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REVIEW ARTICLE

Contact Dermatitis to Foods

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Abstract. Cutaneous adverse reactions to foods and food additives are a growing public health problem which can occur both in the avocational and occupational settings. This article reviews different reaction patterns which can occur upon contact with foods and discusses some clinically important food-associated metal and fragrance allergens responsible for these adverse effects. As ultimately, education and guidance can minimize the morbidity of food allergy and enhance the quality of life of the affected individual; this article highlights this growing problem.

Key words: dermatitis, contact, foods, metals, fragrances.

DERMATITIS DE CONTACTO POR ALIMENTOS

Resumen. Las reacciones adversas de la piel que se presentan por manipulación y/o consumo de alimentos y aditivos alimenticios es un problema que está en crecimiento en el área de salud pública, y que puede ocurrir tanto en el hogar como en el ámbito ocupacional. Este artículo revisa los diferentes tipos de reacciones que pueden ocurrir por contacto con alimentos y discute algunos alérgenos, como metales y fragancias, presentes en ellos que son clínicamente importantes y responsables de dichas reacciones adversas. Por último, con educación y orientación se puede minimizar la morbilidad por alergia a alimentos y mejorar la calidad de vida del sujeto afectado; este artículo resalta este problema creciente.

Palabras clave: dermatitis, contacto, alimentos, metales, fragancias.

Introduction

Adverse food reactions are common and can occur through ingestion or inhalation, or through contact with chemicals present in the foods via the mucosa or skin.[1] Following contact with those foods, dermatitis can develop either as a result of direct or indirect exposure. Direct exposure occurs when a certain type of food is consumed (which explains the frequent involvement of the hands and perioral area). Another less obvious route of exposure is through the aerosolization of aromatic particles, for instance, during cooking of food—this can predispose to involvement of the face, including the eyelids.[2] It is important to note that exposure to foods in the domestic or work environment (bakers, professional or domestic cooks, butchers, food suppliers, and workers who handle vegetables, fruit, and spices) can be associated with increased risk in these individuals.[1,2]

In the case of indirect exposure, the allergen can be transferred via an object contaminated with a given food (for instance, through plates or cutlery or via physical contact such as kissing, etc).[1] In a study undertaken in 379 individuals with a history of food allergy, Hallett et al[3] reported that 5 % of adverse reactions to foods were associated with kissing. On the other hand, in addition to the different forms of exposure to foods, differences have also been described in the type of response to them, for instance, immunoglobulin (Ig) E-mediated (contact urticaria), T cell-mediated (allergic contact dermatitis), and nonimmune-mediated (irritant contact dermatitis and nonimmunologic contact urticaria) responses.

This article will discuss the various dermatological manifestations of contact with foods, corresponding to a broad spectrum of immunologic and nonimmunologic reactions.

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Dermatological Conditions Caused By Contact With Foods

The cutaneous effects of contact with foods include the following (Table 1):

Table 1. Dermatological Conditions Caused by Contact With Foods

Contact urticaria
Protein contact dermatitis
Irritant contact dermatitis
Allergic contact dermatitis
Phototoxic contact dermatitis
Photoallergic contact dermatitis

Contact Urticaria

There are 2 types of contact urticaria: immunologic (IgE mediated) and nonimmunologic. In immunologic contact urticaria, lipophilic substances present in certain foods penetrate the skin through the hair follicles.[1,4] The substances then interact with preformed IgE in tissue mast cells and circulating basophils, leading to activation of those cells. Histamine and other vasoactive mediators are then released, leading to an immediate reaction. This can be clinically manifested as localized or generalized urticaria, which may or may not progress to angioedema.[1,4] Other systemic symptoms include rhinitis, asthma, and anaphylactic shock.[2,4] Nonimmunologic contact urticaria is more common but rarely presents with systemic effects.[2,4] Release of histamine by direct activation of mast cells and possibly the release of prostaglandins and leukotrienes could be involved in this mechanism.[2]

The foods that are most often associated with non-immunologic contact urticaria are those that contain histamine (sauerkraut, pineapple, yeast, red wine, mature cheeses, pickled herring, and contaminated tuna) and those that cause direct release of histamine (strawberries, tomatoes, and alcohol), as well as additives present in fizzy drinks (for instance, benzoic acid and sodium benzoate), chewing gum (for instance, abietic acid and sorbic acid), and baked products such as bread and cakes (for instance, cinnamic acid and cinnamaldehyde). The foods responsible for immunologic contact urticaria include fish, shrimp, meat, eggs, spices, milk, oats, peanuts, and nuts.[1,4,5]

Diagnosis of immunologic contact urticaria can be carried out with fresh products using an open patch test, prick test, or scratch test, or by radioallergosorbent test (RAST) for specific IgE.[2,4] Notably, oral challenge with foods is often negative, since the chemical composition of the allergens is altered by the process of digestion or cooking.[2]

Protein Contact Dermatitis

Protein contact dermatitis was first described in 1976 by Hjorth and Roed-Petersen.[6] This type of contact dermatitis (distinct from urticaria) is associated with an immediate reaction, in other words, it develops rapidly (within 30 minutes) following contact with high molecular weight proteins in foods; however, the pathophysiology of this reaction is distinct and may represent simultaneous triggering of immediate (type I) and delayed (type IV) hypersensitivity reactions[1,2] in a patient in whom the protective role of the skin is altered or the skin is irritated.[4] Furthermore, some studies indicate that IgE antibodies can bind and activate Langerhans cells.[1,4,7,8]

Chronic, recurrent, or eczematous dermatitis of the hands is a common manifestation of protein contact dermatitis, since most patients with this disorder handle foodstuffs, for instance, butchers and bakers.[2] Individuals in this risk group are predisposed to frequent hand washing and working environments with a high humidity, and these practices can affect the barrier function of the skin and ultimately predispose to the condition. Likewise, Janssens et al[9] reported that 50% of patients with protein contact dermatitis presented atopic predisposition, suggesting the important role played by the skin barrier when it is damaged. In that review, the authors classified the proteins responsible for protein contact dermatitis in 4 groups: *a)* fruits, vegetables, spices, and plants; *b)* animal proteins; *c)* grains; and *d)* enzymes.

The foods that are commonly associated with protein contact dermatitis include raw seafood, eggs, and flour, and less commonly, meat, vegetables, fruits, and spices.[1,2,4] Prick tests and scratch tests are diagnostic and show severe positive reactions in response to the causative foods.[2,4] Additionally, specific IgE antibodies can be detected in blood.[1,4] The patch test is usually negative.

Irritant Contact Dermatitis

Irritant contact dermatitis is by far the most common adverse food reaction[1,2] and is the result of direct contact with a given substance without a requirement for prior sensitization. The areas with the greatest predisposition to develop this condition are the hands and face, and it is generally localized to the region in which the allergen has been in direct contact (for instance the finger pads).[1]

The foods that most commonly induce irritant contact dermatitis are spices, garlic, onion, citrus fruits, potatoes, pineapple, sweetcorn, radish, mustard, and carrots

Table 2. Irritants Found in Food

Food	*Irritant*
Pineapple juice	Bromelain
Mustard, radish, hot radish, cabbage, mustard leaves, broccoli, cauliflower, Brussels sprouts	Sinigrin → Allyl isothiocyanate
Cayenne pepper and jalapeños	Capsaicin

Table 3. Types of Food Additive[1,2,10]

Type of Additive	*Additives*
Antioxidants	Benzoin gum, butylated hydroxyanisole, butylated hydroxytoluene, sodium bisulfite, esters of gallic acid, tocopherol (vitamin E), nordihydroguaiaretic acid[a]
Bleaches	Benzoyl peroxide, ammonium and potassium sulfate
Colorants	Citrus red No. 2 (in Florida oranges), sunset yellow, curcumin, tartrazine
Emulsifying agents	Propylene glycol[b]
Stabilizing agents	Acacia (gum arabic), agar-agar, ammonium, calcium, and potassium alginate, carob gum, carrageenan gum, ghatti gum, guar gum, sterculia gum (karaya gum), gum tragacanth
Preservatives	Parabens, sorbic acid, calcium propionate, citric acid, guar gum, monoglyceride citrate, sodium benzoate
Flavor enhancers	Anethole, D- or L-carvone, cinnamaldehyde, citral, eugenol, geraniol, limonene, vanillin

[a]Not currently used in foods in the USA.[10]
[b]Propylene glycol is the only emulsifier that acts as a sensitizing agent.[10]

Figure. Perioral dermatitis caused by mango. (Image provided courtesy of Dr Golara Honari.)

(Table 2).[1,2] The food additives that can trigger irritant contact dermatitis include acetic acid, ascorbic acid, calcium acetate, calcium sulfate, lactic acid, potassium bicarbonate, potassium iodide, potassium bromate, and yeasts.[2]

Allergic Contact Dermatitis

Allergic contact dermatitis is defined as a type IV delayed hypersensitivity reaction and can be triggered by "natural" foodstuffs (for instance cinnamic acid and tomatoes) or contaminants, such as insecticides on fruit and vegetables (Table 3).[4,10] Allergic contact dermatitis to food is generally considered a rare entity[2]; however, this may represent an association bias. Allergic contact dermatitis is frequently observed in response to oleoresins in fruits and vegetables, or in response to spices.[1,2,10] Many foods have been implicated, such as garlic, onions, citrus fruits, mango, asparagus, broccoli, cauliflower, celery, chicory, artichoke, endive, and lettuce (the last 4 are members of the *Asteracea/Compositae* family, which contain chemical compounds, sesquiterpene lactones, that act as sensitizing agents).[1]

Allergic contact dermatitis to a certain food can be established according to the symptoms presented. For instance, contact dermatitis caused by handling of garlic cloves normally presents with fissures in the pads of the first 3 fingers. Diallyl disulfide and to a lesser extent allyl propyl disulfide and allicin are considered to be the most important allergens.[1,2] Urushiol, which is also present in poison ivy, poison oak, and other members of the *Anacardiaceae* family, is the allergen responsible for causing contact dermatitis associated with consumption of mango and raw chestnuts.[2] Contact dermatitis caused by mangos commonly presents as a perioral reaction (Figure), whereas it has been observed that chestnuts trigger dermatitis affecting the finger pads and the perianal area. On the other hand, it is important to note that the reactivation of prior dermatitis in the perianal area due to repeated exposure to a given allergen (also known as baboon syndrome) represents a form of systemic contact dermatitis.[11]

Systemic contact dermatitis is defined as a generalized eczematous reaction, possibly presenting with rhinitis, conjunctivitis, headache, fever, and gastrointestinal symptoms that develop after the patient is exposed to an oral or parenteral allergen to which he or she was previously sensitized via the skin.[1,2,4] This type of reaction has been associated with ingestion of garlic, onion, herbs, quinine in tonic water, food additives, propylene glycol, aspartame,[12] and a variety of other substances.[1] Two different categories of allergens—metals and fragrances—can play an important role in the development of chronic systemic contact dermatitis and therefore require more extensive discussion.

Metals Present in Foods

Nickel

It has been observed that patients previously sensitized to nickel can develop systemic contact dermatitis following ingestion of foods that contain this metal, and as a consequence this form of exposure assumes clinical importance.[1,4] In a study of individuals sensitized to nickel it was shown that a diet low in that metal effectively controlled the symptoms in 39.28% of patients.[13]

Normal daily consumption of nickel in adults in the United States of America is between 0.3 and 0.6 mg.[10] Most foods contain less than 0.5 mg of nickel per kilogram; however, the levels are partly determined by the presence of nickel in the soil in which the foods are cultivated, the fungicides used, and the equipment and containers used for processing of the food (Table 4).[10,14] It has been suggested that storage methods, such as the use of metal containers, are an additional source of nickel added to that already present in the food. In addition, leaching of nickel from cooking utensils and water pipes can add up to 1 mg to the daily dose.[14] Andersen et al[16] investigated the influence of nickel from water pipes and concluded that avoiding consumption of the first water from the tap in the morning (which has been sitting in the pipes throughout the night) could have a positive effect on dermatitis of the hands produced by nickel.

Table 4. Foods With a High Nickel Content[10,14,15]

Hazelnuts
Cocoa and dark chocolate[a]
Fruits (almonds, dates, figs, pineapple, plums, raspberries)
Grains (bran, buckwheat, millet, whole grain bread, oats, brown rice, sesame seeds, sunflower seeds)
Peanuts
Seafood (shrimps, mussels, oysters, crab, salmon)
Baking powder
Liquorice
Soya and soya products
Tea from drinks dispensers
Vegetables (beans, savoy cabbage, leeks, lettuce, lentils, peas, spinach, cabbage)
Vitamins containing nickel

[a]Contains concentrations of nickel between 8.2 and 12 mg/kg net weight.[14]

Cobalt

Cobalt is an essential trace element that is required for the synthesis of vitamin B12 (cobalamin). In the 1960s, some breweries added cobalt salts to beer to stabilize the foam, leading to exposure of 0.04 to 0.14 mg of cobalt per kg. Currently, cobalt is not added during the brewing process since cases of cardiomyopathy were observed in individuals who consumed large quantities (8 to 25 pints per day, the equivalent of 3.76 to 11.75 L) of beer containing this element.[17] Table 5 shows some of the foods that contain cobalt. Normally, an average person consumes close to 11 μg of cobalt per day in a diet that contains meat and dairy products.[17] This quantity of cobalt is sufficient and makes dietary supplementation unnecessary. On the other hand, in patients with pernicious anemia, intramuscular cobalamin is necessary and consequently supplementation is not contraindicated (even in allergic patients).

Table 5. Foods With a High Cobalt Content[10,18]

Apricot
Coffee
Cloves
Beer[a] – Foam stabilizer: Cobalt acetate Cobalt chloride hexahydrate
Cocoa and chocolate
Beans
Wholewheat flour
Liver
Nuts
Scallops
Animal products[b] (meat, poultry, and dairy products)
Beetroot
Cabbage
Tea
Green leafed vegetables

[a]Cobalt is no longer added to beer.
[b]High in cobalt.

Chrome

The quantity of chrome in the diet in the United Status of America ranges between 25 and 224 μg per day (a mean

Table 6. Foods That Contain Chrome[10,17,18]

Watercress
Broccoli
Processed meats[a] (cattle and sheep)
Onion
Cereals
Beer[a] (brewer's yeast)
Mushrooms
Cloves[a]
Cocoa and chocolate
Spices
Fruits and vegetables[a] (plums, raisins, sweetcorn, cooked beans)
Frozen peas[a]
Wholewheat flour
Whole egg[a]
Green beans
Apples
Seafood (oysters, mussels, clams)
Potatoes
Black pepper[a]
Tea
Thymus[a]
Wine

[a]Can contain up to 200 μg of chrome per kilogram.

Table 7. Foods That Contain Peru Balsam[22]

Alcoholic drinks: wine, beer, gin, and vermouth
Chocolate
Citrus fruits: oranges, lemons, grapefruit, bitter oranges, mandarins
Flavor enhancers: baking products, sweets, chewing gum, tea
Ice cream
Pickled vegetables: beetroot, cucumber
Spices, condiments, fizzy drinks: Cinnamon, cloves, vanilla, curry, allspice, aniseed, and ginger. Chili, barbecue sauce. Cola drinks
Tomatoes and tomato-based products: foods with *salsa roja* (red sauce), ketchup

of 60 to 79 μg/d).[19] Preserved foods contain a high concentration of chrome due to leaching from metal containers, particularly in the case of acidic foods.[20] Likewise, leaching of chrome into wine from green bottles and, during storage, from stainless steel tanks has been reported.[21] The amount of chrome in water for human consumption in the United Status of America ranges from 0.4 to 8 μg/L[19] and in multivitamins from 15 to 200 μg. Table 6 shows chrome-containing foods, which should be avoided in individuals sensitized to this element.

Fragrances Present in Foods

Peru Balsam

Peru balsam is a dark brown viscous resin extracted from the *Myroxylon pereirae* tree, mainly in El Salvador. Interestingly, despite the fact that this tree is found in a remote country, its resin is highly valued and exported throughout the world. The main chemical components that make up Peru balsam include cinnamic acid, cinnamaldehyde, cinnamic alcohol, methyl cinnamate, benzyl cinnamate, vanillin, and eugenol; individuals who are sensitized to the different compounds found in Peru balsam can be aggravated simply by ingestion of foods containing any of the components of this complex mixture.[10] Clinically, the hands, face, and anogenital area have been reported as the 3 most commonly affected regions, all with the same rate of involvement. Table 7 shows the use of these substances, both artificially and naturally, in different food sources that contain the same chemical compounds found in this resin.

In 2001, Salam and Fowler[22] identified tomatoes, citrus fruits, and spices as the foods most commonly implicated in systemic contact dermatitis associated with Peru balsam. In addition, in 2005, through the use of high performance liquid chromatography, Srivastava et al[23] discovered that tomatoes naturally contain cinnamic acid, one of the most potent allergens found in Peru balsam.

It should be remembered that the patch test for diagnosis of allergic contact dermatitis to foods can be performed with fresh foods. However, in certain circumstances, this diagnostic technique should not be used due to the high risk of sensitizing the patient to highly potent allergens, for instance urushiol in mango.[2] In the case of metals and Peru balsam, the closed patch test is the diagnostic gold standard. It should be noted that prick tests and RAST for specific IgE are usually negative in these patients.[1]

Phototoxic Contact Dermatitis

Phototoxic contact dermatitis associated with vegetables and fruit is referred to as phytophotodermatitis. This reaction

generally occurs after exposure to sunlight, mainly in the UV-A range (320-400 nm), in areas of the body that have previously been in contact with a food containing a chemical that has been photoactivated, converting it into a direct toxin for keratinocytes.[1,2,10] One of the best known groups of chemicals are the furocoumarin compounds, which can be found in celery, carrot, lime, lemon, orange, fig, grapefruit, parsley, parsnip, and spices.[1,2]

Phototoxic contact dermatitis is often seen in tourists and waiters (through squeezing limes into drinks), while farmers, gardeners, and vegetable harvest workers, who are frequently in contact with these compounds, may also be at risk.[2] The most common presentation of phototoxic contact dermatitis is pruritic dermatitis with a linear pattern (through exposure to juices) in areas exposed to the sun, leaving behind hyperpigmentation of the skin that can last for months.[2]

Photoallergic Contact Dermatitis

Photoallergic contact dermatitis associated with foods and spices is a rare entity. As in the case of allergic contact dermatitis, it is a T cell-mediated immune response. The reaction is differentiated from allergic contact dermatitis by the fact that the allergen is photoactivated by sunlight or artificial light in the UV-A range, and for this reason it is commonly encountered in sun-exposed areas.[2] An example is photoallergic contact dermatitis to garlic.

Comment

Contact dermatitis to foods is a disease that can be controlled by elimination of the causative food or its sources present in the diet. Effective clinical management of food allergies must take into account 4 factors:

1. Recognition of food allergy as a problem
2. Awareness of allergens that are cross-reactive with other foods
3. Availability of support and information in the home and in school and work environments
4. Recognition of food allergy as an increasing public health problem

Finally, education and awareness raising can minimize morbidity due to food allergies and improve the quality of life of the affected individuals. From the point of view of research, it will be necessary to undertake studies on the long-term effectiveness of dietary removal of specific allergens present in food. With this in mind, the patient would ideally have access to a complete multidisciplinary team including pediatricians or internal medicine specialists, nutritionists, allergologists, and dermatologists.[24]

Conflicts of Interest
The authors declare no conflicts of interest.

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