J. Appl. Cosmetol. **24**, 115-122 (July/September 2006)

BIORESONANCE AS A TOOL TO PREDICT CONTACT DERMATITIS TO COSMETIC PRESERVATIVES

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Received: *July, 2006*

Key words: *Bioresonance; Cosmetic preservatives; Allergic contact dermatitis; Patch test; EAV test;*

Summary

Preservatives could be regarded as one on the main causes of cosmetic-induced contact dermatitis. In this work we evaluated the feasibility of using an unconventional diagnostic procedure based on bioelectrical skin responses referred to as Electro-Acupuncture Diagnostics according to Voll (EAV) to predict contact dermatitis to cosmetic preservatives. This technique could provide a fast, easy, non invasive and sensitive evaluation of the irritating potential of cosmetic ingredients, in addition to patch test. Five of the most commonly used preservatives in cosmetic products (methyl paraben, propyl paraben, imidazolidinyl urea, benzalkonium chloride, methylcholoroisothiazolinone/methyltioisothiazolinone) were assessed on 46 healthy human volunteers. The results obtained by the EAV bioresonance method were compared to conventional patch tests performed on the same subjects. The percentages of subjects who showed a matching response for the same preservative using both the patch test and the EAV bioresonance method ranged from 74% (methyl paraben) to 85% (benzalkonium chloride). These findings suggest that the EAV bioresonance method could represent a valuable and sensitive tool to evaluate potential contact dermatitis arising from the use of preservatives in cosmetics.

Riassunto

I conservanti possono essere considerati una delle principali cause di dermatiti da contatto causate da prodotti cosmetici. In questo lavoro è stata valutata la possibilità di utilizzare una procedura diagnostica non convenzionale basata sulle risposte biolelettriche della cute, l'elettro-agopuntura secondo Voll (EAV), per prevedere l'insorgenza di forme allergiche da contatto indotte da conservanti di uso cosmetico. Questa tecnica potrebbe consentire di ottenere una valutazione rapida, semplice, non-invasiva e sensibile del potenziale irritante di ingredienti cosmetici, in alternativa al patch test. Sono stati, quindi, testati sperimentalmente cinque dei più comuni conservanti cosmetici (metilparaben,

propilparaben, imidazolidinilurea, benzalconio cloruro e metilcloroisotiazolinone/metiltioisotiazolinone) in 46 soggetti volontari sani. I risultati ottenuti mediante il test EAV sono stati confrontati con quelli determinati mediante il patch test. Le percentuali di soggetti che hanno mostrato la stessa risposta con entrambe le tecniche variava dal 74% (metilparaben) all'85% (benzalconio cloruro). Questi risultati suggeriscono che il test EAV potrebbe essere utilizzato con successo per la valutazione delle dermatiti da contatto indotte dai conservanti impiegati nei prodotti cosmetici.

INTRODUCTION

Cosmetics and toiletries may induce several adverse effects among which irritation, contact dermatitis, photosensitivity and pigmentary changes are the most commonly reported (1,2). Cosmetic products contain many kinds of preservatives whose type, concentration and ratio vary among products, manufacturers and countries. Preservatives are regarded as a group of important contact allergens (3). Their activity depends on their chemical reactivity since the low molecular weight of these substances allows their penetration into the skin and their reaction with endogenous proteins (4). The most frequently used preservatives in cosmetic products are the parabens, followed by imidazolidinyl urea, quaternium, formaldehyde releasing preservatives and isothiazolinones (5-7). Their ability to elicit cutaneous adverse effects is routinely evaluated in humans by patch testing.

Many unconventional diagnostic procedures based on bioelectrical skin responses are widely used for allergic diseases. The perturbation of the skin electrical response is evoked by a process of bioresonance (8). According to Voll (9) the electromagnetic frequencies typical of test substances can be sent to the patient via cables and their effects on the organism can be determined by means of electro-acupuncture measurements (EAV). Previous studies showed that the EAV acupuncture technique could be regarded as useful test to evaluate food allergy (8,10). Since this diagnostic technique is fast, easy to perform and non-invasive, it could provide an alternative method to patch test to evaluated the toxicological potential of several harmful substances to which the skin could be exposed.

In this paper we assessed the feasibility of using electro-acupuncture tests according to Voll (EAV) to predict contact dermatitis to some of the most frequently used cosmetic preservatives such as methyl paraben, propyl paraben, imidazolidinyl urea, benzalkonium chloride, isothiazolinones. The results obtained by EAV measurements were compared to those obtained by means of conventional patch tests performed on healthy human volunteers.

MATERIALS AND METHODS

Materials

Imidazolidinyl urea (Gram 1) and methylchloroisothiazolinone/methyltio-isothiazolinone (Kathon CG) were a kind gift of Sinerga (Italy). Methyl paraben (MP), propyl paraben (PP) and benzalkonium chloride (BC) were bought from Galeno (Italy). Deionised water was prepared in our laboratories. Hill Top Chambers were supplied by Hill Top Research Inc. (Cincinnati, OH).

Methods

Subjects

Patch tests and EAV tests were performed on 46 healthy volunteers (both sexes, 33 women and 23 men) in the age range 18-60. The participants did not suffer from any ailment and were not on any medication at the time of the study. The volunteers were fully informed of the nature of the study and the procedure involved. They were rested for 15 min prior to the tests and room conditions were set at 22 ± 2°C and 40-50% relative humidity.

Patch tests

Six sites on the ventral surface of the forearm of each volunteer were demarcated with permanent ink using a circular template (1 cm^2). One site was used as control applying one Hill Top chamber whose cotton pad was saturated with 100 µl of deionised water.

On the other five sites, Hill Top chambers containing 100 µl of an aqueous solution of each preservative under investigation were applied. The following concentrations were used for

each preservative: MP 0,2% w/v; PP 0,2% w/v; Gram 1 0,2% w/v; Kathon CG 0,1% w/v; BC 0,1% w/v. After 24 h, the chambers were removed, the skin surfaces were gently washed with water and the induced erythema was visually scored by an observer using a 0-4 arbitrary scale codified as follows: 0, no variation; 1, slight, diffuse erythema with indistinct outline; 2, more intense erythema with half of the treated site perimeter outlined; 3, marked erythema with a distinct outline of the treated site; 4, severe erythema with a distinct outline of the treated site.

EAV tests

EAV bioresonance tests were performed using a Bicom 2000 (Brugermann GmbH, Germany) equipped with an electrodermal screening device (EDS) (Fig. 1). This instrument is basically a galvanometer that measures current variations of acupuncture points and has been used to indicate the energetic state of meridians for the diagnosis and the treatment of body disorders.

The device Bicom measures the skin conductivity at acupuncture points via two electrodes. One electrode is a brass cylinder with a large surface and has to be kept by the subject in his hand; the other electrode (stylus) has a small contact area and delivers a direct current (approximately 1 V), by applying a slight pressure at chosen skin meridian points. The body impedance between the skin point and the hand electrode is then measured: the value is shown on an analogical device with an arbitrary scale reading from 0 to 100 units.

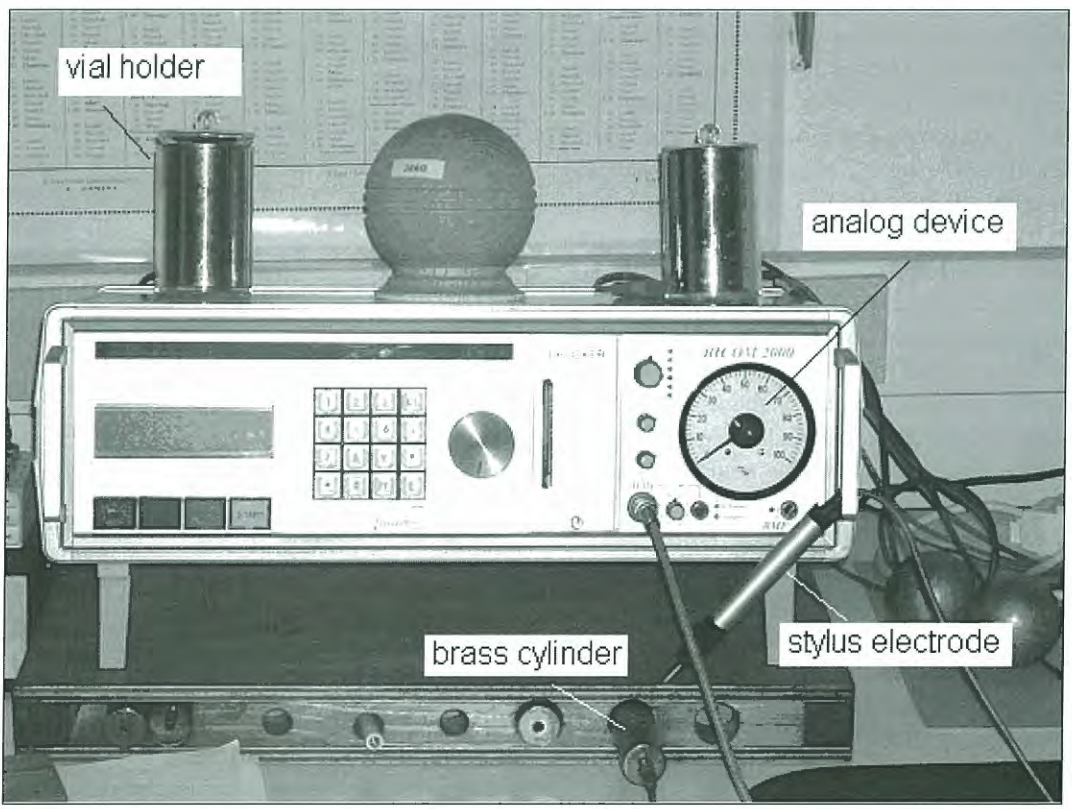

Fig. 1 The instrument Bicom 2000 used to perform EAV tests.

The operator was an experienced acupuncturist physician. As there is a great variability of skin conductivity among individuals due to a number of factors (skin thickness, humidity, blood flux), a baseline level of resistance was determined for each subject by placing a brass electrode in each hand. The subject was considered "in balance" if the instrument readings were at approximately 80% of the full scale. Subjects with readings below 70% and above 90% were disqualified from the study. Then, the level of conductivity of the terminal point of the meridian selected was measured in the absence of the test compounds, and the value was taken as the reference baseline value. A vial containing an aqueous solution of the preservative to be tested was put in a metal vial-holder electrically connected to the hand electrode via Bicom device. Skin conductivity was then measured for each of the substances placed in the vial-holder. A positive reaction to the compound being tested was recorded as a decrease from the baseline value. The same concentrations of preservatives used for the patch test were analysed.

RESULTS AND DISCUSSION

The results of patch tests performed using the cosmetic preservatives under investigation are shown in Fig. 2. Each preservative was tested at the concentration generally used in cosmetic products. The maximum score observed in our patch test was 1 for all the preservatives assayed. The induced erythema was regarded as an index of the irritation potential of the preservatives tested due to the development of irritant (nonimmunologically mediated inflammation of the skin) or allergic contact dermatitis.

Methyl- and propylparaben caused a slight skin erythema in 21,7% and 10,9% of the subjects, respectively. Although the use of paraben preservatives is very popular in cosmetics due to their broad spectrum of activity, low toxicity, regulatory acceptance, biodegradability and low cost, parabens have been reported to cause contact dermatitis in some individuals after skin exposure (11). Furthermore, parabens have been involved in several cases of cutaneous sensitisation although the mechanism of this sensitivity is still unclear (11).

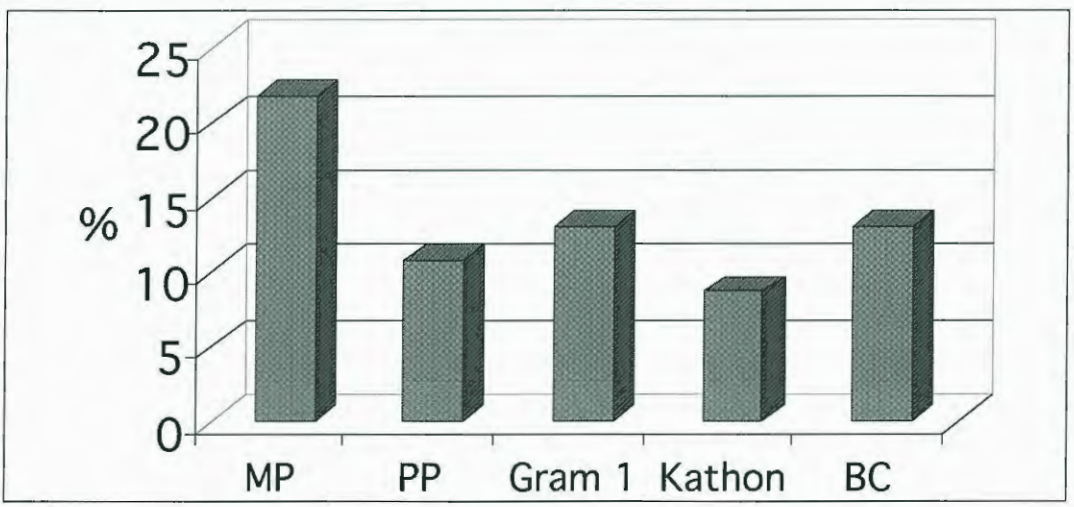

Fig. 2 Percentages of subjects showing a light erythema (score 1) after topical application of cosmetic preservatives (patch test).

In our study, propylparaben proved less irritant compared to methylparaben likely due to its higher molecular weight (MW 180,2) and hence the lower number of millimoles (1,11) applied on the skin surface with respect to methylparaben (MW 151,1; mmol 1,31).

As shown in Fig. 2, using the patch test, Kathon CG resulted the less irritant preservative since only 2,2% of the subjects showed a slight skin erythema after its topical application for 24 h. Kathon is regarded as an allergen with a prevalence of positive reactions of 3% - 8% among patients with contact dermatitis (12). However, studies on humans showed that the induction of allergic contact dermatitis was strongly dependent on Kathon concentration in the product and concentrations as high as 15 ppm in rinse-off products and 7,5 ppm in leave-on products were unlikely to elicit any sensitisation (13-14).

As regards imidazolinyl urea, our patch test results were in agreement with previous works reporting that this preservative is the safest among formaldehyde releasers (15).

Benzalkonium chloride is a cationic surfactant used as preservative in cosmetic and pharmaceutical products. Harvell et al. (16) observed that its irritation potential after topical application of a 0,5% solution is higher that that observed for a 0,5% solution of sodium lauryl sulphate. In our study BC proved as irritating as Gram1 using the patch test likely due to the low concentration used.

As shown in Fig. 3, the percentages of subjects showing a positive response using the EAV test were similar for all the assayed preservatives and ranged between 17% and 24%.

The comparison between the individual reactions observed using the patch test and the EAV technique showed that at least 70% of the responses matched for all the preservatives tested (Fig. 4). Similar findings have been reported by Tsuei at al. (10) comparing the EAV technique results with those obtained by routinely laboratory tests for the diagnosis of food allergy.

As shown in Fig. 4, some individuals gave a positive response to the patch test but not to the EAV test. However, these subjects showed a slight erythema also at the control site where a patch without preservative was applied on the skin surface.

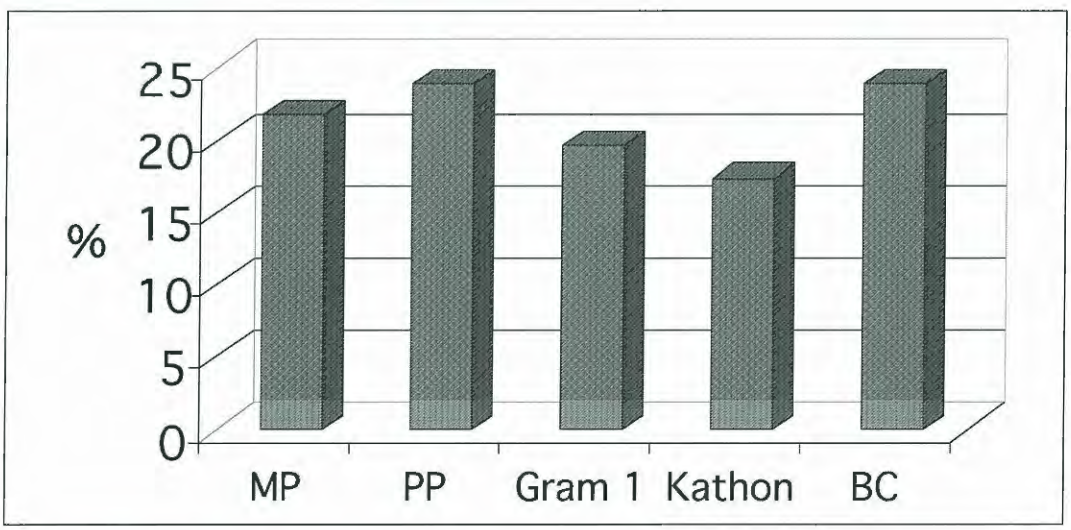

Fig. 3 Percentages of subjects showing a positive response to cosmetic preservatives using the EAV technique.

Therefore, this slight erythema could be attributed to a skin irritation caused by the patch itself rather than to the cosmetic ingredient tested.
Furthermore, some of the subjects who did not show any reaction to a given preservative using the patch test, gave a positive response using the EAV technique. These data suggest that measurements of electrical alterations of the skin may provide more sensitive evaluations of the irritation potential a topically applied substances compared to patch tests.
However, several factors such as the environmental influences, the healthy conditions of the volunteers and the diagnostician skill, need to be better investigated in order to improve EAV test's sensitivity and specificity.

CONCLUSIONS

The ability of identifying the factors that may elicit skin irritation and of performing an exact evaluation of the irritation potential of cosmetic products and their ingredients are major concerns of cosmetic manufacturers. Therefore, many tests have been developed to assess skin irritation both *in vivo* an *in vitro*.
In this paper, we evaluated the feasibility of using the EAV electro-acupuncture technique for the diagnosis of contact dermatitis to cosmetic preservatives. This technique is safe, non-invasive, time and cost saving. Furthermore, it avoids the actual contact between the patient and the substance being tested, thus eliminating the risk of adverse reactions during the test.
The results of our study suggest that the EAV technique may offer an interesting alternative to other diagnostic methods such as the patch test since the EAV data obtained showed a high degree of compatibility with the patch test. However, further studies are needed for a better comprehension of the factors affecting EAV data in order to obtain close correlations for other cosmetic ingredients so as to investigate their irritation potential by the EAV technique.

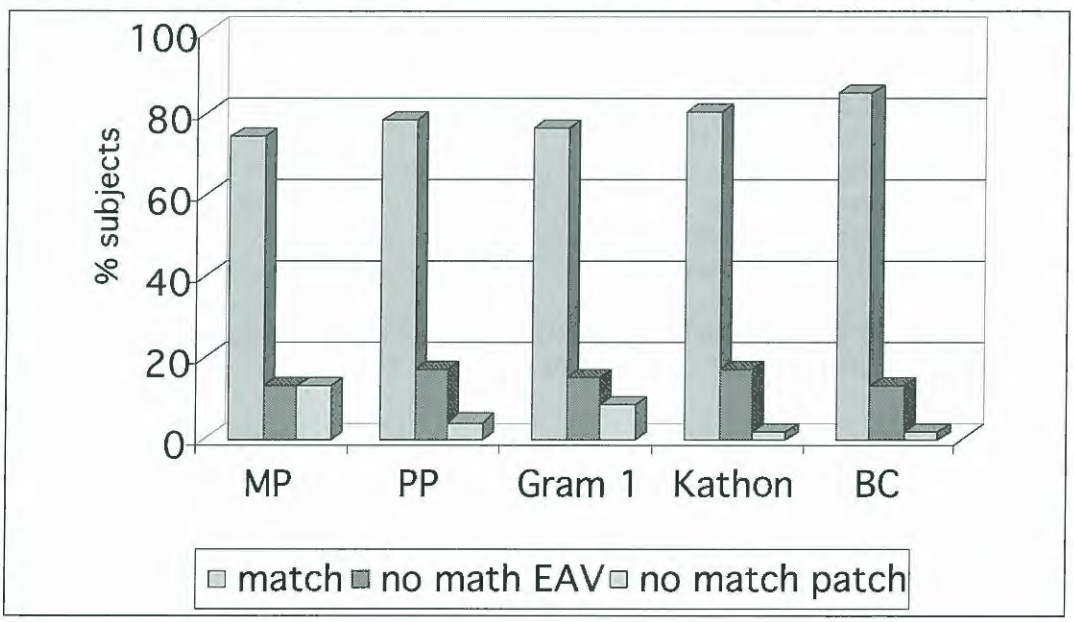

Fig. 4 *Percentages of subjects showing the same results using patch and EAV tests (match) or a positive response only to patch test (no match patch) or a positive response only to EAV test (no match EAV) for each cosmetic preservative assayed.*

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