

Contact sensitization to florists' chrysanthemums and marguerite daisies in Denmark: A 21-year experience

Evy Paulsen  | Klaus E. Andersen 

Department of Dermatology and Allergy
Centre, Odense University Hospital, University
of Southern Denmark, Odense, Denmark

Correspondence

Evy Paulsen, Department of Dermatology and
Allergy Centre, Odense University Hospital,
J.B.Winslows Vej 4, Entrance 1, 7th floor, DK-
5000 Odense C, Denmark.
Email: evy.paulsen@rsyd.dk

Abstract

Background: Both florists' chrysanthemums (*Chrysanthemum* cultivars) and marguerite daisies (*Argyranthemum frutescens* [L.] Sch.Bip. and its varieties and cultivars) are popular ornamental plants in Denmark.

Objectives: To present results of aimed patch testing with chrysanthemum and marguerite daisy extracts in Danish patients with Compositae sensitization.

Methods: The results of patch testing with chrysanthemum extract 3% petrolatum (pet.) and marguerite daisy extract 3% pet. (and possibly 1% pet.) from 1998 to 2019 were analyzed.

Results: Altogether, 111/191 (58%) patients tested positive to chrysanthemum extract and 104/179 (58%) tested positive to marguerite daisy. The majority was recreationally exposed, and most reactions were considered relevant. Feverfew extract 1% pet., Compositae mix 5% or 6% pet., or parthenolide 0.1% pet. may cross-react with chrysanthemum; Compositae mix seems to be best at detecting sensitization to marguerite daisy.

Conclusions: In areas where exposure to chrysanthemum or marguerite daisies is prevalent, it is suggested to include extracts of these plants in the plant series to improve diagnosis of, and advice to, Compositae-allergic patients.

KEYWORDS

allergic contact dermatitis, *Argyranthemum frutescens*, Asteraceae, *Chrysanthemum*, Compositae, marguerite daisy, patch testing

1 | INTRODUCTION

Florists' chrysanthemums are flowering plants of the genus *Chrysanthemum*, tribe Anthemideae, in the Compositae (Asteraceae) family (Figure 1). Originally native to East China and Japan, they are today popular ornamental plants in large parts of the world, notably Asia, Europe, and North America.^{1,2} Chrysanthemums are used as both cut flowers and potted plants as well as in gardening for herbaceous borders. Most chrysanthemum cultivars are hybrids/chimeras developed from *Chrysanthemum indicum* L. (formerly known as *Dendranthema indicum* [L.] Des Moul) and *Chrysanthemum morifolium* Ramat.

(*Dendranthema morifolium* [Ramat.] Tzvelev).^{3,4} Owing to such biological variability, the phytochemical profile may differ between cultivars.

The first case of contact dermatitis from a *C. indicum* cultivar was reported in 1904 in a female gardener, whereas the first patch test with leaves and stem of the plant was performed in the 1930s.³ Several case reports followed, and more case series from both Europe and Japan were reported subsequently.^{3,5-9} Hausen and Schulz reported that chrysanthemum was the most important sensitizer among occupationally exposed persons in Northern Germany, and McGovern and Barkley stated that chrysanthemums caused more occupational dermatitis than any other Compositae species.^{2,3,10}

Marguerite daisy (*Argyranthemum frutescens* [L.] Sch.Bip.), native to the Macaronesian islands (found in Madeira, Selvagens, and Canary archipelagos), has become a very popular summer plant in Denmark, where it is planted in pots, containers, and window boxes (Figure 2).¹¹ The first reports of contact sensitization to daisies appeared in 1998 and 2001 in occupationally and non-occupationally exposed persons in Denmark, respectively. Among 190 consecutively tested persons with Compositae sensitization, 89 were patch tested with a marguerite daisy extract, with 66 (74%) found to be patch test positive.^{7,12}

As both chrysanthemums and marguerite daisies are commonly cultivated and may be important sensitizers, we report our results with aimed patch testing with extracts of these plants in Compositae-sensitive patients with special reference to cross-reactivity.

2 | MATERIALS AND METHODS

Short ether extracts of unidentified *C. indicum* and marguerite daisy cultivars were incorporated into petrolatum (pet.) at a concentration of 3% (and additionally 1% for marguerite daisy) at the pharmacy of Odense University Hospital and tested in controls as previously reported.⁷ The concentration of 3% was chosen because of our experience with a syringe of chrysanthemum cultivar extract 3% pet., kindly supplied by the late Professor B.M. Hausen and used prior to the making of our own extract.

The extracts were tested in patients with known Compositae sensitization as well as in patients with suspected Compositae contact allergy. Only results from the former group will be presented here. The baseline series included the following Compositae allergens and extracts: sesquiterpene lactone mix (SL mix) 0.1% pet. from February 1990 (Trolab, Hermal, Reinbek, Germany and in recent years allergEaze; SmartPractice, Phoenix, Arizona, parthenolide 0.1% pet. from January 1995 (first prepared at the hospital pharmacy in Odense, later provided by Chemotechnique Diagnostics [Vellinge, Sweden]), parthenolide 3 µg/cm² from October 2015 (allergEaze), and Compositae mix II 2.5% pet. from January 2015 (Chemotechnique

Diagnostics). Furthermore, the original Compositae mix 6% pet., consisting of ether extracts of arnica (*Arnica montana* L.) 0.5% pet., German chamomile 2.5% pet. (*Matricaria chamomilla* L.), yarrow 1.0% pet. (*Achillea millefolium* L.), tansy 1.0% pet. (*Tanacetum vulgare* L.), and feverfew 1.0% pet. (*Tanacetum parthenium* [L.] Sch.Bip.), from Trolab was included in the baseline series from October 1998 to April 2001.

The patch test materials were applied to the back for 2 days using Finn Chambers (Epitest, Helsinki, Finland) on Scanpor (Norgesplaster, Oslo, Norway) and more recently using Finn Chambers on Scanpor (SmartPractice). Readings were performed on day (D) 3 or D4, and D7 whenever possible, according to the latest guidelines.¹³ The χ^2 test and Fisher's exact test were used for statistical comparisons between frequencies, and the level of significance (P) was set at .01.

3 | RESULTS

In the period from February 1998 to February 2019, 191 Compositae-sensitive patients were patch tested with chrysanthemum extract 3% pet., and 111 (58%) had positive reactions. Likewise, 179 Compositae-sensitive patients were patch tested with the marguerite daisy extracts 3% and/or 1% pet. (only 13 patients were tested with the latter and nine had positive reactions), and 104 (58%) were patch test positive. Altogether, 108 patients were tested with both chrysanthemum and marguerite daisy extracts, and the majority (n = 90, 83%) had positive patch test reactions to both.

The 111 chrysanthemum-positive patients comprised 94 females (85%) with a mean age of 55 years, and 17 males (15%) with a mean age of 60 years. The majority of the positive chrysanthemum reactions (n = 91, 82%) were considered to be of current or old relevance, whereas seven were of unknown relevance, and 13 were not documented. The 80 chrysanthemum-negative patients comprised 62 females (77.5%) and 18 males (22.5%), and in both genders the mean age was 56 years. The results of patch testing with selected Compositae extracts and allergens in patients with positive and negative chrysanthemum reactions are presented in Table 1.

The 104 patients sensitized to marguerite daisy comprised 89 females (86%) with a mean age of 53 years, and 15 males (14%) with a mean age of 60 years. The patch test reactions were considered to be of current/old relevance in 80 patients (77%), unknown in 14 patients, and not documented in 10 patients.

Altogether, 28 patients were partly/possibly/definitely occupationally sensitized to Compositae, including 10 with lettuce exposure. However, only five were exposed mainly to marguerite daisies, and three were exposed to chrysanthemums, and another to chrysanthemum and marguerite daisies at a nursery and later at a flower shop. Several patients had a mixed Compositae exposure, being flower arrangers, florists, and persons working in gardens, parks, or in agriculture sectors. Table 2 shows the results of patch testing with selected Compositae extracts and allergens in those exposed to marguerite daisies or chrysanthemums, respectively, and, for comparison, some florists with a mixed exposure to Compositae plants.



FIGURE 1 Cultivar of florists' chrysanthemum. Photograph: Grafik og Klinisk Foto, Odense Universitetshospital, Odense, Denmark



FIGURE 2 Marguerite daisy (*Argyranthemum frutescens* [L.] Sch. Bip.) cultivar. Photograph: Grafik og Klinisk Foto, Odense Universitetshospital, Odense, Denmark

4 | DISCUSSION

The prevalence of sensitization is high for both plant extracts. For chrysanthemum, a study of the first 8 years (1990 to 1998) with systematic Compositae screening at our department showed a prevalence of positive chrysanthemum reactions of 72% (83/115).⁷ The lower prevalence in the present study may reflect that comparatively fewer patients have been tested in the past 21 years. Reports on the prevalence of positive patch test reactions to chrysanthemums in a general patch test population are scarce: Roed-Petersen and Hjorth detected one positive reaction to *Chrysanthemum* spp. (oleoresin in pet.) tested in 23 persons as part of the baseline series.¹⁴ By aimed patch testing, the prevalence of positive chrysanthemum reactions—for both occupationally and recreationally exposed cases—has been reported to range between 45% and 72% in Europe.^{6,7,15} In an Indian study, 52% of 62 patients suspected of chrysanthemum contact dermatitis tested positive.¹⁶ In another Indian study of 75 patients suspected of contact dermatitis, six (8%) had positive patch test reactions to chrysanthemum, which placed the plant in the top 5 of allergens eliciting positive reactions.¹⁷

According to Hausen and Oestmann,¹⁸ chrysanthemum sesquiterpene lactones elicited positive reactions most frequently among 64 flower market vendors with occupational dermatitis. In a Danish study on 25 gardeners with Compositae sensitization, 13 of 16 (81%) were patch test positive to the German chrysanthemum extract and six of seven positive to the Danish chrysanthemum extract.¹² Previously, the paucity of reports on chrysanthemum dermatitis in Japan, where chrysanthemum is the national flower, has been ascribed to ingestion of young chrysanthemum plants as salad as well as floating the flower on soup, inducing oral tolerance.^{1,19} However, in a Japanese study on chrysanthemum growers, the prevalence of positive reactions to a chrysanthemum leaf extract rose from 27.3% in 1976 to 43.3% in 1982.⁸ By contrast, Ueda et al, in their study on 58 male and 47 female chrysanthemum farmers in Japan, reported 5% positive reactions among males and 17% among females patch tested with six different chrysanthemum cultivars.⁹ As most of the Japanese cases seem to be occupational, the theory of oral tolerance may still be true: the balance between tolerance because of ingestion and cutaneous sensitization may be tipped in favor of sensitization when the exposure is heavy.¹⁹⁻²³ In conclusion, despite differences in patch test materials, the prevalence of positive reactions seems to be high by aimed patch testing. This may reflect a high level of exposure, a strong sensitizing potential, a high degree of cross-reactivity, or a combination of these three explanations. The numerous case reports from occupational settings—reviewed by Hausen and Schulz up to 1973³—and the fact that more than 30% of occupationally exposed become affected emphasize the importance of intense exposure.^{1,18-22,24,25} As pointed out by Schmidt and Kingston,²⁶ amateur gardeners may also be affected because of years of exposure; this is indeed the case for most patients in our study.

Concerning the sensitizing potential of chrysanthemum, there is experimental evidence to classify chrysanthemum as a strong sensitizer, surpassing both arnica and sunflower (*Helianthus annuus* L.).¹⁰ Several sesquiterpene lactones have been detected in chrysanthemum: the main allergen seems to be arteglin A, a guaianolide sesquiterpene lactone with an epoxy group, isolated by Hausen et al.^{1,27-29} Incidentally, arteglin A was suggested as one of the allergens for a new SL mix.³⁰

Concerning cross-reactivity, Schulz et al, in their combined experimental clinical and animal study on allergens from florists' chrysanthemum, showed reciprocal cross-reactions between chrysanthemum and parthenolide, and cross-reactivity between chrysanthemum and alantolactone, but not reciprocally, although neither of these

TABLE 1 Results of patch testing with selected Compositae allergens and extracts in Compositae-sensitive patients with or without sensitization to chrysanthemum extract

Allergen	Feverfew 1% pet.	PTH 0.1% pet.	SL mix 0.1% pet.	CM 5 or 6% pet.
Chrysanthemum-positive patients	98/100 (98%)*	93/110 (85%)**	89/111 (80%)**	106/108 (98%)**
Chrysanthemum-negative patients	36/71 (51%)**	31/80(39%)**	31/80 (39%)**	61/79(77%)*

Note: Data are presented as number of patients positive/tested (%).

Abbreviations: CM, Compositae mix; PTH, parthenolide; SL mix, sesquiterpene lactone mix.

* $P < .00001$ by Fisher's exact test; ** $P < .00001$ by χ^2 test.

TABLE 2 Distribution of selected patch test results in persons occupationally sensitized to marguerite daisies, chrysanthemums, or mixed Compositae plants

Patient no	Sex/age	Occupation	Chrys. 3% pet.	Marg. 3% pet.	SL mix 0.1% pet.	PTH 0.1% pet.	CM 5 or 6% pet.	Feverfew 1% pet.
1	F/39	Gardener (M)	?+	+	++	++	++	++
2	F/21	Greenhouse worker (M)	–	+	–	–	+	?+
3	F/36	Home help (previous work with M)	NT	++	–	–	++	?+
4	F/28	Greenhouse worker (M)	–	++ ++ 1% pet.	–	–	?+	–
5	F/55	Gardener (M)	–	++ + 1% pet.	?+	+	+	?+
6	F/34	Gardener/florist (C and M)	++	+++ ++ 1% pet.	++	++	++	++
7	F/55	Florist	++	+	++	++	++	++
8	M/42	Gardener (C)	++	++ ? + 1% pet.	?+	+	+	++
9	M/84	Pensioner/florist	++	++	++	+	++	++
10	F/48	Greenhouse worker (C)	++	+	?+	?+	+++	++
11	F/51	Florist	++	++	++	++	+++	NT
12	F/55	Florist	++	++	+++	++	+++	+++

Note: (C) or (M) means that the patient has been exposed mainly to chrysanthemum (C) or marguerite daisy (M).

Abbreviations: Chrys., chrysanthemum extract 3% pet.; CM, Compositae mix 5% or 6% pet.; Marg., marguerite extract 3% pet.; NT, not tested; PTH, parthenolide 0.1% pet.; SL mix, sesquiterpene lactone mix 0.1% pet.; –, negative reaction; ?+, doubtful reaction.

sesquiterpene lactones could be detected in the plants.²⁷ Thus, 10 of 15 guinea pigs sensitized to the florists' chrysanthemum had positive patch test reactions to parthenolide, whereas only two tested positive to alantolactone. In five chrysanthemum-sensitive persons, four tested positive to parthenolide 0.1% ethanol (eth.) and 1% to 0.5% eth.; only two persons had positive patch test reactions to alantolactone 1% and 0.5% eth.²⁷ These findings are in accordance with the clinical observations reviewed by Schmidt and Kingston²⁶ who reported that cultivar-specific sensitization, because of phytochemical variability, may cause false-negative patch test reactions in chrysanthemum-allergic persons, and that this may be avoided by patch testing with an ether extract of the parthenolide-containing feverfew plant. In a previous study from our department,⁷ only 32% of chrysanthemum-negative individuals were positive to parthenolide compared with 85% of chrysanthemum-positive persons, which was a highly significant difference.

A similar difference was found in the present study, not only for parthenolide, but also for feverfew extract, Compositae mix (which contains either feverfew or parthenolide), and SL mix (Table 1). Even though the cross-reactivity between alantolactone and florists' chrysanthemum was modest in experimental studies,²⁷ it may contribute to the cross-reactivity with SL mix together with cross-reactions between the guaianolides artemisin A from chrysanthemum and dehydrocostus lactone from the SL mix, and cross-reactions between the germacranolides parthenolide and costunolide from the SL mix. Some of the patients were tested on separate occasions, and as patch testing may boost sensitivity, this could be a contributory factor to the high prevalence of positive reactions to the four allergens and

extracts, respectively, in Table 1. Another explanation is that most Compositae-sensitive patients have been exposed to a wide range of Compositae species and are broadly sensitized in an individual pattern. Broadly sensitized persons will react to most allergens and extracts. A high concordance between positive reactions in clinical studies may thus reflect both cross-reactivity and co-sensitization. In general, the patients with negative chrysanthemum reactions seemed to be less sensitive. However, it may be concluded from Table 1 that Compositae mix, feverfew extract, parthenolide, and to a lesser degree SL mix are most often positive in patients with chrysanthemum sensitization.

The preponderance of females is typical for Compositae-sensitive patients in our area.³¹ Likewise, the mean age for both genders, although higher than those reported in the first 8 years,³² is characteristic of Compositae-sensitive patients who are often middle-aged or elderly.³³ The slightly lower mean age in female patients sensitive to marguerite daisies probably reflects the inclusion of young gardeners and greenhouse workers occupationally exposed to this species.

The prevalence of positive patch test reactions to marguerite daisy is lower than that previously reported from our department.⁷ However, it parallels the prevalence of positive reactions to the chrysanthemum extract, and most of the reactions were relevant. In occupationally sensitized patients, prevalences of 65%–73% have been reported.^{7,12} In the present study, most of the reactions were found in non-occupationally exposed, and the question is whether the reactions represent primary sensitization or cross-reactivity. Patients 1 to 5 in Table 2 have worked primarily with marguerite daisies, which implies intense exposure to the plants: patient 2 reported that she handled

12 000 to 14 000 cuttings per day. Obviously, these patients are narrowly sensitized to marguerite daisies with sometimes strong reactions to both the 3% and 1% extracts, but few or weak reactions to other Compositae allergens and extracts, notably the screening allergens SL mix and parthenolide (Table 2). The Compositae mix was best at picking up sensitization, but in some cases this mix was negative as well, making it necessary to test with an extract of the plant to detect the sensitization. The allergens of marguerite daisy are unknown. Although sesquiterpene lactones have been isolated from other *Argyranthemum* species, no data on their occurrence in *A. frutescens* (L.) Sch.Bip. have been published.¹¹ Cross-reactivity to chrysanthemum does not seem to be the rule based on our results (Table 2). Nevertheless, the number of individuals with marguerite daisy sensitization of unknown relevance was two times as high as that for chrysanthemum-sensitive individuals, so some of the reactions to marguerite daisy are probably caused by cross-reactivity. It is also evident from Table 2 that florists with mixed exposure and middle-aged or elderly gardeners, who are probably recreationally exposed as well, are broadly sensitized and hence have more positive reactions.

In conclusion, more than half of the Compositae-allergic patients were sensitized to chrysanthemum and/or marguerite daisy. Contrary to previous reports on chrysanthemum contact allergy, most of the patients were non-occupationally sensitized to both chrysanthemum and marguerite daisy. The majority of the reactions were considered relevant, which, combined with experimental studies on the sensitizing potential of chrysanthemums, and the fact that both plants need manual "disbudding", suggests that both plants are important sensitizers. Chrysanthemum and marguerite daisy extracts are not commercially available; however, feverfew extract 1% pet., Compositae mix 5% or 6% pet., and to a lesser degree, parthenolide 0.1% pet. may cross-react with chrysanthemum, and Compositae mix 5% or 6% pet. seems to be the best extract to detect sensitization to marguerite daisy. However, in occupationally exposed persons, it may be necessary to test with an ether extract of marguerite daisy 3% or 1% pet. as cross-reactions to other Compositae extracts and allergens are unreliable in narrowly sensitized individuals. In areas where exposure to chrysanthemums and marguerite daisies is prevalent, it is worthwhile to include extracts of these species in the plant series to improve the diagnosis of, and advice to, Compositae-sensitive patients.

CONFLICTS OF INTEREST

K.E.A. is advisor for SmartPractice. E.P. has previously been principal investigator for SmartPractice.

ORCID

Evy Paulsen  <https://orcid.org/0000-0001-9738-6613>

Klaus E. Andersen  <https://orcid.org/0000-0002-6181-824X>

REFERENCES

1. Hausen BM, Vieluf IK. *Allergiepflanzen-Pflanzenallergene: Handbuch und Atlas der allergie-induzierenden Wild- und Kulturpflanzen. Kontaktallergene. Allergische Frühreaktionen*. 2nd ed. Landsberg/München: ecomed Verlagsgesellschaft mbH; 1997.
2. McGovern TW, Barkley TM. Botanical briefs: chrysanthemums-*Dendranthema* spp. *Cutis*. 1999;63:319-320.
3. Hausen BM, Schulz KH. Chrysanthemen-Allergie. *Berufsdermatosen*. 1973;21:199-214.
4. Schmidt RJ. When is a chrysanthemum dermatitis not a *chrysanthemum* dermatitis? The case for describing florists' chrysanthemums as *Dendranthema* cultivars. *Contact Dermatitis*. 1985;13:115-119.
5. Mitchell JC, Rook A. *Botanical Dermatology. Plants and Plant Products Injurious to the Skin*. Greengrass: Vancouver; 1979.
6. Hausen BM. A 6-year experience with Compositae mix. *Am J Contact Dermatitis*. 1996;7:94-99.
7. Paulsen E, Andersen KE, Hausen BM. Sensitization and cross-reaction patterns in Danish Compositae-allergic patients. *Contact Dermatitis*. 2001;45:197-204.
8. Bando A, Imura T, Inoue H, Fujita T, Takeda Y. 菊栽培農業者にみられるアレルギー性接触性皮膚炎の研究 [A study of allergic contact dermatitis caused by chrysanthemums on growers]. *J Jpn Assoc Rural Med*. 1982;31:641-649.
9. Ueda A, Aoyama K, Fujita Y, et al. 菊栽培従事者におけるアレルギー症状とその要因に関する研究 [Survey on allergic symptoms and their pathogenesis in chrysanthemum growers]. *J Jpn Assoc Rural Med*. 1986;35:55-66.
10. Hausen BM. The sensitizing capacity of Compositae plants III. Test results and cross-reactions in Compositae-sensitive patients. *Dermatologica*. 1979;159:1-11.
11. González AG, Bermejo Barrera J, Díaz JG, Zaragoza Garcia T, de Paz PP. Distribution of acetylenes and sesquiterpene lactones in *Argyranthemum* from Tenerife. *Biochem Syst Ecol*. 1988;16:17-21.
12. Paulsen E, Søgaard J, Andersen KE. Occupational dermatitis in Danish gardeners and greenhouse workers (III). Compositae-related symptoms. *Contact Dermatitis*. 1998;38:140-146.
13. Johansen JD, Aalto-Korte K, Agner T, et al. European Society of Contact Dermatitis guideline for diagnostic patch testing- recommendations on best practice. *Contact Dermatitis*. 2015;73:195-221.
14. Roed-Petersen J, Hjorth N. Compositae sensitivity among patients with contact dermatitis. Value of Compositae oleoresins in a standard test series. *Contact Dermatitis*. 1976;2:271-281.
15. Fernández de Corres L. Contact dermatitis from *frullania*, Compositae and other plants. *Contact Dermatitis*. 1984;11:74-79.
16. Sharma SC, Tanwar RC, Kaur S. Contact dermatitis from chrysanthemums in India. *Contact Dermatitis*. 1989;21:69-71.
17. Singhal V, Reddy BSN. Common contact sensitizers in Delhi. *J Dermatol*. 2000;27:440-445.
18. Hausen BM, Oestmann G. Untersuchungen über die Häufigkeit berufsbedingter allergischer Hauterkrankungen auf einem Blumengrossmarkt. *Derm Beruf Umwelt*. 1988;36:117-124.
19. Sugai T, Takahashi Y, Okuno F. Chrysanthemum dermatitis in Japan. *Contact Dermatitis*. 1980;6:155.
20. Tanaka T, Moriwaki S-I, Horio T. Occupational dermatitis with simultaneous immediate and delayed allergy to chrysanthemum. *Contact Dermatitis*. 1987;16:152-154.
21. Kuno Y, Kawabe Y, Sakakibara S. Allergic contact dermatitis associated with photosensitivity, from alantolactone in a chrysanthemum farmer. *Contact Dermatitis*. 1999;40:224-225.
22. Fujii S, Washio K, Masaki T. Case report of chronic actinic dermatitis accompanied by ultraviolet A photosensitivity in a *Chrysanthemum* farmer. *J Dermatol*. 2019;46:e229-e230.
23. Mak RKH, White IR, White JML, McFadden JP, Goon AJT. Lower incidence of sesquiterpene lactone sensitivity in a population in Asia

- versus a population in Europe: an effect of chrysanthemum tea? *Contact Dermatitis*. 2007;57:163-164.
24. Obtulowicz A, Antoszczyk G, Wojas-Pelc A. Air-borne dermatitis from *Chrysanthemum*- case report with a discussion of diagnostic procedures and therapy. *Ann Agric Environ Med*. 2014;21:531-533.
 25. Nahas O, Colomb S, Demoly P, Bourrain JL. Protein contact dermatitis to chrysanthemum. *J Investig Allergol Clin Immunol*. 2017;27:318-319.
 26. Schmidt RJ, Kingston T. Chrysanthemum dermatitis in South Wales; diagnosis by patch testing with feverfew (*Tanacetum parthenium*) extract. *Contact Dermatitis*. 1985;13:120-121.
 27. Schulz KH, Hausen BM, Wallhöfer L, Schmidt-Löffler P. Chrysanthemen-Allergie 2. Experimentelle Untersuchungen zur Identifizierung der Allergene. *Arch Derm Forsch*. 1975;251:235-244.
 28. Hausen BM, Schulz KH. Chrysanthemum allergy III. Identification of the allergens. *Arch Derm Res*. 1976;255:111-121.
 29. Schmalte HW, Klaska KH, Jarchow O. Die Kristall- und Molekülstruktur von Arteglasin A, 8 α -Acetoxy-3,4-epoxy-4 ξ -guaia-1 (10), 11(13)-dieno-6 α ,12-lacton. *Acta Crystallogr*. 1977;B33:2213-2217.
 30. Jacob M, Brinkmann J, Schmidt TJ. Sesquiterpene lactone mix as a diagnostic tool for Asteraceae allergic contact dermatitis: chemical explanation for its poor performance and Sesquiterpene lactone mix II as a proposed improvement. *Contact Dermatitis*. 2012;66:233-240.
 31. Paulsen E, Andersen KE. Clinical patterns of Compositae dermatitis in Danish monosensitized patients. *Contact Dermatitis*. 2018;78:185-193.
 32. Paulsen E, Andersen KE, Hausen BM. An 8-year experience with routine SL mix patch testing supplemented with Compositae mix in Denmark. *Contact Dermatitis*. 2001;45:29-35.
 33. Ross JS, du Peloux Menagé H, Hawk JLM, White IR. Sesquiterpene lactone contact sensitivity: clinical patterns of Compositae dermatitis and relationship to chronic actinic dermatitis. *Contact Dermatitis*. 1993;29:84-87.

How to cite this article: Paulsen E, Andersen KE. Contact sensitization to florists' chrysanthemums and marguerite daisies in Denmark: A 21-year experience. *Contact Dermatitis*. 2020;82:18-23. <https://doi.org/10.1111/cod.13395>