springer Verlag; 2012.
8. Paulsen E, Andersen KE. Compositae dermatitis in a Danish dermatology department in one year. (II) Clinical features in patients with Compositae contact allergy. *Contact Dermatitis*. 1993;29:195-201.
9. Le Coz CJ, Ducombs G. Plants and plant products. In: Frosch PJ, Menne T, Lepoittevin JP, eds. *Contact Dermatitis*. 4th ed. New York, NY: Springer Berlin, Heidelberg; 2006.
10. Paulsen E. Systemic allergic dermatitis caused by sesquiterpene lactones. *Contact Dermatitis*. 2017;76:1-10.
11. Rozas-Muñoz E, Lepoittevin JP, Pujol RM, Giménez-Arnau A. Allergic contact dermatitis to plants: understanding the chemistry will help our diagnostic approach. *Actas Dermosifiliogr*. 2012;103:456-477.
12. Schnuch A, Szliska C, Uter W. Facial allergic contact dermatitis. Data from the IVDK and review of literature. *Hautarzt*. 2009;60:13-21.
13. Fischer NH, Olivier EJ, Fischer HD. The biogenesis and chemistry of sesquiterpene lactones. *Prog Chem Org Nat Prod*. 1979;38:47-430.
14. Herout V, Sorm F. Chemical taxonomy of the sesquiterpenoids of the Compositae. In: Harbone JB, Swain T, eds. *Perspectives in Phytochemistry*. Vol 1. London: Academic Press; 1969:39-165.
15. Herz W. Pseudoguaianolides in Compositae. In: Mabry TJ, ed. *Recent advances in Phytochemistry*. New York, NY: Appleton-Century-Crofts; 1968.
16. Schnuch A, Geier J, Lessmann H, Arnold R, Uter W. Surveillance of contact allergies: methods and results of the Information Network of Departments of Dermatology (IVDK). *Allergy*. 2012;67:847-857.
17. Uter W, Schnuch A, Gefeller O. Guidelines for the descriptive presentation and statistical analysis of contact allergy data. *Contact Dermatitis*. 2004;51:47-56.
18. Uter W, Mackiewicz M, Schnuch A, Geier J. Interne Qualitätssicherung von Epikutantest-Daten des multizentrischen Projektes "Informationsverbund Dermatologischer Kliniken" (IVDK). *Dermatologie in Beruf und Umwelt*. 2005;53:107-114.
19. Schnuch A, Aberer W, Agathos M, et al. Durchführung des Epikutantests mit Kontaktallergenen. Leitlinien der Deutschen Dermatologischen Gesellschaft (DDG) und der Deutschen Gesellschaft für Allergie und klinische Immunologie (DGAKI). *Journal der Deutschen Dermatologischen Gesellschaft*. 2008;6:770-775.
20. Schnuch A, Geier J, Uter W, et al. National rates and regional differences in sensitization to allergens of the standard series. Population-adjusted frequencies of sensitization (PAFS) in 40,000 patients from a multicenter study (IVDK). *Contact Dermatitis*. 1997;37:200-209.
21. Wrangsjö K, Ros AM. Compositae allergy. *Semin Dermatol*. 1996;15: 87-94.
22. Bauer A, Geier J, Elsner P. Type IV allergy in the food processing industry: sensitization profiles in bakers, cooks and butchers. *Contact Dermatitis*. 2002;46:228-235.
23. Bauer A, Geier J, Mahler V, Uter W. Contact allergies in the German workforce: Data of the IVDK network from 2003-2013. *Hautarzt*. 2015;66:652-664.
24. Bauer A, Schubert S, Geier J, Mahler V. Type IV contact allergies in the food processing industry: an update. *Hautarzt*. 2018;69:443-448.

25. Hausen BM. A simple method for extracting crude sesquiterpene lactones from Compositae plants for skin tests, chemical investigations and sensitizing experiments in guinea pigs. *Contact Dermatitis*. 1977;3: 58-60.
26. Geier J, Hausen BM. Epikutantestung mit dem Kompositenmix. *Allergologie*. 2000;23:334-341.
27. Dickel H, Leiste A, Tran DH, Stücker M, Altmeyer P. "Spring-summer-fall dermatitis" in a florist. Consequences for workmen's compensation insurance. *Hautarzt*. 2008;59:922-928.
28. Paulsen E, Søgaard J, Andersen KE. Occupational dermatitis in Danish gardeners and greenhouse workers (I). Prevalence and possible risk factors. *Contact Dermatitis*. 1997;37:263-270.
29. Paulsen E. Occupational dermatitis in Danish gardeners and greenhouse workers (II). Etiological factors. *Contact Dermatitis*. 1998;38: 14-19.
30. Pesonen M, Jolanki R, Larese Filon F, et al. Patch test results of the European baseline series among patients with occupational contact dermatitis across Europe—analyses of the European Surveillance System on Contact Allergy network, 2002–2010. *Contact Dermatitis*. 2015;72:154-163.
31. Wilkinson M, Gallo R, Goossens A, et al. A proposal to create an extension to the European baseline series. *Contact Dermatitis*. 2018; 78:101-108.
32. Wilkinson SM, Pollock B. Patch test sensitization after use of the Compositae mix. *Contact Dermatitis*. 1999;40:277-278.

SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of the article.

How to cite this article: Bauer A, Geier J, Schreiber S, Schubert S, For the IVDK: Contact sensitization to plants of the Compositae family: Data of the Information Network of Departments of Dermatology (IVDK) from 2007 to 2016. *Contact Dermatitis*. 2019;80:222–227. <https://doi.org/10.1111/cod.13169>

Additional material

Table S1: Interconnected reactions of Compositae and SL-Mix if at least 1 positive reaction to an ingredient of a mix was seen

Sesquiterpene lactone Mix	<i>Tanacetum vulgare</i> (L.)(common tansy)	<i>Tanacetum parthenium</i> (L.) <i>Sch. Bip.</i> (feverfew)	<u><i>Achillea millefolium</i></u> (L.) (yarrow)	Chamomile (<i>Chamomilla rectutica</i> (L.) Rauschert, <i>Anthemis nobilis</i> (L.))	n	%
+	-	-	-	-	39	11.47
-	+	-	-	-	12	3.53
-	-	+	-	-	29	8.53
-	-	-	+	-	16	4.71
-	-	-	-	+	13	3.82
+	+	-	-	-	6	1.76
+	-	+	-	-	59	17.35
+	-	-	+	-	2	0.59
+	-	-	-	+	1	0.29
-	+	+	-	-	4	1.18
-	+	-	+	-	12	3.53
-	+	-	-	+	5	1.47
-	-	+	+	-	2	0.59
-	-	+	-	+	1	0.29
-	-	-	+	+	3	0.88
+	+	+	-	-	46	13.53
+	+	-	+	-	3	0.88
+	+	-	-	+	0	0.00
-	+	+	+	-	0	0.00

-	+	+	-	+	3	0.88
-	+	-	+	+	2	0.59
-	-	+	+	+	0	0.00
+	-	+	+	-	5	1.47
+	-	-	+	+	0	0.00
+	-	+	-	+	0	0.00
-	+	+	+	+	1	0.29
+	-	+	+	+	3	0.88
+	+	-	+	+	0	0.00
+	+	+	-	+	2	0.59
+	+	+	+	-	48	14.12
+	+	+	+	+	23	6.76

Table S2: Compositae Mix – ingredients: interconnected reactions if at least 1 positive reaction to an ingredient of a mix was seen

<i>Tanacetum vulgare</i> (L.)(common tansy)	<i>Chamomilla recutita</i> (L.) Rauschert (German chamomille)	<i>Anthemis nobilis</i> (L.) / (Roman chamomille)	<i>Achillea millefolium</i> (L.) (yarrow)	<i>Arnica montana</i> (L.)(Arnica)	<i>Tanacetum parthenium</i> (L.) Sch. Bip. (feverfew)	n	%
1						18	4.5
	1					5	1.2
		1				8	2.0
			1			17	4.2
				1		33	8.2
					1	146	36.3
1	1					2	0.5
1		1				2	0.5
1			1			15	3.7
1				1		1	0.2
1					1	52	12.9
	1	1				0	0.0
	1		1			0	0.0
	1			1		0	0.0
	1				1	0	0.0
		1	1			3	0.7
		1		1		1	0.2
		1			1	1	0.2
			1	1		1	0.2
			1		1	7	1.7
				1	1	3	0.7
1	1	1				0	0.0

1	1		1			1	0.2
1	1			1		0	0.0
1	1				1	2	0.5
1		1	1			0	0.0
1		1		1		0	0.0
1		1			1	2	0.5
1			1	1		1	0.2
1			1		1	49	12.2
1				1	1	1	0.2
	1	1	1			0	0.0
	1	1		1		0	0.0
	1	1			1	0	0.0
	1		1	1		0	0.0
	1		1		1	0	0.0
	1			1	1	0	0.0
		1	1	1		0	0.0
		1	1		1	3	0.7
		1		1	1	0	0.0
			1	1	1	0	0.0
1	1	1	1			0	0.0
1	1	1		1		1	0.2
1	1	1			1	1	0.2
1	1		1	1		0	0.0
1	1		1		1	1	0.2
1	1			1	1	0	0.0
1		1	1	1		1	0.2
1		1		1	1	0	0.0
1		1	1	1		17	4.2
1		1		1	1	0	0.0
1			1	1	1	1	0.2
	1	1	1	1		0	0.0
	1	1	1		1	0	0.0

	1	1		1	1	0	0.0
	1		1	1	1	0	0.0
		1	1	1	1	0	0.0
1	1	1	1	1		0	0.0
1	1	1	1		1	3	0.7
1	1	1		1	1	0	0.0
1	1		1	1	1	0	0.0
1		1	1	1	1	3	0.7
	1	1	1	1	1	0	0.0
1	1	1	1	1	1	0	0.0