

Dicaprylyl maleate – an emerging cosmetic allergen

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Dicaprylyl maleate (DCM) has been reported rarely as a cause of allergic contact dermatitis. The objectives of this study were to identify patients from multiple centres with allergy to DCM in cosmetic products confirmed by patch testing and, in addition, to investigate the effect of testing with aged DCM. This is an international multicentre study of 22 patients with 26 reactions to products containing DCM. Patch testing was carried out to ingredients including DCM obtained from the manufacturer. Further testing was carried out with deliberately aged DCM in a sample of patients. 22 patients had clinical and positive patch test reactions at 4 days to a total of 26 cosmetic products containing DCM. 5 patients did not react to DCM prepared by the manufacturer from concurrent factory stock but did have positive reactions to a deliberately aged batch of DCM. DCM is an emerging cosmetic allergen. Testing with aged material yields a greater number of positive results. Co-operation between cosmetics manufacturers and clinicians is important in the identification of new allergens.

Key words: ageing; allergic contact dermatitis; cosmetics; dicaprylyl maleate; dioctylmaleate; patch test. © Blackwell Munksgaard, 2007.

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Dicaprylyl maleate (DCM), also known as dioctyl maleate, is a synthetic diester of capryl alcohol and maleic acid (Fig. 1). It has been used as an emollient and solvent in cosmetic products for the past 10 years. Original chemical testing demonstrated low irritancy potential and no induction of allergic contact dermatitis (ACD) (1). Since then ACD to DCM in moisturizers has been reported by two authors (2–4). We now report a large series of patients from multiple centres with clinical and positive patch test reactions to cosmetic products containing DCM along with positive patch test reactions to DCM.

Patients and Methods

The subjects were 22 patients from 18 dermatology clinics in the UK and Finland. They were

suspected of having ACD to a total of 26 cosmetic products containing DCM, including moisturizing products, fake tanning lotions, foundation and sunscreen products, during a 4 year period (2001–2005). The subjects were all female. They were identified by reports from their dermatologists to a major cosmetics manufacturing company (Boots the Chemist) whose products were implicated in 23 of the 26 reactions.

All patients had patch testing performed to their original product and the product ingredients including DCM as supplied by the manufacturer, with results read at 2 and 4 days. In 18 cases, the patients were tested to DCM prepared from concurrent factory stock and diluted in petrolatum. 6 of these patients, who had negative reactions to DCM on this initial testing, went on to have

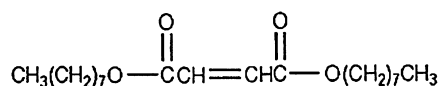


Fig. 1. Chemical formula of dicaprylyl maleate.

further testing to a sample of deliberately aged DCM, exposed to air and light for a minimum of 2 months and then diluted in petrolatum. 4 patients were tested from the outset with aged DCM rather than DCM from concurrent factory stock.

20 control patients were tested to aged DCM. These were consecutive patients in patch test clinics who gave their consent for control testing.

Results

Table 1 gives details of the 22 cases. 22 patients had clinical and positive patch test reactions at 4 days to a total of 26 cosmetic products containing DCM. 18 of the 22 patients were tested with DCM prepared from the manufacturer's concurrent factory stock. 10 of these 18 patients had positive patch test reactions at 4 days to this preparation of DCM. 6 of the 8 patients with a negative reaction to patch testing went on to have testing to the deliberately aged DCM. The other 2 patients declined further testing. Of the 6 patients who had the further testing, 5 had positive reactions to the aged DCM, 1 after a 5 day repeat open application test and 4 after patch tests. Therefore, overall, 5 of the 22 patients did not react to DCM prepared by the manufacturer from concurrent factory stock but did have positive reactions to a deliberately aged batch of DCM.

4 patients were tested from the outset with aged DCM rather than concurrent factory stock because these patients were identified after our initial findings suggested that aged DCM was more likely to produce a positive result. Results were positive in all 4 cases.

Positive patch test reactions occurred at varying concentrations of DCM, up to 10% in petrolatum. In 5 cases the reaction was only seen at 10%, not at lower concentrations. Although our information on concentration is incomplete in 6 cases, we know that 10% was the maximum concentration supplied for testing.

Figure 2 illustrates an example of an open application test carried out by a patient herself with one of the fake tanning products.

See Fig. 3 for reactions to serial dilutions of DCM in petrolatum.

One of the patients (no. 9) who had initially reacted to a sunscreen containing DCM but tested negative to concurrent stock of DCM later went

Table 1. Results of patch testing 22 patients to products and dicaprylyl maleate (DCM)^a

Patient No	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
Age (years)	48	39	42	63	62	61	56	58	36	54	72	NS	44	27	51	42	40	73	46	NS	21	79
Reaction to products	+++	++	+	++	++	++	++	++	+	+	++	+	+	+	+	+	+	+	++	+	+	+
Reaction to DCM concurrent stock	+																					
Conc	NS																					
1%																						
2%																						
4%																						
5%		+		+																		
10%		++		+	+					+												
Reaction to DCM aged sample																						
1%																						+
2%																						
5%																						+
10%																						
Outcome	Clear	Clear	Clear	Clear	NS	NS	Clear	Clear	Clear	NS	Clear	Clear	Clear	Clear	Clear	Clear	Clear	Clear	Clear	Clear	Clear	Clear

^aReaction to DCM = reaction to DCM in petrolatum, concentrations given; NS = concentration not specified (maximum 10%). Outcome = outcome after avoiding DCM-containing product(s); NS = outcome not specified.



Fig. 2. Open application test with self-tanning lotion containing dicaprylyl maleate. Note 'kissing lesion' on upper arm caused by flexing of forearm during sleep.

on to have patch testing performed to the same sunscreen when it was reformulated without DCM, and this test was negative.

The 20 control patients were tested to the aged DCM at 1% and 5%, and results were all negative.



Fig. 3. Results of patch testing at 4 days with serial dilutions of aged DCM in petrolatum. From the top down, in pairs: 0.2%, 1%, 2%, 5%, 10%.

Discussion

We have identified a relatively new agent in leave-on cosmetic products as a cause of ACD. The large, multicentre case series highlights the importance of DCM as an emerging cosmetic allergen and illustrates the benefits of co-operation between clinicians and cosmetics manufacturers in the identification of allergens. On the basis of the positive patch test results to DCM, one large cosmetics manufacturing company (Boots the Chemist) began the process of withdrawing DCM from its products in 2003. By early 2006, the reports from clinicians to this company regarding suspected contact dermatitis to the previously identified products have almost ceased, implying that the withdrawal of DCM from the products has reduced the problem of contact dermatitis.

The results also suggest that the ageing of DCM in products may contribute to its allergenicity. At present we do not know the precise mechanism responsible for this, but we postulate that oxidation or another process of degradation may be occurring. Oxidation is recognized to occur with ageing in the case of other substances such as terpenes, resulting in allergenic degradation products (5, 6). We are currently planning laboratory analysis of the aged DCM to investigate this further. We recognize that to date the numbers tested to the aged DCM are small and other explanations for the findings could be postulated, for example initial testing producing sensitization or false-positive irritant reactions occurring to the aged material. The negative control results suggest that false-positive reactions are unlikely. Ideally, we should like to test any future patients and controls with the concurrent factory stock and the aged DCM simultaneously, although since the phasing out of DCM in the products of Boots the Chemist, we have not identified any new cases that require patch testing in recent months. We should also like to perform further testing work to define the elicitation threshold. The dilutional series that was performed in our cases included 0.2%, 1%, 2%, 5% and 10% DCM. The concentration of DCM in products manufactured by Boots the Chemist ranged from 2% in skin care products to 15% in sun care products. Based on our results to date, we recommend testing suspected cases with DCM 10% in petrolatum and if possible using aged raw material.

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