A STUDY ON ALLERGIC REACTIONS TO VARIOUS PRESERVATIVES USED IN FOODS AND COSMETICS

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ABSTRACT

Allergic contact dermatitis (ACD) is a common occupational and environmental health issue. Fragrances and preservative agents are the most important contact allergens. But reactions also occur to category-specific products such as hair dyes and other hair-care products, nail cosmetics, sunscreens, as well as to antioxidants, vehicles, emulsifiers, and, in fact, any possible cosmetic ingredient. The reaction of such ingredients was tested by using Skin prick testing on individuals using suspect cream or lotion in order to detect the response. Once the specific allergens are identified, the subjects were informed of which products can be safely used in the future.

KEYWORDS: Allergy, fragrances, preservatives, cosmetics, skin prick testing.

1. INTRODUCTION

Cosmetics products are being used by almost every individual. They include cleansing products such as soaps, bath and shower products, shampoos and toothpaste, deodorants and make-up products. The ingredients in cosmetics may trigger allergies depending on the immune response of an individual.[1]

The cosmetic allergens involved can reach the skin in several different ways: by direct application, by occasional contact with an allergen-contaminated surface, by airborne contact (e.g., vapours or droplets), by transfer by the hands to more sensitive areas (e.g., the eyelids), by a product used by the partner (or any other person), or be photo-induced, resulting from
contact with a photo-allergen and exposure to sunlight, particularly UV-A light. An allergic contact dermatitis may sometimes spread (symmetrically) to other areas of the body not in direct contact with the allergen (id-like spread reaction); this is comparable to a reaction by systemic exposure (in which the allergen may reach the skin through the circulatory system and produce systemic contact-type dermatitis).[2]

1.1 Fragrances
Fragrances are the mixtures of different chemicals that show flavouring properties. They include Cinnamic alcohol, Cinnamic aldehyde, Eugenol, Isoeugenol, Alpha amyl cinnamic alcohol and Hydroxycitronellal.[3] Fragrances are ubiquitous in our daily lives and are present in items ranging from toiletries to toilet tissue. Although fragrances enhance the smell or mask unpleasant odors of various cosmetics and household items, it becomes very difficult for fragrance-allergic patients to find products they can use. Many items labelled unscented and fragrance-free contain esoteric fragrance chemicals that most consumers would not recognize.[4]

1.1.1 Fragrance sensitivity
Fragrance sensitivity is a condition wherein people exhibit sensitivity or allergic reactions to ingredients in perfume. The most common allergic reactions to perfume or fragrances added to products is contact dermatitis, though other symptoms may occur, including allergic conjunctivitis.[5]

1.2 Preservatives
A preservative is a substance that is added to products such as foods, paints, pharmaceuticals, biological samples, cosmetics, tires, wood, beverages and many other products to prevent decomposition by microbial growth or by undesirable changes. Of these, food and cosmetics preservatives are responsible for allergies.[6]

1.2.1 Food preservatives
Food preservatives are substances ‘that are added to food items in order to inhibit, retard or arrest the process of fermentation, acidification, and decomposition of food items’. Or, in other words, preservatives in food help keep the food safe, without spoiling, for longer.[7]

Food preservatives are classified as: Class I preservatives or the natural preservatives such as salt, sugar, vinegar, syrup, spices, honey and edible oil; Class II preservatives or the chemical
preservatives such as benzoates, sorbates, nitrites and nitrates of sodium or potassium, sulfites, glutamates, glycerides and the like. Both, natural and chemical preservatives are categorized into 3 types:

i) Antimicrobials that destroy or delay the growth of bacteria, yeast and molds. E.g. nitrites and nitrates prevent botulism in meat products. Sulfur dioxide prevents further degradation in fruits, wine and beer. Benzoates and sorbates are anti-fungals used in jams, salads, cheese and pickles.

ii) Anti-oxidants that slow or stop the breakdown of fats and oils in food that happens in the presence of oxygen (Oxidation) leading to rancidity. Examples of anti-oxidants include BHT, BHA, TBHQ, and propyl gallate.

iii) Anti-enzymatic preservatives that block the enzymatic processes such as ripening occurring in foodstuffs even after harvest. E.g. Erythorbic acid and citric acid stop the action of enzyme phenolase that leads to a brown color on the exposed surface of cut fruits or potato.\[8\]

According to the FDA, common chemical food preservatives are considered safe if the quantity of the preservative added to the food ‘does not exceed the amount required to accomplish its intended physical, nutritional, and technical effect in food’. Their level should be within the Acceptable Daily Intake (ADI).\[9\]

1.2.2 Cosmetic preservatives
Preservatives are included in cosmetic formulations to ensure that products are safe to use for a long time. They protect cosmetics from contamination by micro-organisms present in the air, in water and on our own skin.\[10\]

Cosmetics contaminated with bacteria and yeasts could cause irritations or infections, particularly on damaged or broken skin, or the sensitive areas around the eyes. To prevent this, preservatives are used. Some will require levels of only 0.1%, while others will require levels up to 5% to properly preserve the product.\[11\]

2. Methodology
Various people in the city of Visakhapatnam who suffering from various allergies were considered for this work. The cosmetics they regularly use and foods they eat frequently were taken as samples to perform the test.
Subject (Cases)
Total 20,000 cases were for about 54 months and found only 81 cases suitable for performing allergy test. The cases were numbered from case1 to case 81 who are having the following history:
i) those have allergy problem only when consuming street foods or food from hotels and curry points. At the same time they donot have any allergic history when they consume homemade food.
ii) those donot have any allergic history to insect bites, inhalants and medicines.

Food samples
Foods from various curry points and noodle points were collected and slowly given in increasing amounts within 2 hours.[12] They are numbered from FS-1 TO FS-117.

Cosmetic samples
Cosmetics such as creams, lotions, deodorants, face packs and hair dyes were collected and prepared a suspension using sterile water. They are numbered from CS-1 to CS-198.

2.1 Skin Prick Testing (SPT)
The primary mode of skin testing for immediate IgE mediated allergy. It is widely practiced, carries very low (but not negligible) risk of serious side effects to patients and provides high quality information when performed optimally and interpreted correctly. (Also called prick skin testing or PST). Skin prick testing demonstrates an allergic response to a specific allergen. SPT is a simple, safe and quick test, providing results within 15-20 minutes. In this test, a tiny amount of sample ranging from 2µl to 4µl is introduced into the skin at fore arm of a case numbering from 1 to 81, using a disposable duotip lancet and observed for the “wheal and flare” (W-F) reactions. The subject chosen had avoided anti-histamines and certain other medications before the test for about 48 hours. Two control samples are included to make sure the test has worked; one of the controls will cause a reaction in all people (positive control) and the other should not cause a reaction in anyone (negative control).[13]

3. RESULTS
Total 81 cases were studied for food (outside) and cosmetic allergies. The results are tabulated for those having atleast one positive reaction in table 3.1.
3.1 Table: Positive reactions (W-F) shown for the food sample (FS) and cosmetic samples (CS)

| CASE – 3 | FS – 3 (dal) | FS – 4 (noodles) | CS – 3 (cream) | - |
| CASE – 5 | CS – 5 (deo) | - | - | - |
| CASE – 6 | FS – 15 (dal) | CS – 6 (dye) | - | - |
| CASE – 11 | CS – 12 (deo) | - | - | - |
| CASE – 15 | CS – 17 (deo) | - | - | - |
| CASE – 19 | FS – 30 (dal) | FS – 31 (curry) | CS – 25 (cream) | - |
| CASE – 28 | FS – 50 (noodles) | FS – 51 (fried rice) | CS – 50 (cream) | - |
| CASE – 37 | FS – 62 (curry) | CS – 83 (deo) | - | - |
| CASE – 42 | FS – 68 (fried rice) | FS – 69 (curry) | CS – 96 (cream) | - |
| CASE – 48 | FS – 72 (noodles) | - | - | - |
| CASE – 52 | CS – 109 (talc) | CS – 110 (deo) | CS – 111 (cream) | CS – 112 (dye) |
| CASE – 60 | CS – 145 (dye) | - | - | - |
| CASE – 68 | FS – 99 (noodles) | CS – 163 (deo) | - | - |
| CASE – 73 | FS – 105 (curry) | FS – 106 (noodles) | CS – 170 (cream) | - |
| CASE – 77 | CS – 181 (dye) | CS – 182 (lotion) | - | - |

4. DISCUSSION

4.1 Food allergies

4.1.1 Dal: Positive reactions were observed with FS - 3, 15, 30 & 44 in case of 3, 6, 19 & 25. IgE binding proteins have been identified in majority of legumes, and allergic response to these legumes may range from mild skin reactions to anaphylactic reaction.\[14\]

4.1.2 Noodles

People with wheat allergies or gluten intolerance can respond with a variety of possible signs and symptoms, including breathing difficulties, nausea, hives, bloated stomach and an inability to focus. With some people the consumption of wheat and wheat products may result in anaphylaxis - a life-threatening allergic response. Positive reactions were observed with FS - 4, 32, 50, 72, 99 & 106 in case of 3, 20, 28, 48, 68 & 73.\[15\]

4.1.3 Curry

Curry is a mixture of vegetables, legumes and spices. So people who are allergic to legumes, preservatives used in pepper and chilli powders. Positive reactions were observed with FS-31, 33, 45, 62, 69 & 105 in case of 19, 20, 25, 37, 42 & 73.\[16\]
4.1.4 Puff
Vegetable puffs contain peanuts to which some people are allergic. Positive reactions were observed with FS-34 in case of 20.[17]

4.1.5 Manchuria
Positive reactions were observed with FS-38 in case of 23. Sauce added to the Manchuria may contain the allergens.[18]

4.1.6 Fried rice
Some people are allergic to egg or dried egg powder used in the prepared in fried rice. Positive reactions were observed with FS - 51 & 68 in case of 28 & 42.[19]

4.2 Cosmetic allergies
It is estimated that the average woman uses 12 personal care products daily, which comprise 168 unique ingredients. The average man uses six personal care products each day with 85 unique ingredients.[20] Cosmetic ingredients can be classified into several categories: fragrances, preservatives, antioxidants, vehicles, ultraviolet absorbers, humectants, emollients, emulsifiers, acrylates, hair dyes, nail polish components, and others. Preservatives and fragrances are the most frequently detected allergens. Preservatives were identified as the most common cosmetic contact allergens in several recent studies.[21,22] They can be classified into three broad categories: antimicrobials, antioxidants, and ultraviolet light absorbers. There are over 3000 different fragrances used in cosmetics today.[23]

Commonly Used Cosmetic Preservatives
Phenoxyethanol, Methylparaben, Ethylparaben, Propylparaben, Butylparaben, Isobutylparaben, Salicylic Acid, Potassium Sorbate, DMDM Hydantoin, Benzyl Alcohol, Sodium benzoate, Formaldehyde, Chlorphenism, Triclosan, Imidazolidinyl Urea, Diazolidinyl Urea, Sorbic Acid, Methylisothiazolinone, Sodium Dehydroacetate, Dehydroacetic Acid, Quaternium – 15, Stearalkonium Chloride, Zinc Pyrithione, Sodium Metabisulfite, 2-Bromo-2-Nitropropane, Chlorhexidine Digluconate, Polyaminopropyl biguanide, Benzalkonium Chloride, Sodium Sulfite, Sodium Salicylate, Citric Acid, Grape fruit Seed Extract, Neem Oil, Lactic Acid and Vitamin E (tocopherol).

Fragrances represent the second most common group of cosmetic allergens. Below is the North American Contact Dermatitis Group’s (NACDG) list of top screening allergens
associated with cosmetics in females. They are Quaternium-15, Myroxylon pereirae (balsam of Peru), Fragrance mix 1, p-Phenylenediamine, Methyl dibromo glutaronitrile / phenoxy ethanol, Formaldehyde, Tosylamide formaldehyde resin, Cocamidopropyl betaine, Glyceryl thioglycolate, Diazolidinyl urea, DMDM hydantoin, Lanolin alcohol, Imidazolidinyl urea, Methylchloroisothiazolinone/methylisothiazolinone, Methyl methacrylate, Amidoamine, Propylene glycol, DMDM hydantoin and Imidazolidinyl urea.\(^{[24]}\)

4.2.1 Cream
Positive reactions were observed with CS - 3, 25, 26, 39, 50, 96, 111 & 170 in case of 3, 19, 25, 42, 52, 73, 20 & 28.

4.2.2 Deodorant
Positive reactions were observed with CS - 5, 12, 17, 35, 83, 110 & 163 case of 5, 11, 15, 23, 37, 52 & 68.

4.2.3 Dye
Positive reactions were observed with CS - 6, 34, 112, 145 & 181 in case of 6, 23, 52, 60 & 77.

4.2.4 Lotion
Positive reactions were observed with CS – 33 & 182 in case of 23 & 77.

4.2.5 Face pack
Positive reactions were observed with CS - 40 in case of 25.

4.2.6 Talc
Positive reactions were observed with CS - 109 in case of 52.

CONCLUSIONS
Many of the specific fragrance ingredients are protected by the Fair Packaging and Labelling Act as they are considered trade secrets. It is important to think logically that products labelled as ‘preservative-free’ are exactly free from preservatives or not because without a preservative, the product cannot maintain its nature. Also products labelled as ‘unscented’, ‘hypoallergenic’, or even ‘fragrance-free’ do, in fact, contain masking fragrances. One should be aware of the cosmetic ingredients whether they are sensitive or not by observing the label.
If they have sensitive skin or a skin condition such as eczema or psoriasis, they should avoid any product that contains these known allergens.\textsuperscript{[24]}

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