Chapter 31

Adverse Reactions to Food

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"For this changed concept of reactivity, I propose the term allergy. 'Allos' implies deviation from the original state, from the behavior of the normal individual..."
Von Pirquet, 1906

CLINICAL IMPORTANCE

An adverse reaction to food is an abnormal response to an ingested food or food additive. Adverse reactions to food are composed of a variety of subclassifications based on pathomechanisms (**Figure 31-1**) (Anderson, 1986; Strombeck and Guilford, 1991). The terms food allergy and food hypersensitivity should be reserved for those adverse reactions to food that have an immunologic basis. Food intolerance refers to a large category of adverse food reactions due to nonimmunologic mechanisms. Traditionally, the terms food hypersensitivity and food allergy have been used to describe all adverse reactions to food in dogs and cats, including reactions that were truly food intolerances.

In view of the number of diverse foods that are routinely ingested by dogs and cats, it is not surprising that adverse reactions develop. That food-related reactions appear relatively infrequently is testimony to the effectiveness of the gastrointestinal (GI) mucosal barrier and oral tolerance. Adverse reactions to food were reported in dogs and cats as early as 1920 and have been blamed for a variety of clinical syndromes usually involving the skin and GI tract.

Carefully controlled prevalence studies of adverse food reactions in dogs and cats have not been performed. The major problem with establishing prevalence is that adverse food reactions mimic other diseases, especially other pruritic dermatoses, and they often coexist with other allergic conditions. Veterinary dermatologists suggest that adverse food reactions account for 1 to 6% of all dermatoses in general practice and that food allergy constitutes 10 to 49% of allergic responses in dogs and cats (MacDonald, 1993; Scott et al, 2001; Chesney, 2002; Loeffler et al, 2004; Jackson et al, 2005). Several investigators have suggested that adverse food reactions are relatively more common in cats than in dogs (MacDonald, 1993; Scott et al, 2001). Food allergy is one of the most common causes of hypersensitive skin disease in dogs and cats along with arthropod (flea) hypersensitivity and atopic dermatitis triggered by environmental allergens (MacDonald, 1993; Scott et al, 2001; Jackson et al, 2005). Adverse food reactions can cause a wide variety of cutaneous lesions and should be considered as a cause of any pruritic disease in dogs or cats. Most of the reported adverse food reactions causing dermatoses have been termed food allergy or food hypersensitivity, although no specific tests were performed to confirm an immunologic basis for the clinical signs.

Adverse reactions to foods also appear to be an important cause of GI signs in cats and dogs. In one study of chronic idiopathic GI problems in cats, 16 of 55 cats (29%) were diagnosed as food sensitive by elimination-challenge tests (Guilford et al, 2001). Furthermore, the clinical signs of 11 cats (20%) in this

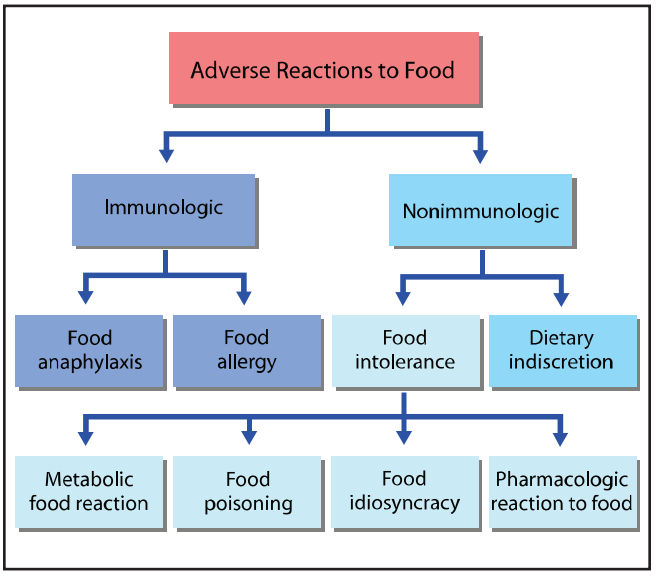

Figure 31-1. Classification of adverse reactions to food.

study resolved when they were fed the elimination food but signs did not recrudesce when the previous food was fed. Food sensitivity may also be involved in some cases of inflammatory bowel disease (IBD) in dogs and cats, particularly lymphocytic-plasmacytic enteritis and eosinophilic gastroenteritis (Elwood et al, 1994; Rutgers et al, 1995; Guilford, 1996). Clinical response to a modification in the feeding plan suggests that hypersensitivity to food antigens plays a role in dogs with chronic idiopathic or lymphocytic-plasmacytic colitis (Simpson et al, 1994; Leib et al, 1989; Nelson et al, 1988). It is unknown if chronic colitis or other forms of inflammatory disease of the small bowel are a direct manifestation of an adverse food reaction or if modifying the feeding plan is merely palliative in some patients.

PATIENT ASSESSMENT

Nutritional History

The authors of two series of dermatologic cases due to adverse food reactions could not relate the onset of clinical signs with recent food changes (Walton, 1967; Baker, 1974). This finding suggests that dogs and cats may develop food allergies after prolonged exposure to one brand, type or form of food. In contrast, adverse reactions due to food intolerance may occur after a single exposure to a food ingredient because immune amplification is unnecessary.

The nutritional history of the patient should be reviewed carefully for ingredients thought to be commonly associated with adverse food reactions. The nutritional history should include a complete list of the foods used in the pet's regular feeding plan or as treats including: 1) specific commercial foods, 2) commercial snacks and treats, 3) supplements, 4) chewable medications, 5) chew toys, 6) human foods and 7) access to other food sources. As an example, a dog might be given a dry commercial food as its main source of nutrition, but may also be given rawhide chews, commercial dog biscuits, flavored monthly oral heartworm prophylactic medication and leftover foods from human meals, and it may have access to commercial food fed to cats in the household. All of these ingested items could be sources of adverse food reactions. It is often helpful to have the pet owner keep a diary for several weeks documenting the types of food and other items the pet ingests daily. Nutritional assessment is described in more detail later in this chapter.

History and Physical Examination

Dermatologic Responses to Adverse Food Reactions in Dogs

Reports of adverse food reactions in dogs with cutaneous disease did not document a gender predisposition and ages ranged from four months to 14 years (MacDonald, 1993; Scott et al, 2001; Walton, 1967; Baker, 1974; August, 1985; White, 1986; Carlotti et al, 1990; Jeffers et al, 1991; Kunkle and Horner, 1992; Rosser, 1993; Harvey, 1993; Paterson, 1995; Roudebush and Schick, 1995). Up to one-third of cases, however, may occur in dogs less than one year of age (Rosser, 1993; Harvey, 1993). Most investigators have not found a breed predilection, although when compared to the local hospital case population, West Highland white terriers were found to be at increased risk (Rosser, 1993; Chesney, 2002; Jackson et al, 2005).

Adverse food reactions in dogs typically occur as nonseasonal pruritic dermatitis, occasionally accompanied by GI signs (MacDonald, 1993; Scott et al, 2001; Walton, 1967; Baker, 1974; August, 1985; White, 1986; Carlotti et al, 1990; Jeffers et al, 1991; Kunkle and Horner, 1992; Rosser, 1993; Harvey, 1993; Paterson, 1995; Roudebush and Schick, 1995). The pruritus varies in severity. Lesion distribution is often indistinguishable from that seen with atopic dermatitis triggered by environmental allergens; feet, face, axillae, perineal region, inguinal region and ears are often affected (MacDonald, 1993; Scott et al, 2001; Walton, 1967; Baker, 1974; August, 1985; White, 1986; Carlotti et al, 1990; Jeffers et al, 1991; Kunkle and Horner, 1992; Rosser, 1993; Harvey, 1993; Jackson, 2005). The similarity of clinical presentation has prompted the International Task Force on Canine Atopic Dermatitis to publish a position statement to the effect that canine atopic dermatitis should be considered a disease condition that can be triggered by environmental and or food allergens and both should be considered in dogs with nonseasonal disease (Olivry et al, 2007).

In one report, one-fourth of dogs with adverse food reactions had lesions only in the region of the ears (Rosser, 1993). This finding suggests that adverse food reactions should always be suspected in dogs with pruritic, unilateral or bilateral otitis externa, if accompanied by secondary bacterial or *Malassezia* infections (MacDonald, 1993; Scott et al, 2001). Unusual or atypical dermatologic responses to adverse food reactions in dogs include: erythema multiforme (Scott and Miller, 1999), claw disease (Mueller et al, 2000) and generalized erythematous wheals (urticarial vasculitis) (Nichols et al, 2000).

Adverse food reactions in dogs produce no set of pathognomonic cutaneous signs. A variety of primary and secondary skin lesions occur and include: 1) papules, 2) erythroderma, 3) excoriations, 4) hyperpigmentation and 5) seborrhea sicca. Adverse food reactions often mimic other common canine skin disorders including pyoderma, pruritic seborrheic dermatoses, folliculitis and ectoparasitism (MacDonald, 1993; Scott et al, 2001). Twenty to 30% or more of dogs with suspected adverse food reactions may have concurrent allergic disease, such as flea-allergic or atopic dermatitis (Baker, 1974; Jeffers et al, 1991; Rosser, 1993; Hillier and Griffin, 2001; Jackson et al, 2005). Some dogs present with only recurrent bacterial pyoderma, with or without pruritus, wherein all clinical signs resolve temporarily with antibiotic therapy (Scott et al, 2001; White, 1986; Harvey, 1993).

Food anaphylaxis is an acute reaction to food or food additives with systemic consequences. The most common clinical manifestation in dogs occurs in localized form referred to as angioedema or facioconjunctival edema (Scott et al, 2001; Thompson, 1995). Angioedema is typically manifested by large edematous swellings of the lips, face, eyelids, ears, conjunctiva and/or tongue, with or without pruritus (Scott et al, 2001; Thompson, 1995). The same types of substances that induce systemic anaphylaxis evoke angioedema (Thompson, 1995). Most veterinary practitioners attribute angioedema solely to insect envenomation (biting or stinging insects) but a number of other common causes include food, drugs, vaccines, infections and blood transfusions (Scott et al, 2001; Thompson, 1995; Nichols et al, 2001). These reactions usually occur within minutes of allergen exposure and generally subside after one to two hours.

One of the authors (PR) has seen angioedema of the tongue, palate and throat repeatedly in the same dogs after ingestion of mushrooms, domestic flowers or other plants. This presentation resembles the oral allergy syndrome in people, which is a form of contact urticaria confined almost exclusively to the oropharynx (Sampson, 1993). Clinical signs in people include rapid onset of pruritus and angioedema of the lips, tongue, palate and throat. Signs usually resolve rapidly. This syndrome is most commonly associated with ingestion of various fresh fruits and vegetables. Affected people are often primarily sensitized to certain airborne pollens (especially birch or ragweed pollen); the immunologic basis for this syndrome is IgE cross reactivity. One report details the clinical and immunologic findings in a dog that developed oral allergy syndrome to tomato after prior sensitization with Japanese cedar (Fujimora et al, 2002).

Dermatologic Responses to Adverse Food Reactions in Cats

The age of cats affected with food sensitivity has ranged from six months to 12 years; a gender predisposition has not been documented (Carlotti et al, 1990; White and Sequoia, 1989; Rosser, 1993a; Guaguere, 1995; Roudebush and McKeever, 1993; Medleau et al, 1986). In one study, almost half the cats developed the disease by two years of age (Rosser, 1993a). Siamese or Siamese cross cats accounted for nearly one-third of cases in two studies, suggesting a potential increased risk (Carlotti et al, 1990; Rosser, 1993a).

Dermatologic signs include several different clinical reaction patterns such as: 1) severe, generalized pruritus without lesions, 2) miliary dermatitis, 3) pruritus with self trauma centered around the head, neck and ears, 4) self-induced alopecia, 5) pyotraumatic dermatitis and/or 6) scaling dermatoses (MacDonald, 1993; Scott et al, 2001; Carlotti et al, 1990; White and Sequoia, 1989; Rosser, 1993a; Guaguere, 1995; Roudebush and McKeever, 1993; Medleau et al, 1986). In one study, angioedema, urticaria or conjunctivitis occurred in one-third of cats with adverse food reactions (Rosser, 1993a). Adverse reactions to food may also be implicated in cats with the so-called eosinophilic skin diseases such as eosinophilic plaques, eosinophilic granulomas and indolent ulcers of the lips (MacDonald, 1993; Scott et al, 2001; Roudebush and McKeever, 1993; Waisglass et al, 2006). Concurrent flea-allergy or atopic dermatitis triggered by environmental allergens may occur in up to 30% of cats with suspected adverse food reactions (Carlotti et al, 1990; Rosser, 1993a).

It has been suggested that moderate to marked peripheral lymphadomegaly is found in up to one-third of cats with dermatologic manifestations of food allergy (Scott et al, 2001). Absolute peripheral eosinophilia occurs in 20 to 50% of feline cases (Scott et al, 2001; White and Sequoia, 1989; Medleau et al, 1986).

GI Responses to Adverse Food Reactions in Dogs and Cats

Gender predilections have not been established for GI disease resulting from adverse reactions to foods (Walton, 1967; Baker, 1974). Similarly, there are no well-documented breed predispositions to GI food allergy, but Chinese Shar-Pei and German shepherd dogs are commonly affected. Furthermore, gluten-sensitive enteropathy has been well documented in Irish setter dogs (Batt et al, 1984). A wide age range of patients can be affected, including dogs and cats as young as weaning age.

Every level of the GI tract can be damaged by food allergies. In dogs, cats and people, clinical signs usually relate to gastric and small bowel dysfunction, but colitis can also occur (Heyman, 1989; Guilford and Badcoe, 1992; Sampson et al, 2001). Vomiting and diarrhea are prominent features. The diarrhea can be profuse and watery, mucoid or hemorrhagic (Guilford and Badcoe, 1992; Baker, 1990). Intermittent abdominal pain, intermittent diarrhea, weight loss, flatulence, irritable demeanor, soft feces and increased frequency of defecation are also seen (Guilford et al, 2001; Loeffler et al, 2004). Concurrent cutaneous signs may be seen. GI disturbances occur in up to half of dogs and cats with cutaneous manifestations of food hypersensitivity (MacDonald, 1993; Scott et al, 2001; Loeffler et al, 2004, 2006). In experimentally induced food hypersensitivity, the most common clinical signs are diarrhea, an increase in the number of bowel movements and occasional vomiting (Roudebush and McKeever, 1993; Frick, 1991). Pruritic dogs with more than three bowel movements per day are more likely to have an adverse reaction to food as part of the reason for

Box 31-1. Gastroscopic Food Sensitivity Testing.

Gastroscopic food sensitivity testing (GFST) is a diagnostic technique in which food extracts (5,000 to 15,000 protein nitrogen units/ml) are dripped onto the gastric mucosa by means of the operating channel of an endoscope. The site is then observed for two to three minutes. Mucosal swelling suggests an immediate sensitivity to the food extract tested. Erythema, blanching, edema and petechiation at the mucosal site also suggest the test subject is hypersensitive to the food, and the food, therefore, should not be used as part of the sensitive patient's diet. Sampling of the mucosal site with subsequent measuring of histamine levels, other mediator levels or mast cell degranulation can be used to determine whether the response was immune mediated. The diagnostic accuracy of GFST isn't known.

The Bibliography for **Box 31-1** can be found at www.markmorris.org.

their dermatoses (Scott et al, 2001; Paterson, 1995; Loeffler et al, 2004, 2006). The increased frequency of defecation will normalize with use of an appropriate elimination food (Loeffler et al, 2004).

There are at least five subacute to chronic GI conditions thought to involve food allergy in people: 1) food protein-induced enterocolitis, 2) food-induced colitis syndrome, 3) food-induced malabsorption syndrome, 4) gluten-sensitive enteropathy and 5) allergic eosinophilic gastroenteritis (Sampson, 1991; Sampson et al, 2001; Motala, 2008). All of these conditions can occur in dogs and cats. The role of food allergy in canine and feline IBD is unknown. Hypersensitivity to food is probably involved in the pathogenesis of this syndrome; at least some affected animals could be more appropriately diagnosed as suffering from food protein-induced enterocolitis. Dogs with GI diseases, including IBD, have more food allergen-specific serum IgG than normal dogs, a finding that may reflect increased antigen exposure due to increased mucosal permeability (Foster, 2003). Currently, 10% of dogs with IBD diagnosed by one of the authors (WGG) have positive gastroscopic food sensitivity tests (GFST) to food antigens (**Box 31-1**). Positive GFST results to foods used in the treatment of the disease are often detected during followup endoscopic studies. This finding strongly implies that food allergy is involved in the perpetuation of IBD but that it may not be the primary cause. That is, inflammation of the mucosa predisposes animals to the development of acquired food allergies. Therefore, a change in food antigens may temporarily reduce the immune-mediated mucosal inflammatory response. The longevity of this amelioration is questionable; however, because most of the so-called "hypoallergenic" foods commonly used in veterinary medicine contain intact proteins that are hypoallergenic primarily by virtue of their novelty to the host's immune system. The duration of protein novelty to the gut-associated lymphoid tissue (GALT) is likely to be very limited if the antigen is fed to a patient with a highly porous mucosal barrier. Irritable bowel syndrome is a disease of dogs characterized by chronic recurrent abdominal pain and large bowel diarrhea (Guilford, 1996a). Feeding changes will often alleviate the signs of irritable bowel disease, implying that food sensitivity plays a role in this syndrome. In the experience of one of the authors (WGG), avoiding gas-producing foods (e.g., homemade vegetable-based foods) or foods with a high fat content is particularly advantageous in the management of dogs with irritable bowel syndrome. In affected dogs, the adverse reactions to these nutrients are most likely due to food intolerance rather than food allergy.

Diagnostic Methods

The diagnosis of an adverse reaction to a food is confirmed by elimination-challenge trials (Jackson, 2009). In food-sensitive patients, resolution of clinical signs occurs after elimination of the responsible food from the diet followed by a return of the signs when the patient is challenged with the original food. Subsequently, feeding the elimination food should again alleviate clinical signs. Correct design of elimination-challenge trials is imperative for reliable diagnosis and is described below in the Feeding Plan section.

Failure to challenge a suspected food-sensitive patient will lead to marked over diagnosis of food sensitivity (Guilford et al, 2001). However, whether to challenge the patient or not is a decision that needs to be made collectively with the owner. Many owners are happy with a presumptive diagnosis of food sensitivity and do not wish to undertake a challenge test. After a diagnosis of food sensitivity is made, further cycles of elimination-challenge trials may then be undertaken in an attempt to identify the responsible food ingredients. It is noteworthy that dietary trials confirm or rule out adverse reactions to food but do not indicate the underlying mechanism (allergy or intolerance).

The place of skin tests, laboratory assays and endoscopic provocation tests remains uncertain in the diagnosis of food sensitivity. None of these are suitable as screening tests for adverse reactions to food because they do not screen for the entire spectrum of adverse reactions to foods (both allergy and intolerance). Some tests (e.g., measurement of food-specific serum IgE) suggest that an adverse reaction to a particular food (identified in an elimination-challenge trial) may be due to a type-1 hypersensitivity response rather than another type of allergic reaction or a food intolerance. However, at the present time, intradermal testing, radioallergosorbent tests (RASTs) and enzyme-linked immunosorbent assays (ELISAs) for food hypersensitivity are considered unreliable in patients with dermatologic (Jeffers et al, 1991; Kunkle and Horner, 1992) and GI disease (Foster, 2003). Although it is sensible to avoid feeding proteins that have caused positive gastroscopic or colonoscopic food sensitivity tests (especially more severe reactions such as edema and petechiation), the diagnostic accuracy of these endoscopic provocation tests requires further evaluation (Guilford et al, 1994; Vaden et al, 2000; Allenspach et al, 2006) as does the diagnostic accuracy of ultrasonography for food sen-

sitivity, which has recently shown some promise (Arslan et al, 2006; Gaschen et al, 2008).

Risk Factors

Risk factors for adverse food reactions in animals are currently unknown but may include: 1) certain foods or food ingredients (see below), 2) poorly digestible proteins, 3) any disease that increases intestinal mucosal permeability (e.g., viral enteritis), 4) selective IgA deficiency, 5) genetic predisposition, 6) age (six months to four years) and 7) concurrent allergic disease.

Etiopathogenesis

Normal Mucosal Barrier and Oral Tolerance

Ingested food represents the greatest foreign antigenic load confronting the immune system. The defense against hypersensitivity to food antigens includes an effective mucosal barrier and oral tolerance generated by the cellular immune system of GALT (Strombeck and Guilford, 1991; Sampson, 1993; Walker, 1987; Murphy and Walker, 1991).

An important adaptation of the GI tract is the development of a mucosal barrier that prevents the overwhelming uptake of food antigens (Sampson, 1993; Walker, 1987; Murphy and Walker, 1991). Efficient functioning of the mucosal barrier excludes the majority of ingested antigens, thus minimizing antigen exposure to GALT. The concept of a mucosal barrier includes effective digestion, the mucous layer, intact and functioning epithelial cells and IgA (**Table 31-1** and **Figure 31-2**).

Complete digestion of food protein results in free amino acids and small peptides that are poor antigens. An incompletely digested food protein has the potential to incite an allergic response because of residual antigenic proteins and large polypeptides. The composition of the mucous coat overlying the intestinal surface contributes to the defense against antigen attachment and penetration. Mucus contains carbohydrate moieties that may act as receptor inhibitors, thereby interfering with attachment of antigens to the intestinal microvillous surface (Sampson, 1993; Walker, 1987; Murphy and Walker, 1991). A direct association between intestinal cell membrane protein/phospholipid ratios and antigen uptake has been demonstrated in some species. Changes in cell membrane composition and function occur early in life, but how these changes affect food antigen uptake is unknown. IgA is the major immunologic component of the mucosal barrier because it is present in high concentrations in intestinal secretions. IgA may complex with food antigens in the intestinal lumen or within the mucous coat, thereby preventing their transport.

Despite these defense mechanisms, the mucosal barrier is not completely impervious to macromolecules; food proteins cross the intact intestinal mucosa in small but significant amounts. Antigens that enter and pass through the lamina propria are removed by the mononuclear-macrophage (reticuloendothelial) system of the liver and mesenteric lymph nodes.

The intestine, traditionally viewed as an organ of digestion and absorption of nutrients, maintains an indispensable immunologic function (Walker, 1987; Murphy and Walker, 1991). The gut is probably one of the largest immune organs in the body. GALT is composed of four distinct lymphoid compartments: 1) aggregates of lymphoid follicles throughout the intestinal mucosa, 2) lymphocytes and plasma cells scattered throughout the lamina propria, 3) intraepithelial lymphocytes interdigitated between enterocytes and 4) mesenteric lymph nodes (**Figure 31-3**) (Sampson, 1993).

Although GALT must mount a rapid and potent response against potentially harmful foreign substances and pathogenic organisms, it also must remain unresponsive to enormous quantities of food antigens. Absorbed food antigens (Van Wijk and Knippels, 2007) are presented to GALT in such a manner that a potent gut-associated, cell-mediated suppressive response develops (**Figure 31-4**).

Table 31-1. Gastrointestinal barriers to ingested food antigens.

Physiologic barriers
Breakdown ingested antigens
Gastric acid and pepsin
Pancreatic enzymes
Intestinal enzymes
Intestinal epithelial cell lysozyme activity
Block penetration of ingested antigens
Unstirred water layer
Intestinal mucous coat (glycocalyx)
Intestinal microvillous membrane composition
Intestinal peristalsis
Immunologic barriers
Block penetration of ingested antigens
Antigen-specific secretory IgA in gut lumen
Clear antigens penetrating GI barrier
Monocyte-macrophage system
Serum antigen-specific IgA and IgG

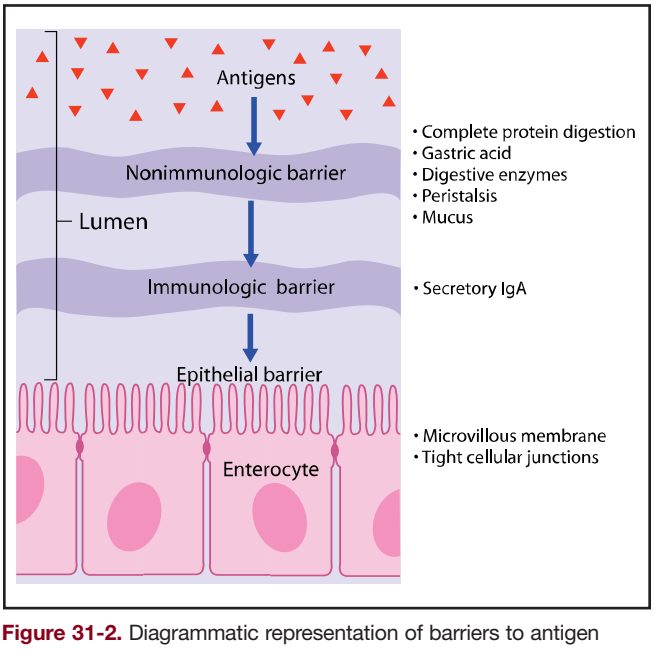

Figure 31-2. Diagrammatic representation of barriers to antigen penetration of the intestinal mucosa. Antigens are prevented from entering the mucosa by nonimmunologic and immunologic mechanisms and the physical structure of the epithelium. (Adapted from Iyngkaren N, Abidin Z. Intolerance to food proteins. In: Lifshitz F, ed. Pediatric Nutrition. New York, NY: Dekker, 1981; 453.)

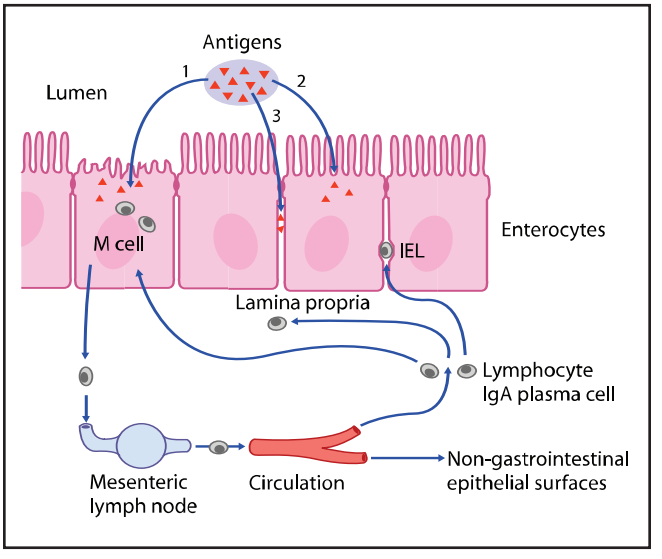

Figure 31-3. Diagrammatic representation of the gut-associated lymphoid tissue (GALT) and the mucosal immune cycle. GALT is composed of Peyer's patches, lamina propria lymphocytes and plasma cells, intraepithelial lymphocytes (IEL) and mesenteric lymph nodes. Food antigens are absorbed via specialized M cells (1) or enterocytes (2,3). These antigens stimulate lymphocytes, which migrate by way of the intestinal lymphatics to mesenteric lymph nodes, ultimately reaching the systemic circulation via the thoracic duct. Specific immune-primed lymphocytes cycle back to GALT or are deposited at other mucosal surfaces. (Adapted from Patrick MK, Gall DG. Protein intolerance and immunocyte and enterocyte interaction. Pediatric Clinics of North America 1988; 35: 17-34.)

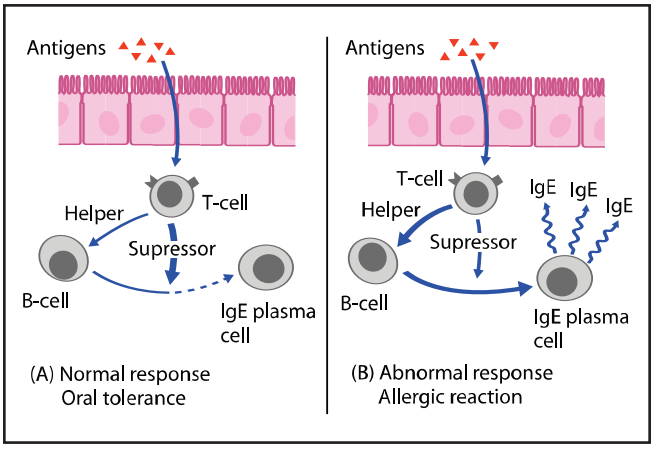

Figure 31-4. Diagrammatic representation of food antigen absorption under different conditions. With a normal response (A), T-cell suppressor activity occurs and contributes to oral tolerance. In (B), an abnormal immune response contributes to production of excess IgE and may result in allergic disease. (Adapted from Walker WA. Pathophysiology of intestinal uptake and absorption of antigens in food allergy. Annals of Allergy 1987; 59: 7-16.)

This immune suppressor response, along with anergy and cell deletion is the basis of oral tolerance. Conversely, an allergic response may result if the antigen encounters a defective suppressor arm of GALT or escapes into the systemic circulation. The concept of "immune exclusion" of food antigens is important because systemic lymphoid tissue responds by active immunoreactivity, which could lead to allergic clinical signs rather than immune suppression (tolerance).

Immunologic Reactions to Food

FOOD ALLERGENS

The specific food allergens or ingredients that cause problems in animals have been poorly documented (**Table 31-2**). In general, the major food allergens that have been identified in people are water-soluble glycoproteins that have molecular weights ranging from 10,000 to 70,000 daltons and are stable to treatment with heat, acid and proteases (Sampson, 1993). Other physiochemical properties that account for their unique allergenicity are poorly understood (Aalberse, 2000; Breiteneder and Ebner, 2000).

The most common food allergens in children are found in chicken egg, peanut, cow's milk, fish, soy and wheat (Sampson, 1993, 1991a, 1988; Yunginger, 1991). In human adults, various fruits, tree nuts, peanut, fish, seafood (mollusks, crustaceans) and cow's milk are confirmed most often as causing food allergy (Sampson, 1993, 1991a, 1988; Yunginger, 1991). Discussion of the specific protein fractions and allergens in these foods that are thought to cause problems are reviewed elsewhere (Sampson, 1993; Yunginger, 1991; Breiteneder and Ebner, 2000; Sicherer, 2001; www.allergen.org).

Fifteen different studies, representing 278 dogs, described primarily cutaneous lesions associated with adverse reactions to specific foods or ingredients (Elwood et al, 1994; Walton, 1967; Carlotti et al, 1990; Jeffers et al, 1991, 1996; Kunkle and Horner, 1992; Harvey, 1993; Paterson, 1995; Mueller and Tsohalis, 1998; Mueller et al, 2000; Chesney, 2002; Tapp et al, 2002; Ishida et al, 2003, 2004) (**Table 31-2**). Beef, dairy products and wheat are most commonly reported as ingredients causing adverse food reactions in dogs. After analysis, specific food allergens identified in dogs include chicken serum albumin, bovine IgG (cow's milk, beef), ovine IgG (lamb), muscle phosphoglucomutase (beef, lamb) and Gly proteins 50 and 75 kD (soy) (Cave et al, 2000; Cave, 2001; Cave and Guilford, 2004; Martin et al, 2004; Serra et al, 2006).

Ten different studies or case reports, representing 56 cats, described cutaneous lesions and/or GI disorders associated with adverse reactions to specific foods or ingredients (Walton, 1967; Carlotti et al, 1990; White and Sequoia, 1989; Guaguere, 1995; Walton et al, 1968; Stogdale et al, 1982; Reedy, 1994; Guilford et al, 1996b, 2001)[a] (**Table 31-2**). Beef, dairy products and fish are most commonly reported as ingredients causing adverse food reactions in cats. Specific food allergens have not been identified in cats.

Human allergy reference books often contain phylogenetic tables of animal and vegetable foods, so food-allergic persons can avoid other closely related foods. In clinical practice, human patients often report cross reactivity among various fish and crustaceans, but less cross reactivity within vegetable food groups (Sicherer, 2001). Results of oral food challenges in children demonstrate that clinically important cross reactivity to

legumes (peanuts, soybeans, green beans, lima beans, peas, lentils) is very rare (Bernhisel-Broadbent and Sampson, 1989). Wheat, rye and barley cross react in allergic people, but oat allergens appear to cross react only weakly (Varjonen et al, 1994). Cross reactivity between milk proteins from cows, goats and sheep is common. In children, chicken egg cross reacts with egg proteins of other birds (Sampson, 1993). Cross reactivity among food allergens has only been investigated to a minor degree in pet animals (Jeffers et al, 1996; Martin et al, 2004).

PATHOPHYSIOLOGIC MECHANISMS

Abnormalities in GI defense mechanisms may predispose patients to food allergies (Strombeck and Guilford, 1991). Predisposing factors for food allergy include: 1) mucosal barrier failure (poorly digestible proteins, incomplete protein digestion, increased intestinal mucosal permeability, age-related changes in microvillous cell membrane composition, inflammatory-induced changes in mucus composition) and 2) defective immunoregulation (decreased IgA secretion, deranged cell-mediated responses of GALT, monocyte-macrophage system dysfunction) (**Figure 31-4**). Which of these pathomechanisms are important predisposing factors in dogs and cats awaits further investigation. The most extensively studied and best-defined food allergic reactions in people and laboratory animals involve IgE-mediated responses that result in clinical signs of immediate hypersensitivity (within minutes to hours) (Sampson, 1993). IgE-activated mast cells also may release a variety of cytokines that mediate a late-phase response (within several hours to days). With repeated ingestion of a food allergen, mononuclear cells are stimulated to secrete histamine-releasing factors that interact with IgE bound to the surface of basophils and mast cells and increase their releasability (Sampson et al, 1989). This in vitro phenomenon has been associated with increased cutaneous reactivity in children with atopic dermatitis (Sampson et al, 1989).

Unlike food allergy in people, the pathogenesis of adverse food reactions in dogs and cats has not been fully elucidated. Canine models of IgE-mediated food hypersensitivity have been developed by repeated exposure to food allergens and adjuvant (Guilford and Badcoe, 1992; Schiessl et al, 2003; Buchanan and Frick, 2002; Kennis, 2001; Cave and Guilford, 2004). More recent reports describe spontaneous food allergy in dogs in which food-allergen specific IgE responses can be demonstrated in association with clinical disease (Ishida, 2003; Jackson and Hammerberg, 2002; Jackson et al, 2003). However, other studies have been unable to detect clinically relevant food antigen-specific IgE in client-owned dogs with known adverse food reactions (Mueller and Tsohalis, 1998; Hillier and Kunkle, 1994). Although IgE may be involved in the pathogenesis of food allergy in some dogs, it is unlikely to be the sole immunologic mechanism of disease, particularly in chronic situations (Foster et al, 2003).

Type II (cytotoxic), Type III (immune complex) and Type IV (cell-mediated) hypersensitivity reactions have been implicated less commonly in food-allergic disorders in people (Sampson, 2004).

Table 31-2. Ingredients commonly associated with adverse food reactions.*

Dogs

Ingredients	*% of reported cases*
Beef, dairy products, wheat	69
Lamb, chicken egg, chicken, soy	25

Cats

Ingredients	*% of reported cases*
Beef, dairy products, fish	80

*Data from cases reported in North America, Europe, Australia, Japan and New Zealand. Common food allergens may differ in other geographic locations.

GLUTEN (GLIADIN) ENTEROPATHY

Gluten-induced enteropathy (celiac disease) is an important chronic inflammatory disease of the small intestine of people. The prevalence of gluten intolerance in dogs and cats is unknown. Research has conclusively demonstrated that an analogous disorder affects Irish setter dogs (Batt et al, 1984), and clinical experience suggests that other breeds may also be affected.

Flour from cereal grains contains various proteins including: 1) water-soluble albumins, 2) saline-soluble globulins, 3) ethanol-soluble prolamins and 4) acid- or alkali-soluble glutelin (Yunginger, 1991). Prolamins of wheat, rye and barley have marked sequence homology, but not the prolamins of rice and corn, which do not exacerbate the disorder (Kasadra et al, 1976). The prolamin and the glutelin proteins of wheat are gliadin and glutenin. Gliadin is a glutamine- and proline-rich polypeptide with a molecular weight of 15,000 daltons. Gliadin is composed of four major electrophoretic fractions, the most toxic of which in people appears to be α-gliadin (Kasadra et al, 1976). "Gluten" is a crude mixture of gliadin and glutenin. Pancreatic enzymes in the intestinal lumen and intracellular enzymes of the mucosal brush border normally digest these peptides. Completely hydrolyzed gliadin is nontoxic.

The cause of gluten sensitivity is unknown. Studies involving gluten-intolerant Irish setters have demonstrated that increased mucosal permeability predates development of the disease (Hall and Batt, 1990). The pathogenesis of gluten-sensitive enteropathy has been debated for many years, but researchers now think gluten sensitivity in people is probably mediated by the immune system. Knowledge of the complete sequence of immunologic events is incomplete, but it appears IgE mediates acute responses to gluten whereas the delayed hypersensitivity (and mucosal atrophy) is mediated by IgA and IgG (Vojdani et al, 2008). Gliadin-activated macrophages may possibly recruit lamina propria lymphocytes resulting in a delayed hypersensitivity response and various inflammatory changes such as infiltration of inflammatory cells, mast cell degranulation, production of eicosanoids, increased microvascular permeability and complement activation (Marsh, 1992; Loft et al, 1989). The lymphocyte density of the mucosal intraepithelium is increased and serum total IgA levels are elevated in gluten-sensitive dogs (Hall et al, 1992).

In contrast to findings in people, antigliadin antibody (IgG) levels are lower in affected dogs than in age-matched control dogs. In addition, serum immune complex levels are not elevated in dogs whereas they are frequently elevated in people (Hall et al, 1992). These findings do not support a role for a systemic immune response in the pathogenesis of canine gluten-sensitive enteropathy but do not rule out a mucosal delayed hypersensitivity response.

Nonimmunologic Reactions to Food

Nonimmunologic, abnormal reactions to food include food intolerance and dietary indiscretion (**Figure 31-1**). Like the terms food allergy and food hypersensitivity, the term food intolerance has been applied inappropriately to any and all adverse reactions to food. Food intolerance mimics food allergy except that it can occur on the first exposure to a food or food additive, because nonimmunologic mechanisms are involved. The incidence of food intolerance vs. food hypersensitivity or food allergy is unknown.

FOOD POISONING

Food poisoning or food toxicosis is an adverse effect caused by the direct action of a food or food additive on the host. Examples of food poisoning include ingestion of: 1) nutrient excesses (vitamin A or vitamin D toxicosis), 2) food contaminated with microorganisms or their toxic metabolites (scavenging putrefied material, vomitoxin), 3) specific foods (onions, chocolate) or 4) toxic food preservatives (benzoic acid or propylene glycol in cats) (Chapter 11).

Food poisoning is a frequent cause of GI disease in dogs and cats. In addition to ingestion of pathogenic microorganisms or their toxins, food poisoning can result from the ingestion of plant-derived toxins or irritants. For example, high levels of oxalates and anthraquinone glycosides contained in rhubarb, spinach and beets can lead to a corrosive gastroenteritis, and large quantities of spices such as peppers can cause abdominal discomfort in people.

REACTIONS TO FOOD ADDITIVES

Idiosyncratic adverse reactions to food additives often occur in people (Hannuksela and Haahtela, 1987; Simon and Stevenson, 1993; Metcalfe et al, 1991; Fuglsang et al, 1994). Food additives frequently incriminated in human adverse reactions include sulfites, monosodium glutamate, tartrazine and other azo or non-azo dyes, benzoates, parabens and spices (Hannuksela and Haahtela, 1987; Simon and Stevenson, 1993; Metcalfe et al, 1991; Fuglsang et al, 1994). Few of the adverse reactions to food additives appear to involve an immunologic mechanism, although IgE-mediated reactions may occur (Hannuksela and Haahtela, 1987; Simon and Stevenson, 1993; Metcalfe et al, 1991; Fuglsang et al, 1994). Confirmed reactions to food additives are best described as food intolerances or food idiosyncrasies because clinical signs resulting from their ingestion are not thought to be immunologically mediated. Examples are reactions to azo dyes, non-azo dyes and antioxidants that can directly cause histamine release from leukocytes of clinically normal people (Murdoch et al, 1987).

Although food additives are frequently incriminated as causing problems in dogs and cats, few data confirm this perception (Roudebush and Cowell, 1992; Roudebush, 1993). Propylene glycol has been documented to cause hematologic abnormalities in cats and subsequently has been eliminated from cat foods sold in the United States and some other countries (Hickman et al, 1990; Weiss et al, 1990). Disulfides found in onions (onion powder, onion-based broth and baby foods containing onion) promote oxidative damage to hemoglobin in canine and feline red blood cells (Robertson et al, 1998). The result is Heinz body production and red cell destruction.

REACTIONS TO VASOACTIVE AMINES IN FOOD

Another cause of food intolerance is pharmacologic reactions to substances found in food. Vasoactive or biogenic amines such as histamine cause clinical signs in people when present in excessive levels in food (Taylor, 1986; Morrow et al, 1991). Scombroid fish such as tuna, mackerel, skipjack and bonito that spoil before consumption are a frequent cause of histamine toxicosis in people (Taylor, 1986; Morrow et al, 1991). Clinical signs usually include diarrhea, flushing, sweating, nausea, vomiting, urticaria, facial swelling and erythroderma.

The role of histamine and other vasoactive amines in food intolerance in dogs and cats is unknown. Adverse reactions to ingested scombroid fish have been observed in cats and dogs (Guilford et al, 1994a). Surveys to detect histamine in pet foods found the highest levels of histamine in moist fish-based cat foods and those cat foods containing fish solubles (Guilford et al, 1994a; Guraya and Koehler, 1991). Vasoactive amines such as cadaverine may also exacerbate adverse reactions to spoiled fish by inhibiting histamine metabolism (Taylor, 1986; Bjeldanes et al, 1978). Tyramine, spermine, spermidine, phenethylamine, putrescine and cadaverine are other vasoactive amines found in low levels in pet foods (Paulsen, 2000).[b] Vasoactive or biogenic amines may not be present in levels high enough to cause clinical signs, but could lower the threshold levels for allergens in individual dogs and cats. Idiosyncratic intolerances to small quantities of histamine have been reported to occur in people and animals (Guilford et al, 1994a).

CARBOHYDRATE INTOLERANCE

Adult hypolactasia, infantile lactase deficiency, congenital lactose intolerance and congenital glucose-galactose malabsorption are disorders of carbohydrate intolerance in people (Halliwell, 1992). Fewer conditions are associated with recognized carbohydrate intolerance in dogs and cats. However, neonatal death following episodes of diarrhea is common and the same spectrum of metabolic disorders resulting in carbohydrate intolerance in people may occur in dogs and cats (Strombeck and Guilford, 1991; Halliwell, 1992).

The diarrhea, bloating and abdominal discomfort that occur when animals with lactose intolerance ingest milk are relatively common metabolic adverse reactions in dogs and cats (Hill and Kelley, 1974; Mundt and Meyer, 1989). Puppies and kit-

tens normally have adequate levels of intestinal lactase to permit digestion of lactose in the dam's milk. In many subjects, brush border disaccharidase activity decreases after weaning to a fraction of the activity found in young animals. Osmotic diarrhea will often occur when excessive levels of lactose are consumed. Puppies, kittens or adult animals may develop diarrhea when given cow's or goat's milk because these milk sources contain more lactose than either bitch's or queen's milk. One study showed that adult dogs were able to use up to 1 g of lactose/kg body weight/day (Meyer et al, 1984), an amount equivalent to 20 to 22 ml/kg of cow's or goat's milk. Greater amounts increased intestinal lactose and lactic acid concentrations, fecal water content and frequency of defecation.

Intolerance to disaccharides commonly occurs secondary to enteritis or rapid food changes. Loss of intestinal brush border disaccharidase activity contributes to the diarrhea associated with enteritis. Inadequate intestinal disaccharidase activity is also one of the factors responsible for diarrhea following rapid food changes. Several days are required for intestinal disaccharidase activity to adapt to changes in food carbohydrate sources.

DIETARY INDISCRETION

Dietary indiscretions such as gluttony, pica and garbage ingestion usually cause GI signs and can be suspected based on the environmental and nutritional history. The clinical signs may be caused by ingestion of excessive fat, bacterial or fungal toxins, vasoactive amines or indigestible materials such as bone, plastic, wood and aluminum foil. Note that underlying disease such as hyperadrenocorticism can also induce polyphagia and resultant dietary indiscretion.

Key Nutritional Factors

Because most food allergens are thought to be glycoproteins, dietary protein in food is the nutrient of most concern in patients with suspected food allergy. The number of different proteins in the food, protein sources and amount of protein comprise the key nutritional factors for foods for diagnosis and management of adverse food reactions. Whether the patient has been exposed previously to the protein is also important.

Because elimination foods replace regular maintenance foods and are fed long term, several key nutritional factors are included because of their relationship to other common health issues rather than specific benefits for patients suffering from adverse food reactions. **Table 31-3** summarizes the key nutritional factors, which are discussed in more detail below.

Table 31-3. Key nutritional factors for foods for the diagnosis and management of adverse food reactions in dogs and cats.

Factors	Dietary recommendations
Dogs	
Protein	Limit dietary protein to one or two sources Use protein hydrolysate or protein sources to which the dog has not been exposed previously Avoid excess levels of dietary protein (dermatologic cases only): protein should be 16 to 22% DM Use a food that is nutritionally balanced for dogs Avoid foods that contain wheat, barley or rye (dogs with diarrhea)
Vasoactive amines	Avoid foods that contain certain fish ingredients (e.g., tuna, mackerel, skipjack, bonito)
Total omega-3 fatty acids	0.35 to 1.8% DM
Phosphorus*	0.4 to 0.8% DM
Sodium*	0.2 to 0.4% DM
Cats	
Protein	Limit dietary protein to one or two sources Use protein hydrolysate or protein sources to which the cat has not been exposed previously Avoid excess levels of dietary protein (dermatologic cases only): protein should be 30 to 45% DM Use a food that is nutritionally balanced for cats
Vasoactive amines	Avoid foods that contain certain fish ingredients (e.g., tuna, mackerel, skipjack, bonito)
Total omega-3 fatty acids	0.35 to 1.8% DM
Phosphorus*	0.5 to 0.8% DM
Sodium*	0.2 to 0.6% DM
Magnesium*	0.04 to 0.1% DM
Urinary pH*	6.2 to 6.4

Key: DM = dry matter.
*Not related to adverse reactions to food but important when elimination foods are used for long-term feeding: phosphorus and sodium are considered key nutritional factors for apparently healthy adult dogs and cats for purposes of ameliorating or slowing the progression of subclinical kidney disease and/or hypertension; magnesium and urinary pH are important for reducing the risk of feline lower urinary tract disease.

Protein

Commercial veterinary therapeutic foods containing unique or novel protein ingredients have been available for more than 40 years. Novel protein sources are usually defined as animal or vegetable ingredients containing protein that are not commonly used in pet foods and/or are not commonly associated with adverse food reactions. Examples of such protein sources include lamb, venison, rabbit, various fish, rice, potato and green peas. Beef, dairy products and wheat in dogs, and beef, dairy products and fish in cats are the most commonly reported ingredients causing adverse reactions and should be avoided in patients with adverse reactions to foods. A careful dietary history should disclose these protein sources. Several published clinical studies support the use of commercial foods containing novel protein sources in the management of adverse food reactions in cats and dogs (Roudebush et al, 2002).

Using the product label to determine whether a potentially offensive protein source(s) is/are present in a patient's current food can be challenging. A large number of protein ingredients are used to manufacture typical commercial pet foods. Many protein ingredients differ from those commonly used for human consumption and may be unfamiliar to veterinarians, veterinary health care team members and animal owners. For example, chicken for human consumption, chicken used in moist pet foods and poultry by-product meal used in dry pet

foods may each contain unique allergens. Chapter 8 discusses pet food ingredients and reviews several of the more commonly used protein sources. In the U.S., most commercial foods must adhere to the Association of American Feed Control Official (AAFCO) guidelines for label ingredient listings and definitions (AAFCO, 2008). The definitions can help determine what specific protein sources are in a given ingredient. This information might not be obvious from reading a product's label (Chapter 9).

Another approach to providing novel protein ingredients is the use of hydrolyzed protein(s). Protein hydrolysates offer several hypothetical advantages over intact protein sources. Protein hydrolysates of appropriate molecular weight (<10,000 daltons) are less likely to elicit an immune-mediated response. For example, complete digestion of an initially intact food protein results in free amino acids and small peptides that are poor antigens (Yunginger, 1991). In contrast, poorly digested protein has the potential to incite an allergic response because of residual antigenic proteins and large polypeptides.

Several published clinical studies document the efficacy of foods containing protein hydrolysates in veterinary patients. Clinical improvement was seen in 50 to 80% of dogs allergic to the intact protein (Beale et al, 2001; Jackson et al, 2003; Puigdemont et al, 2006; Serra et al, 2006). Additionally, several clinical trials with protein hydrolysate-type foods have been conducted in canine and feline patients seen in private and specialty practices with dermatologic or GI disease. The results of these studies show similar efficacy of hydrolysates as compared with the more traditional novel protein sources (Loeffler et al, 2004, 2006; Ishida et al, 2004; Biourge et al, 2003; Rosser, 2001). Protein hydrolysates have also been used successfully in cats with self-inflicted alopecia (psychogenic alopecia) and chronic GI disorders (Waly et al, 2006; Waisglass et al, 2006).

Foods containing protein hydrolysates may also benefit patients with increased GI permeability, in which enhanced protein absorption contributes to the pathogenesis of the disease. One study showed positive responses in a small number of dogs with IBD (Marks et al, 2002). Protein hydrolysates have been used for many years in human infant formulas and for human patients with various GI diseases. Novel or unique protein sources are less important with protein hydrolysates. Total protein content, average molecular weight of the hydrolyzed protein and digestibility of nutrients vary among these products.

The value of high protein digestibility in foods with intact protein ingredients has been documented for some commercial pet foods marketed as hypoallergenic or elimination foods (Roudebush et al, 1995). As noted above, more complete digestion of an initially intact food protein results in more free amino acids and small peptides that are poor antigens (Yunginger, 1991). Protein digestibility of at least 87% is recommended for such foods. This degree of protein digestibility is typically met by most veterinary therapeutic pet foods.

Elimination foods that use intact novel proteins should contain preferably only one but no more than two protein sources to which the patient has not been previously exposed. This recommendation includes commercial or homemade foods and either animal or vegetable protein sources.

Excess protein levels should be avoided to reduce the amount of potential allergens to which the patient is exposed. Foods for dogs should provide between 16 to 22% dry matter (DM) protein and foods for cats should provide between 30 to 45% DM protein. A higher protein level may be necessary to counteract losses from the GI tract or impaired absorption in patients with hypoproteinemia and weight loss associated with severe GI disease. Certain protein ingredients are more likely sources of excessive levels of vasoactive or biogenic amines such as histamine. The highest levels of histamine occur in moist fish-based cat foods and cat foods containing fish solubles (Guilford et al, 1994a; Guraya and Koehler, 1991). Pet foods containing these fish may be a source of such amines and probably should be avoided. Human foods that may contain excessive levels of vasoactive or biogenic amines include tomato, avocado, cheese, liver, processed meats such as sausage and certain fish. As mentioned above, vasoactive or biogenic amines may not be present in levels high enough to cause clinical signs, but could lower the threshold levels for allergens in individual dogs and cats.

Omega-3 Fatty Acids

Omega-3 (n-3) fatty acids exhibit multiple antiinflammatory and immunomodulating effects. They have the potential to affect allergic and other inflammatory diseases through modulating cytokine production, inhibiting cellular activation and cytokine secretion, altering the composition and, in the case of dermatologic disease, function of the epidermal lipid barrier (Olivry et al, 2001). Their mechanisms of action, therefore, are likely to be explained by a combination of effects. Generally, however, omega-3 fatty acids are thought to produce less inflammatory cytokines (Sigal, 1991; Lands, 1989; Lokesh et al, 1988; Lokesh and Kinsella, 1987; Broughton et al, 1991; Croft et al, 1987).

Based on levels of omega-3 fatty acid supplementation recommended for use in the management of inflammatory skin diseases (Chapter 32), veterinary therapeutic foods for dogs and cats with inflammatory disease related to adverse food reactions should provide 0.35 to 1.8% DM of total omega-3 fatty acids. However, because of their potential benefit in inflammatory diseases, inclusion of omega-3 fatty acids could confuse the diagnostic phase of managing food sensitivity. The ratio of omega-6 to omega-3 fatty acids that should be included in foods for patients with adverse food reactions is currently unknown.

Phosphorus, Sodium, Magnesium and Urinary pH

Elimination foods used to diagnose patients with possible food sensitivity are fed for short time periods. However, if there is a positive diagnosis of food sensitivity, appropriate veterinary therapeutic foods are fed for prolonged periods of time, in the place of regular maintenance foods. Phosphorus and sodium are recommended as key nutritional factors for maintenance foods for apparently healthy adult dogs and cats for purposes of ameliorating, or slowing the progression of possible concurrent

subclinical kidney disease and/or hypertension. Thus, even though phosphorus and sodium are not associated with food sensitivity, they are included as key nutritional factors for overall health. The recommended allowances for phosphorus and sodium in foods for adult dogs are 0.4 to 0.8% DM and 0.2 to 0.4% DM, respectively. For foods for adult cats, the recommended allowances for phosphorus and sodium are 0.5 to 0.8% DM and 0.2 to 0.6% DM, respectively. In addition, for adult cats, magnesium and urinary pH are also key nutritional factors for foods intended for long-term feeding, based on their role in feline lower urinary tract disease. The recommended allowance for magnesium in foods for adult cats is 0.04 to 0.1% DM. Foods for adult cats should produce a urinary pH in the range of 6.2 to 6.4. Chapters 13 and 20 discuss the rationale for including these key nutritional factors for dogs and cats, respectively.

Other Nutritional Factors

Carbohydrate and Fat

Modification of the total dietary fat and carbohydrate content of foods is usually not required in the management of food-sensitive dermatologic patients. However, choosing foods with highly digestible fat and carbohydrate can be important in the management of food-sensitive GI patients because of the enteropathy and malassimilation that may result from allergic inflammation of the GI tract. Furthermore, a reduction in the content of one or both of these macronutrients may be required in patients with nonimmunologic food intolerances to fat and carbohydrate.

Food Additives

Pet food additives such as antimicrobial preservatives, colorants, antioxidant preservatives and emulsifying agents rarely cause food intolerance or allergy. Additives are found least often in moist pet foods and most commonly in semi-moist foods, treats, snacks and dry foods. Many moist commercial pet foods are free of additives. Two of the most frequently incriminated additives in human foods, benzoates and tartrazine, are rarely found in commercial pet foods. However, other additives that have been documented to cause problems in people are found in pet foods (**Table 31-4**). These include azo dyes, non-azo dyes, sodium bisulfite, sodium glutamate, sodium nitrate, butylated hydroxyanisole (BHA), spices, sodium alginate, guar gum and propylene glycol (Fuglsang et al, 1994).

Table 31-4. Food additives that have been reported as occasional causes of food intolerance in people and that are sometimes present in pet foods or treats.*

Antioxidant preservatives
Butylated hydroxyanisole (BHA)
Butylated hydroxytoluene (BHT)
Antimicrobial preservatives
Sodium nitrite
Humectants
Propylene glycol
Coloring agents/preservatives
Azo dyes
  Tartrazine (FD&C No. 5)
  Sunset yellow (FD&C No. 6)
  Allura red (FD&C No. 40)
Non-azo dyes
  Brilliant blue (FD&C No. 1)
  Indigotin (FD&C No. 2)
Flavors/flavor enhancers
Monosodium glutamate
Spices
Emulsifying agents, stabilizers, thickeners
Seaweed extracts (carrageenan, alginates)
Seed gums (guar gum)
*These additives are frequently incriminated as causing adverse food reactions in dogs and cats, but there are no well-documented case reports to substantiate this perception.

FEEDING PLAN

Unlike most other clinical conditions, the feeding plan for possible food sensitivity patients includes a diagnostic phase. At the present time, intradermal testing, RASTs and ELISAs for food hypersensitivity are considered unreliable for patients with dermatologic disease (Jeffers et al, 1991; Kunkle and Horner, 1992). Dietary elimination trials are the primary diagnostic method used in dogs and cats with suspected adverse food reactions (Jackson, 2009) and are discussed below in the Assess and Determine the Feeding Method section.

Assess and Select the Food

Commercial Elimination Foods

Ingredient statements on commercial pet food labels in the U.S. are sources of information for identifying all the food ingredients that might cause adverse reactions. An individual dog or cat may develop an adverse reaction to virtually any pet food ingredient. However, particular attention should be directed at those ingredients that contain protein. Unfortunately, pet food labeling requirements in other countries are not necessarily as stringent and ingredient statement information is often incomplete (Chapter 9). Contact the manufacturer or distributor for more detailed ingredient information when the ingredient statement is incomplete.

Several companies manufacture a variety of foods with limited and different protein sources (**Tables 31-5** and **31-6**). These commercial veterinary therapeutic products are convenient, contain protein hydrolysates and/or novel protein sources and are nutritionally complete and balanced for either dogs or cats (approved for long-term feeding of healthy adults by a credible regulatory agency such as AAFCO). Unfortunately, few of these commercial foods have been adequately tested in dogs and cats with known adverse food reactions; only a limited number of foods (approximately 15 of more than 50 veterinary therapeutic foods marketed for adverse food reactions) have undergone the scrutiny of clinical trials using patients with dermatologic or GI disease (Rutgers et al, 1995; Simpson et al, 1994; Nelson et al, 1988; Jeffers et al, 1991; Rosser, 1993; Paterson, 1995; Roudebush and Schick, 1995; Guilford et al, 2001; Loeffler et al, 2004, 2006). In published clinical trials,

Table 31-5. Selected commercial veterinary therapeutic foods marketed as elimination foods for dogs with adverse food reactions compared to key nutritional factor recommendations.*

Dry foods	Protein ingredients	Protein (%)**	Omega 3 (%)***	P (%)†	Na (%)†
Recommendations	**Maximum of 1-2 protein sources Avoid scombroid fish†† Avoid wheat, barley and rye†††**	**16-22**	**0.35-1.8**	**0.4-0.8**	**0.2-0.4**
Hill's Prescription Diet d/d Potato & Duck Formula Canine	Potato, duck	18	0.35	0.58	0.36
Hill's Prescription Diet d/d Potato & Salmon Formula Canine	Potato, salmon	18.4	0.995	0.58	0.37
Hill's Prescription Diet d/d Potato & Venison Formula Canine	Potato, venison	18	0.337	0.57	0.36
Hill's Prescription Diet d/d Rice & Egg Formula Canine	Rice, egg	18.8	0.366	0.5	0.28
Hill's Prescription Diet z/d Low Allergen Canine	Potato, hydrolyzed chicken/chicken liver	19.6	na	0.57	0.36
Hill's Prescription Diet z/d ULTRA Allergen-Free Canine	Hydrolyzed chicken/chicken liver	19	na	0.51	0.29
Iams Veterinary Formula Skin & Coat/ Response FP Canine	Potato, herring meal, beet pulp	25.0	na	0.99	0.35
Iams Veterinary Formula Skin & Coat/ Response KO Canine	Oat flour, kangaroo, canola meal, beet pulp	22.7	na	1.01	0.44
Medi-Cal Hypoallergenic Formula	Oat flour/hulls, rice, duck meal	21.3	0.7	0.8	0.4
Medi-Cal Hypoallergenic HP	Rice, soy protein isolate hydrolysate, beet pulp	23.1	0.4	0.9	0.4
Medi-Cal Sensitivity RC 21	Rice/rice gluten, catfish meal	25.8	na	1.3	0.5
Medi-Cal Vegetarian Formula	Oat flour, rice, potato protein, flax meal, beet pulp, tomato pomace	20.9	na	0.9	0.4
Natural Balance Limited Ingredient Diet Potato & Duck Formula	Potato, duck/duck meal, flaxseed	na	na	na	na
Natural Balance Limited Ingredient Diet Sweet Potato & Fish Formula	Sweet potato, salmon/salmon meal, flaxseed	na	na	na	na
Natural Balance Limited Ingredient Diet Sweet Potato & Venison Formula	Sweet potato, venison/venison meal, potato protein, flaxseed	na	na	na	na
Purina Veterinary Diets DRM Dermatologic Management Canine Formula	Rice, salmon meal, trout, canola meal, brewers yeast	30.2	na	1.16	0.24
Purina Veterinary Diets HA Hypoallergenic Canine Formula	Soy protein isolate	21.3	na	0.87	0.24
Royal Canin Veterinary Diet Canine Hypoallergenic HP 19	Rice, soy protein hydrolysate, beet pulp	23.1	0.901	0.88	0.44
Royal Canin Veterinary Diet Canine Potato & Duck Formula	Potato/potato protein, duck/duck by-product meal	22.2	na	0.68	0.33
Royal Canin Veterinary Diet Canine Potato & Duck Formula Light	Potato/potato protein, duck/duck by-product meal	26.9	na	0.81	0.38
Royal Canin Veterinary Diet Canine Potato & Rabbit Formula	Potato/potato protein, rabbit/rabbit meal	23.1	na	0.67	0.33
Royal Canin Veterinary Diet Canine Potato & Venison Formula	Potato/potato protein, venison/venison meal	22.3	na	1.01	0.24
Royal Canin Veterinary Diet Canine Potato & Venison Formula Large Breed	Potato/potato protein, venison/venison meal	23.6	na	1.08	0.45
Royal Canin Veterinary Diet Canine Potato & Whitefish Formula	Potato, herring meal, whitefish	22.5	na	0.66	0.44

usually two-thirds to three-fourths of patients with suspected adverse food reactions had significantly improved clinical signs when fed commercial veterinary therapeutic elimination-type foods. **Tables 31-5** and **31-6** compare the recommended key nutritional factors to those in selected commercial veterinary therapeutic foods intended for patients with adverse food reactions.

Novel or unique protein sources are less important when the patient's nitrogen and amino acid requirements are met by protein hydrolysates. Clinical trials with protein hydrolysates show similar efficacy to more traditional novel protein-source foods (Loeffler et al, 2004, 2006; Ishida et al, 2004; Biourge et al, 2003; Rosser, 2001). Protein hydrolysate foods have also been used successfully in cats with self-inflicted alopecia and chronic GI disorders (Waly et al, 2006; Waisglass et al, 2006).

In general, snacks, chews and treats should be avoided.

Royal Canin Veterinary Diet Canine Skin Support SS 21	Menhaden fish meal, rice/brown rice, beet pulp	25.3	0.714	1.21	0.44
Royal Canin Veterinary Diet Canine Vegetarian Formula	Oat flour, rice, yeast culture, tomato pomace, beet pulp, flaxseed, carrot pomace	19.1	na	0.56	0.15
Wellness Simple Food Solutions Rice + Duck Formula	Rice/rice protein concentrate, duck, flaxseed	na	na	na	na
Wellness Simple Food Solutions Rice + Venison Formula	Rice/rice protein concentrate, venison, flaxseed	na	na	na	na
Moist foods	**Protein ingredients**	**Protein (%)****	**Omega 3 (%)*****	**P (%)†**	**Na (%)†**
Recommendations	**Maximum of 1-2 protein sources** **Avoid scombroid fish††** **Avoid wheat, barley and rye†††**	**16-22**	**0.35-1.8**	**0.4-0.8**	**0.2-0.4**
Hill's Prescription Diet d/d Duck Formula Canine	Duck/duck liver, potato	17.4	0.384	0.69	0.36
Hill's Prescription Diet d/d Lamb Formula Canine	Rice, lamb/lamb liver	15.8	0.395	0.31	0.34
Hill's Prescription Diet d/d Salmon Formula Canine	Salmon, potato	18.9	1.787	0.7	0.33
Hill's Prescription Diet d/d Venison Formula Canine	Venison, potato	18.9	0.328	0.53	0.37
Hill's Prescription Diet z/d ULTRA Allergen-Free Canine	Hydrolyzed chicken liver	19.6	na	0.57	0.2
Iams Veterinary Formula Skin & Coat/Response FP Canine	Catfish, herring meal, potato starch, beet pulp	35.5	na	0.92	0.60
Medi-Cal Hypoallergenic Formula	Pheasant, rice flour, duck meal, oat hulls	20.1	0.006	1.0	0.5
Medi-Cal Sensitivity VR	Venison/venison by-products, rice	35.8	na	2.4	1.2
Medi-Cal Vegetarian Formula	Rice/brown rice, soy protein isolate	26.4	na	0.7	0.5
Natural Balance Duck & Potato Formula	Duck/duck liver, potato	na	na	na	na
Natural Balance Fish & Sweet Potato Formula	Ocean white fish, sweet potato, salmon, potato, fish meal	na	na	na	na
Natural Balance Venison & Sweet Potato Formula	Venison/venison liver, sweet potato, potato	na	na	na	na
Royal Canin Veterinary Diet Canine Duck Formula	Potato, duck/duck by-products	18.5	na	0.86	1.45
Royal Canin Veterinary Diet Canine Venison Formula	Potato, venison/venison by-products	18.5	na	0.86	1.45
Royal Canin Veterinary Diet Canine Whitefish Formula	Potato, whitefish	18.5	na	0.86	1.45
Wysong Duck Au Jus	Duck, animal plasma	na	na	na	na
Wysong Rabbit Au Jus	Rabbit	na	na	na	na
Wysong Turkey Au Jus	Turkey/turkey liver, animal plasma	na	na	na	na
Wysong Venison Au Jus	Venison/venison liver, animal plasma	na	na	na	na

Key: Omega 3 = total omega-3 fatty acids, P = phosphorus, Na = sodium, na = not available from manufacturer.
*Values are on a dry matter basis unless otherwise stated.
**A higher protein level may be necessary to counteract protein losses from the GI tract or impaired absorption in patients with hypoproteinemia and weight loss associated with severe GI disease.
***Omega-3 fatty acids are important for dermatologic cases.
†Phosphorus and sodium are not important for adverse food reactions but are important for overall health when feeding these foods long-term.
††Fish source ingredients that can be a source of vasoactive amines.
†††For dogs with diarrhea.

Another criterion for selecting a food that may become increasingly important in the future is evidence-based clinical nutrition. Practitioners should know how to determine risks and benefits of nutritional regimens and counsel pet owners accordingly. Currently, veterinary medical education and continuing education are not always based on rigorous assessment of evidence for or against particular management options. Still, studies have been published to establish the nutritional benefits of certain pet foods. Chapter 2 describes evidence-based clinical nutrition in detail and applies its concepts to various veterinary therapeutic foods.

Homemade Elimination Foods

Results of a survey of veterinarians in the American Academy of Veterinary Dermatology (AAVD) showed that homemade foods were often recommended as the initial test

Table 31-6. Selected commercial veterinary therapeutic foods marketed as elimination foods for cats with adverse food reactions compared to key nutritional factor recommendations.*

Dry foods	Protein ingredients	Protein (%)**	Omega 3 (%)***	P (%)†	Na (%)†	Mg (%)†	Urinary pH†
Recommendations	**Maximum of 1-2 protein sources Avoid scombroid fish††**	**30-45**	**0.35-1.8**	**0.5-0.8**	**0.2-0.6**	**0.04-0.1**	**6.2-6.4**
Hill's Prescription Diet d/d Duck & Green Pea Formula Feline	Peas, duck/duck meal	32	0.353	0.72	0.4	0.111	6.30
Hill's Prescription Diet d/d Rabbit & Green Pea Formula Feline	Peas, rabbit/rabbit meal	32	0.336	0.73	0.34	0.118	6.38
Hill's Prescription Diet d/d Venison & Green Pea Formula Feline	Peas, venison/venison meal	32	0.34	0.74	0.3	0.116	6.32
Hill's Prescription Diet z/d Low Allergen Feline	Rice, hydrolyzed chicken liver/hydrolyzed chicken	33	0.102	0.67	0.34	0.068	6.30
Medi-Cal Hypoallergenic HP 23	Rice/rice gluten, soy protein isolate hydrolysate	27.4	0.3	0.8	0.5	na	na
Medi-Cal Hypoallergenic/Gastro	Potato meal/potato protein, duck meal, rice	29.8	0.24	0.9	0.4	na	6.2
Medi-Cal Sensitivity RD 30	Rice/rice gluten, duck by-product meal	34.4	na	1.3	0.6	na	na
Natural Balance Limited Ingredient Diets Duck & Green Pea Formula	Peas, duck meal, flaxseed	na	na	na	na	na	na
Royal Canin Veterinary Diet Feline Green Peas & Duck Formula	Peas, duck meal/duck	34.9	na	1.45	0.77	0.118	na
Royal Canin Veterinary Diet Feline Green Peas & Lamb Formula	Peas/pea protein, lamb meal/lamb	34.9	na	1.43	0.76	0.129	na
Royal Canin Veterinary Diet Feline Green Peas & Rabbit Formula	Peas/pea protein, rabbit meal/rabbit	34.9	na	1.13	0.77	0.172	na
Royal Canin Veterinary Diet Feline Green Peas & Venison Formula	Peas/pea protein, venison meal/venison	34.9	na	1.81	0.87	0.129	na
Moist foods	**Protein ingredients**	**Protein (%)****	**Omega 3 (%)*****	**P (%)†**	**Na (%)†**	**Mg (%)†**	**Urinary pH†**
Recommendations	**Maximum of 1-2 protein sources Avoid scombroid fish††**	**30-45**	**0.35-1.8**	**0.5-0.8**	**0.2-0.6**	**0.04-0.1**	**6.2-6.4**
Hill's Prescription Diet d/d Duck Formula Feline	Duck/duck liver, peas	38.1	0.479	0.75	0.3	0.083	6.38
Hill's Prescription Diet d/d Rabbit Formula Feline	Rabbit, peas	36	0.594	0.73	0.27	0.08	6.24

food for dogs and cats with suspected food allergy (Roudebush and Cowell, 1992). Homemade test foods usually include a single protein source or a combination of a single protein source and a single carbohydrate source. Ingredients typically recommended for homemade feline foods include lamb baby food, lamb, rice and rabbit. Lamb, rice, potato, fish, rabbit, venison, various beans and tofu are often recommended for homemade canine foods.

Most of the homemade foods recommended in the AAVD survey for initial management of dogs and cats with suspected food allergy were nutritionally inadequate for growth or adult maintenance (Roudebush and Cowell, 1992). Most homemade foods fail to meet nutritional requirements because they are made from a minimum of ingredients. In general, homemade foods lack a source of calcium, essential fatty acids, certain vitamins and other micronutrients and contain excessive levels of protein, which are contraindicated in food allergy cases.

Feeding nutritionally inadequate homemade foods to dogs less than 12 months of age and cats for more than three weeks may result in clinical problems. Anorexia and poor growth occur in puppies within 10 to 20 days of feeding a thiamin-deficient food (NRC, 2006). Anorexia and emesis occur within one to two weeks after a thiamin-deficient food is fed to cats (NRC, 2006). Many previously recommended homemade elimination foods have a severe inverse calcium-to-phosphorus ratio of 1:10. Skeletal disease in young dogs can occur within four weeks of feeding a food with severe mineral imbalances (Goddard et al, 1970; Morris et al, 1971). Such foods should not be fed for longer than three weeks (Codner and Thatcher, 1990).

This book and other references contain complete and balanced homemade food recipes (Lewis et al, 1987; Remillard and Thatcher, 1989; Meyer, 1990; Roudebush, 1994; Brown et al, 1995; Strombeck, 1999). Non-flavored vitamin and mineral supplements are not perceived as causes of adverse food reactions. Additive-free supplements that do not contain animal or vegetable proteins are unlikely to be sources of ingested allergens. Intolerance to calcium supplements has been reported to occur in atopic children, but is rare (Devlin and David, 1990). Homemade rations should also contain a source of essential fatty acids, such as vegetable oil. Vegetable oils are not a routine source of ingested allergens; studies show that people allergic to

Hill's Prescription Diet d/d Venison Formula Feline	Venison/venison liver, peas	37.3	0.654	0.73	0.35	0.088	6.45
Hill's Prescription Diet z/d ULTRA Allergen-Free Feline	Hydrolyzed chicken liver	33.7	na	0.64	0.3	0.064	6.28
Iams Veterinary Formula Skin & Coat/Response LB Feline	Lamb/lamb liver/lamb by-products/lamb meal, barley, beet pulp	43.4	na	1.02	0.34	0.085	na
Medi-Cal Hypoallergenic/Gastro	Duck/duck meal, rice	35.5	0.16	1.7	0.7	na	6.4
Medi-Cal Sensitivity CR	Chicken, rice	34.5	na	1.6	1.1	na	na
Medi-Cal Sensitivity VR	Venison by-products/ venison, rice	43.0	na	1.6	1.0	na	na
Natural Balance Limited Ingredient Diets Duck & Green Pea Formula	Duck/duck liver/duck meal, peas/pea protein	na	na	na	na	na	na
Natural Balance Limited Ingredient Diets Venison & Green Pea Formula	Venison/venison liver, venison meal, peas, flax-seed	na	na	na	na	na	na
Royal Canin Veterinary Diet Feline Duck Formula	Duck/duck by-products, peas	44.1	na	0.74	0.47	0.078	na
Royal Canin Veterinary Diet Feline Lamb Formula	Lamb by-products/lamb, peas	44.1	na	0.74	0.47	0.078	na
Royal Canin Veterinary Diet Feline Venison Formula	Venison by-products/ venison, peas	44.1	na	0.74	0.47	0.078	na
Wysong Duck Au Jus	Duck, animal plasma	na	na	na	na	na	na
Wysong Rabbit Au Jus	Rabbit	na	na	na	na	na	na
Wysong Turkey Au Jus	Turkey/turkey liver, animal plasma	na	na	na	na	na	na
Wysong Venison Au Jus	Venison/venison liver, animal plasma	na	na	na	na	na	na

Key: Omega 3 = total omega-3 fatty acids, P = phosphorus, Na = sodium, Mg = magnesium, na = not available from manufacturer.
*Values are on a dry matter basis unless otherwise stated.
**A higher protein level may be necessary to counteract protein losses from the GI tract or impaired absorption in patients with hypoproteinemia and weight loss associated with severe GI disease.
***Omega-3 fatty acids are important for dermatologic cases.
†Phosphorus, sodium, magnesium and urinary pH are not important for adverse food reactions but are important for overall health when feeding these foods long-term.
††Fish ingredients that can be a source of vasoactive amines.

peanuts and soybeans can safely ingest peanut oil or soybean oil (Taylor et al, 1981; Nordlee et al, 1981; Bush et al, 1985; Bock, 1991). Homemade food recipes should provide an optimal amount of protein and foods for cats should be supplemented with taurine.

Assess and Determine the Feeding Method

Feeding method factors to consider include how the food is offered, amount fed, access to other food and who feeds the pet. All of this information should have been gathered when the history of the patient was obtained. If the patient has a normal body condition score (2.5/5 to 3.5/5), the amount of food it was fed previously (energy basis) was probably appropriate. There are two basic phases to the feeding method for patients suspected of having adverse food reactions: the diagnostic phase and the treatment phase.

Diagnostic Phase

PERFORMING AN ELIMINATION TRIAL IN PATIENTS WITH DERMATOLOGIC DISEASE

Before an elimination trial is initiated, the clinician should discuss potential sources of food allergens with the client (**Figure 31-5**). The patient is then fed a controlled elimination food for six to 12 weeks. In addition to the feeding change, no other substances should be ingested including treats, flavored vitamin supplements, chewable medications, fatty acid supplements and chew toys. Flavored chewable medications (e.g., oral heartworm preventive medications) have been proven to cause adverse reactions in dogs and should be changed or discontinued in patients with suspected food allergy or intolerance (Jackson and Hammerberg, 2002a). During the elimination trial, the client should document daily the type and amount of food ingested and the occurrence and character of adverse reactions (**Figure 31-6**). A daily food diary helps document progression of clinical signs during the elimination trial and whether a strict elimination trial was performed in the home environment. The diary will often reveal different findings than those offered to the clinician by the client during the recheck examination.

A tentative diagnosis of an adverse food reaction in dermatologic patients is made if the level of pruritus markedly decreases. This improvement may be gradual and may take four to 12 weeks to become evident. In many cases, concurrent

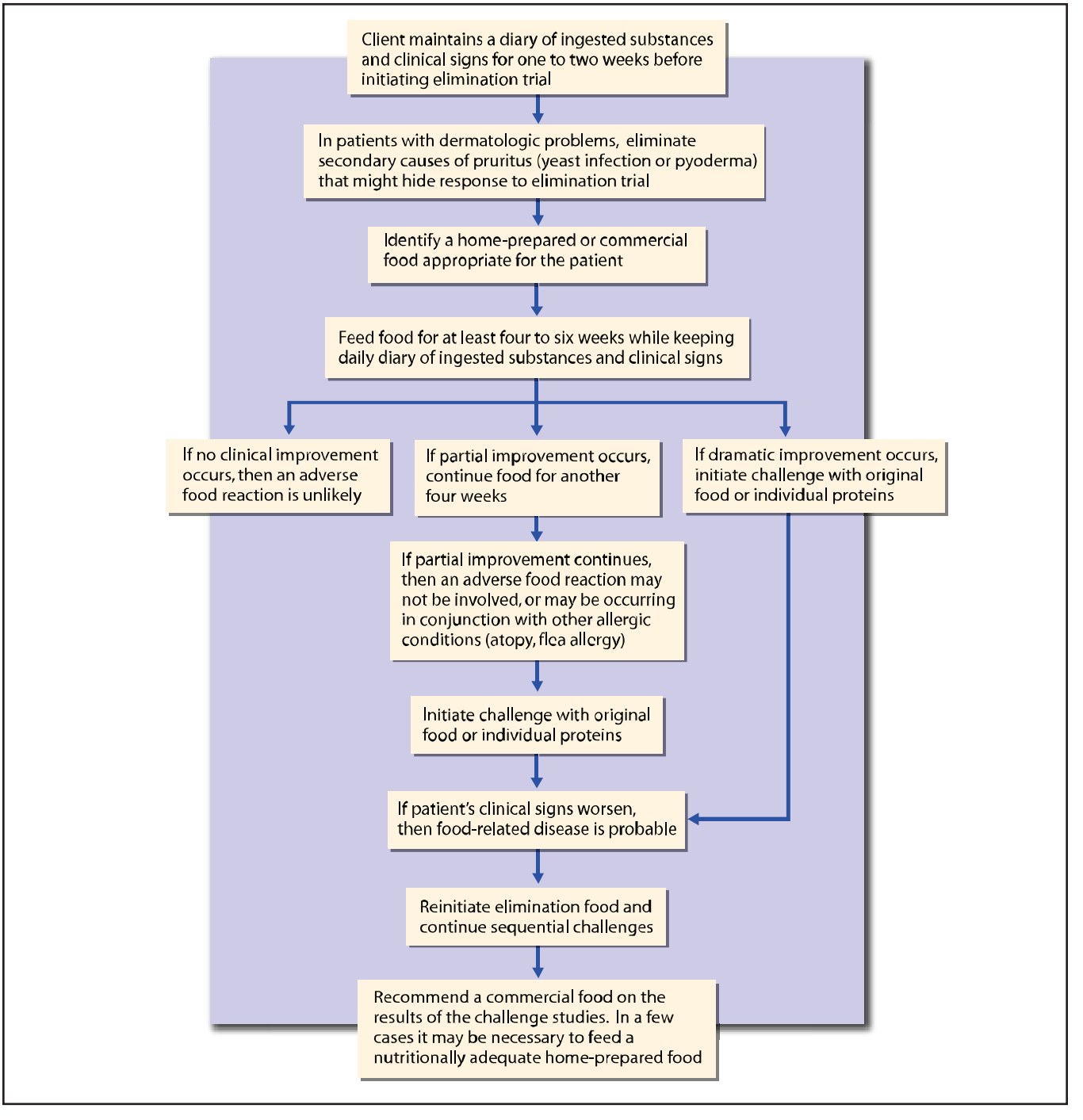

Figure 31-5. Protocol for elimination-challenge trials for the diagnosis of adverse reactions to food.

Malassezia dermatitis, pyoderma and/or otitis externa are present at the time of initial presentation. Treatment for these conditions may be prescribed concurrent with the elimination trial, but after therapy is completed the patient should be fed the elimination food only for two to three weeks before challenge (see below) to ensure that any improvement is maintained. It is also prudent to check that the client is not administering prescribed medications in elicit foods. Patients with chronic otitis externa due to adverse food reactions may require four to six month for obvious improvement to be noted, especially if proliferative lesions are present.

A diagnosis of an adverse food reaction is confirmed if clinical signs reappear after the patient's former food and other ingested substances are offered as a challenge. Clinical signs may be evident within hours of challenge or take up to 14 days. Reinstituting the elimination food should resolve the clinical signs induced by the food challenge. Food challenges can be performed in an "open," "single-blind" or "double-blind" manner. In an open food challenge, both the client and veterinarian are aware that a specific food or previous food is being fed. In a

single-blind food challenge, only the veterinarian is aware of what food is being given. In a double-blind food challenge, neither the client nor veterinarian is aware of whether a specific food is being given. Double-blind, placebo-controlled food challenges are considered to be the "gold standard" for the diagnosis of adverse food reactions in people (Sampson, 1993; Bock, 1991). Only half of human patients thought to be allergic to a food react to the food when challenged in controlled, blinded conditions (Bock, 1991). Unfortunately, all reports and most food challenge recommendations in the veterinary literature have been open challenges. Open challenges will continue as the most practical method of establishing tentative diagnoses of adverse food reaction in dogs and cats, but are subject to false interpretation by clients and veterinarians.

Provocation involves introducing single ingredients until as many positive reactions as possible can be documented. Clients and veterinarians are often reluctant to pursue challenge and provocation after clinical signs have improved or have been eliminated. Provocation may also be difficult to perform in many dogs and cats because commercial pet foods contain large numbers of ingredients and feeding the same ingredients often cannot be duplicated in challenge studies. As an example, use of chicken meat in a provocative food challenge may not duplicate the types or levels of antigens found in poultry by-product meal.

Elimination trials are often difficult to interpret because of concurrent allergic skin disease. In several studies, up to 30% of dogs and cats with adverse food reactions had concurrent hypersensitivities (White, 1986; Carlotti et al, 1990; Rosser, 1993, 1993a; Paterson, 1995; Roudebush and Schick, 1995). These patients may only partially respond to an elimination trial. Flea-allergy and atopic dermatitis triggered by environmental allergens are the most common concurrent diseases and should be eliminated through other diagnostic testing.

PERFORMING AN ELIMINATION TRIAL IN PATIENTS WITH GI DISEASE

Elimination-challenge trial designs for patients with GI disease are similar to those for patients with dermatologic problems. However, shorter elimination periods are usually satisfactory (two to four weeks). One study in cats with GI sensitivity showed that vomiting stopped almost immediately in all affected cats and diarrhea resolved within two or three days (Guilford et al, 2001). In chronic relapsing conditions, the elimination period chosen must be longer than the usual symptom-free period of the patient to allow reliable assessment of how food sensitivity contributes to the patient's signs.

As with skin disease, the degree of clinical improvement during the elimination trial will be 100% only if food sensitivity is the sole cause of the patient's problems. For instance, resolution of allergies acquired as a *result* of GI disease will not eliminate the clinical signs due to the primary GI disease process. A return of GI signs after challenge with the responsible allergen will usually occur within the first three days, but may take as long as seven days, particularly if the responsible allergen was removed from the food for longer than one month (Guilford et al, 2001; Walton, 1967).

Treatment Phase

For most adverse food reactions, avoiding the offending foods or food additives is the most effective treatment. Thus, after a diagnosis of adverse food reaction has been made through the proper use of elimination-challenge trials, the elimination food, if nutritionally complete and balanced, should be fed for maintenance. Ideally, when used for long-term feeding, the food choice should also have appropriate levels of phosphorus and sodium for dogs and cats, and magnesium and the recommended urinary pH range for cats (**Tables 31-5** and **31-6**). An attempt should always be made to find an acceptable commercial food that will increase owner compliance with the feeding change.

REASSESSMENT

How selective or meticulous an avoidance food must be depends on the individual patient's sensitivity. Some dogs and cats may suffer adverse reactions to even trace quantities of an offending food or food additive, whereas others may have a higher tolerance level. Concurrent allergies may influence the threshold level of clinical signs in some patients. Symptomatic therapy for pruritic patients may also include corticosteroids and antihistamines. Corticosteroids along with feeding changes are often used in cats with IBD. One-third of people fed a strict avoidance food for one to two years have tolerated the reintroduction of food allergens (Pastorello et al, 1989). Whether this is the case in dogs and cats is not known.

ACKNOWLEDGMENT

The authors and editors acknowledge the contribution of Dr. Kevin J. Shanley in the previous edition of Small Animal Clinical Nutrition.

ENDNOTES

a. Ishida R, Masuda K, Kurata K, et al. Lymphocyte blastogenic responses to inciting food antigens in cats with food sensitivity. Unpublished data. University of Tokyo, Japan, 2002.

b. Roudebush P. Unpublished data. May 1992.

REFERENCES

The references for **Chapter 31** can be found at www.markmorris.org.

Diary for Dietary Elimination Trial							
Day	**Date**	**Food Offered**	**Food Consumed**	**Other Items Ingested***	**Clinical Signs** (Scale 0-5 and Comments)**	**Feces** (Scale 1-5 and Comments)***	**Other Observations**
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2							
3							
4							
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6							
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Figure 31-6. Example of a diary that can be maintained at home by clients during a food elimination trial.

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***Other Items Ingested**
List rawhide chews, vitamin supplements, chewable medications, treats or snacks, fatty acid supplements, table foods, fresh food or access to other food sources (e.g., dog eating cat food or cat eating an animal it has captured outdoors).

****Clinical Signs**
0 = no clinical signs
5 = severe clinical signs
Itching (scratching, rubbing face, chewing, licking, head shaking); hair loss; skin lesions (scabs, scales, bleeding, red skin, pimples)

*****Feces**
1 = liquid feces that have lost all form
2 = soft-liquid feces with no form
3 = soft feces that form a pile
4 = mixture of soft and firm feces with a cylindrical shape
5 = firm feces with cylindrical shape
Presence of mucus or fresh blood; number of daily bowel movements

CASE 31-1

Pruritic Dermatitis in a Domestic Shorthair Cat

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Patient Assessment

A five-year-old neutered female domestic shorthair cat was referred for severe pruritus with self-trauma around the head, neck, forelimbs and ventral abdomen. The owner reported that intense pruritus had been evident for several weeks and that antihistamines given by another veterinarian had been only partially effective in decreasing the itching. The owner took systemic corticosteroids herself several years ago and developed severe side effects. Because of her experience, she was very reluctant to give corticosteroids to her cat. The owner was very upset about the intense pruritus and apologized for her cat's appearance.

The medical history was unremarkable except for intermittent bouts of lower urinary tract disease that had been treated with antibiotics and a veterinary therapeutic food. The cat spent almost all of its time indoors; no other animals were in the home.

Physical examination revealed excoriations and evidence of self-trauma around the face, neck, ventral abdomen and posterior aspects of the forelimbs (**Figures 1** to **3**). No other abnormalities were noted. There was no evidence of flea infestation. The cat weighed 3.2 kg and had a body condition score of 3/5.

Assess the Food and Feeding Method

The cat was currently fed a dry veterinary therapeutic food (Prescription Diet c/d Feline[b]) and various commercial moist cat foods from the grocery store. The dry food was available free choice and small amounts of the moist foods were offered each day.

Questions

1. What are the major rule outs (differential diagnoses) for this cat's generalized pruritus?
2. If an adverse reaction to food is suspected as a cause of this cat's problem, then an elimination trial would be appropriate. What criteria should be used to select a food for the elimination trial?
3. Describe the feeding method and reassessment plan for this patient.
4. How will the history of lower urinary tract disease influence the feeding plan for this patient?

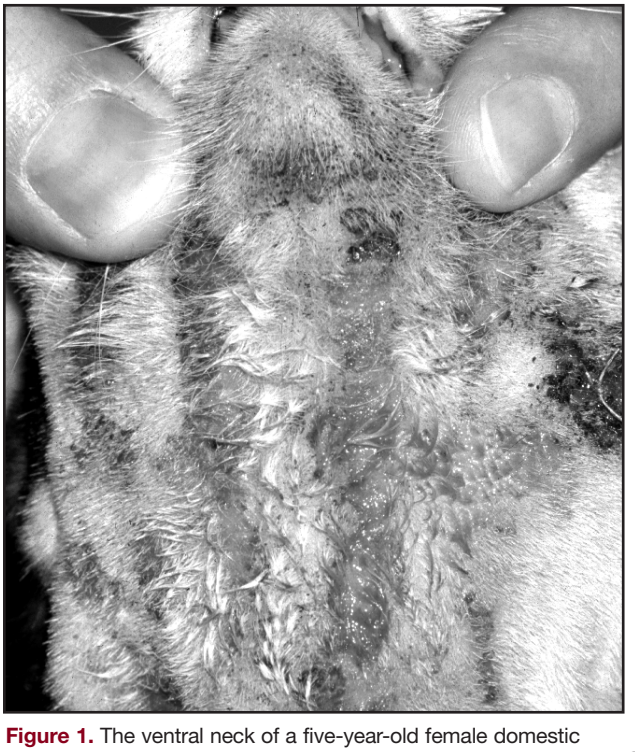

Figure 1. The ventral neck of a five-year-old female domestic shorthair cat showing evidence of severe pruritus with self-trauma.[a]

Answers and Discussion

1. The major rule outs for pruritic dermatitis in this cat include 1) otodectic mange, 2) flea-allergy dermatitis, 3) adverse food reaction, 4) atopic dermatitis triggered by environmental allergens, 5) secondary infections with *Malassezia* spp., and staphylococci spp. and 6) dermatophytosis.

   Otodectic mange. Otodectes cynotis (ear mite) is a nonburrowing, psoroptid mite that lives on the surface of the skin. Lesions are usually restricted to the ear canal (otitis externa) but mites are commonly found on other areas of the body, especially on the neck, rump and tail. These ectopic mites often cause no disease but some animals have a pruritic dermatitis that may resemble flea-bite hypersensitivity, atopy or food allergy.

   Arthropod hypersensitivity. Flea-bite hypersensitivity (flea-allergy dermatitis) is the most common feline hypersensitivity disease in areas where fleas are present, causing a variety of clinical syndromes all characterized by pruritus. No age, breed or gender predilections have been reported in cats. Papulocrustous eruptions are the most typical lesions, although alopecia, excoriations, crusts and scales may also be found. The presence of fleas, flea dirt, flea eggs or infection with the tapeworm *Dipylidium caninum* provide circumstantial evidence of flea allergy. Recent bathing or grooming may, however, remove all evidence of fleas. In this case, there was no history of flea exposure and no evidence of fleas on the cat.

Adverse reaction to food (food allergy or food intolerance). The intense pruritus in this patient with traumatic alopecia centered around the head, neck and ears is one of the more common clinical manifestations of adverse food reactions in cats. Other dermatologic signs of adverse food reactions in cats include severe, generalized pruritus without significant lesions, miliary dermatitis, moist dermatitis and scaling dermatoses. Angioedema, urticaria and conjunctivitis may occur in up to one-third of cats with adverse food reactions. Concurrent flea-allergy dermatitis and atopy also commonly occur in these patients.

Atopic dermatitis. Feline atopic dermatitis is caused by an exaggerated or inappropriate response of the affected cat to environmental allergens. It is considered the second most common hypersensitivity in cats after flea-allergy dermatitis. The most common clinical signs are noninflammatory alopecia, eosinophilic granuloma complex lesions, miliary dermatitis and pruritus of the face or pinnae. The clinical signs in this patient are compatible with those of feline atopic dermatitis although concurrent flea-bite hypersensitivity and adverse food reactions may also occur.

Secondary infections. Malassezia spp. or staphylococci infections are common and may contribute to the pruritus. Skin surface cytology should be performed to detect these organisms and treatment instituted if necessary.

Dermatophytosis. Feline dermatophytosis most often appears as one or more irregular or annular areas of alopecia on the head, pinnae or paws. The alopecia may be severe and widespread, accompanied by little evidence of inflammation. Pruritus is usually absent to minimal although some cats have a more inflammatory reaction with pruritus and widespread papulocrustous dermatitis. Dermatophytosis is more common in young cats.

Figure 2. The head and face of the cat in Figure 1 with evidence of intense pruritus and self trauma.[a]

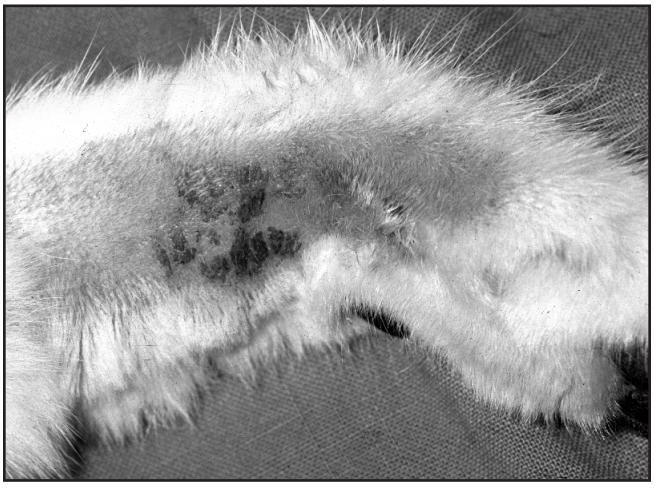

Figure 3. The antebrachium of the cat in Figure 1 showing erythroderma and hair loss due to excessive licking.[a]

2. The key nutritional factors for elimination foods for feline patients with dermatologic disease should: 1) have a limited number of protein sources, 2) have protein hydrolysates or novel protein sources to which the patient has not been previously exposed, 3) avoid excess levels of protein (30 to 45% dry matter), 4) avoid excessive levels of biogenic amines such as histamine, putrescine, cadaverine, etc., 5) have increased levels of omega-3 fatty acids and be nutritionally appropriate for long-term feeding of adult cats (including these key nutritional factors: phosphorus, sodium, magnesium and urinary pH). **Table 31-6** lists selected commercial veterinary therapeutic foods that meet many of these criteria.
3. Before an elimination trial is initiated, the client should be instructed to feed the cat its usual food for several days. During this time the client should record the type and amount of food ingested, any other ingested food items such as table scraps, treats or snacks and the occurrence and character of adverse reactions. The patient should then be fed a controlled elimination food for four to 12 weeks. No other substances such as treats, flavored vitamin supplements or heartworm prophylaxis, fatty acid supplements or toys should be offered. During the elimination trial, the client should document daily the type and amount of food ingested, and the occurrence and character of adverse reactions (**Figure 31-6**). This daily diary is important for documenting the progression of clinical signs during the elimination trial and determining whether a strict elimination trial was performed in the home environment. The diary will often document different findings than those described by the client during the recheck examination.

   A tentative diagnosis of an adverse food reaction is made if the level of pruritus markedly decreases. Improvement may take four to 12 weeks to become evident.
4. Further questioning revealed that this cat had previous problems with struvite urinary precipitates. The struvite precipitates had been well controlled by the veterinary therapeutic food. Offering a food that avoids excess magnesium and produces normal acidic urine helps prevent struvite precipitates (Chapter 46). Therefore, commercial elimination foods used in this patient should also

avoid excess magnesium (<0.1% dry matter magnesium) and produce normal acidic urine (urinary pH 6.2 to 6.4). The urinary pH can be checked periodically as part of the reassessment.

Progress Notes

Diagnostic evaluation included multiple skin scrapings (negative), cytologic evaluation of ear swabs and skin cytology (negative). Intradermal skin testing revealed a few positive reactions to house dust mite antigen and several mold antigens. The cat was treated with an anthelmintic twice at three-week intervals.

Food and Feeding Method

The cat was fed a homemade lamb-based food for four weeks. The food dosage was calculated to maintain current body weight and optimum body condition.

Reassessment

The cat improved slightly after being fed the homemade food for four weeks. Severe pruritus with self-trauma occurred when the previous dry veterinary therapeutic food and one of the moist grocery store foods were fed. The owner refused further testing to establish exactly which ingredients in these foods were causing the problem. Nutritional therapy with a commercial canned lamb and rice food was begun and the cat again responded partially.

A tentative diagnosis of atopic dermatitis, initiated by environmental and food allergens, was made based on the positive skin test results and partial response to a dietary elimination trial. Concurrent allergies occur in up to 20% of cats with adverse reactions to food. The commercial lamb and rice food was continued at the same dosage and an antihistamine (chlorpheniramine) was used to manage periods of intermittent pruritus.

Endnotes

a. Adapted with permission from Roudebush P. Nutritional management of the allergic patient. In: August JR, ed. Consultations in Feline Internal Medicine, 2nd ed. Philadelphia, PA: WB Saunders Co, 1994; 201-208.
b. Hill's Pet Nutrition Inc., Topeka, KS, USA.

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CASE 31-2

Allergic Dermatitis in a German Shepherd Dog

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Patient Assessment

A seven-year-old neutered male German shepherd dog weighing 37 kg (body condition score of 3/5) was admitted with the primary complaint of moderate to severe pruritus during the previous two years. The pruritus began on the face and feet, and progressed to involve the axillae, ears and abdomen. The pruritus was nonseasonal, but worsened slightly in the summer when it also involved the dorsal lumbosacral area.

The dog spent most of its time indoors but also had access to a fenced yard for several hours a day. The other household pet, a cat, had no dermatologic disease or pruritus. None of the people associated with the dog had pruritus or dermatologic disease. The dog had three episodes of bilateral ear infections the previous year that were treated with unknown topical medications that resolved the problem. Prior treatment with injectable and oral glucocorticoids provided marked relief but not complete remission of the pruritus. The pruritus returned within a few days after discontinuing corticosteroid therapy. Oral antihistamines (diphenhydramine and hydroxyzine) and various medicated shampoos and topical sprays provided little benefit.

Dermatologic examination revealed marked traumatic and complete alopecia with hyperpigmentation and erythema involving the periocular areas, inner pinnae, axillae, feet and ventral abdomen (**Figures 1** to **3**). Small numbers of papules were found on the ventral abdomen. Excoriations were present in the axillae and periocular areas.

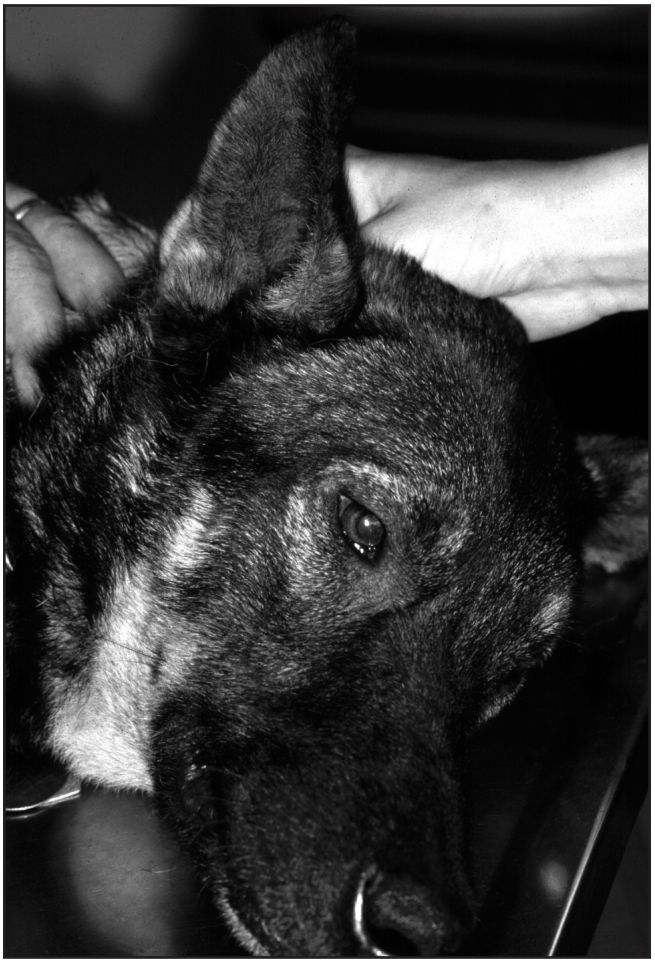

Figure 1. View of the lateral face and right pinna of a seven-year-old male German shepherd dog with periocular alopecia, hyperpigmentation, erythema and mild excoriations. The inner pinnal surface was hyperpigmented, erythematous and alopecic.

Assess the Food and Feeding Method

The dog was fed a variety of commercial dry foods; the client changed brands frequently. The dry food was fed free choice. Other food sources included occasional table food, commercial canine biscuit treats, rawhide chews and flavored heartworm preventive medication, which was given monthly for nine months of the year.

Questions

1. What are the primary diseases in the differential diagnosis of this patient? What secondary diseases may be present?
2. What food and feeding method is appropriate for this patient?
3. How might the dog's otitis externa correlate with the other evidence of dermatologic disease?

Answers and Discussion

1. The primary diseases in the differential diagnosis include:

Atopic dermatitis. Most patients with atopic dermatitis have pruritus and clinical disease at six months to three years of age. A seasonal history also suggests atopic dermatitis. This dog's dermatologic problems began at five years of age and the pruritus is nonseasonal, which is still compatible with atopic dermatitis. Atopic dermatitis is more common than food allergy but less common than flea allergy.

Adverse reaction to food (food allergy or food intolerance). The typical age at onset of food allergy is unclear. A recent report described an age predilection of several months to three years of age whereas previous reports did not find an age predilection. The pruritus associated with food allergy is nonseasonal and a variety of clinical presentations and distribution of lesions may be seen. The response to corticosteroid therapy is variable. Food allergy is not as common as flea allergy or atopy.

Flea-allergy dermatitis. Flea allergy usually begins at three to seven years of age and has a marked predilection for the dorsal lumbosacral area, the ventral abdomen and legs. This dog is the correct age for development of flea-allergy dermatitis, but the distribution of lesions on the face, feet and ears is not likely without more prominent disease on the dorsal lumbosacrum. The increased pruritus and involvement of the dorsal lumbosacrum in the summer suggests that flea allergy may be adding to the pruritus seasonally.

Scabies. Infestation with *Sarcoptes scabiei* is often difficult to prove. Pruritus is usually severe and nonseasonal. No age, breed or gender predilection is present. The pinnal margins, periocular areas, elbows, hocks and ventrum are usually involved. Contagion or zoonosis is present in approximately 30% of the cases. Skin scrapings are positive in 25% of affected dogs. Response to therapy may be the only way to diagnose many cases.

Dermatophytosis. The dermatologic lesions typically seen with dermatophyte infections include many of those seen in this patient. Although no strong breed or gender predilection exists, young animals are affected most often. Pruritus is variable. The distribution of lesions is quite variable but usually is not bilaterally symmetric as seen in this patient.

The secondary diseases in the differential diagnosis include:

Superficial pyoderma (bacterial folliculitis). Superficial pyoderma is a secondary infection seen with many pruritic skin diseases, including food allergy and food intolerance. *Staphylococcus intermedius* is the most common causal bacteria in dogs. Typical lesions include follicular papules, pustules, complete alopecia, epidermal collarettes, erythema and focal circular postinflammatory hyperpigmentation. Oral antibiotic therapy should clear the lesions and pruritus associated with the pyoderma.

Malassezia dermatitis. Pruritus associated with *Malassezia* infection is common. *Malassezia* species proliferate in moist, hyperplastic apposed skin surfaces, particularly lip folds, nasal folds, interdigital areas, axillae, ventral abdominal skin, ear canals and the

Figure 2. View of the left front foot showing traumatic alopecia with hyperpigmentation and focal excoriations.

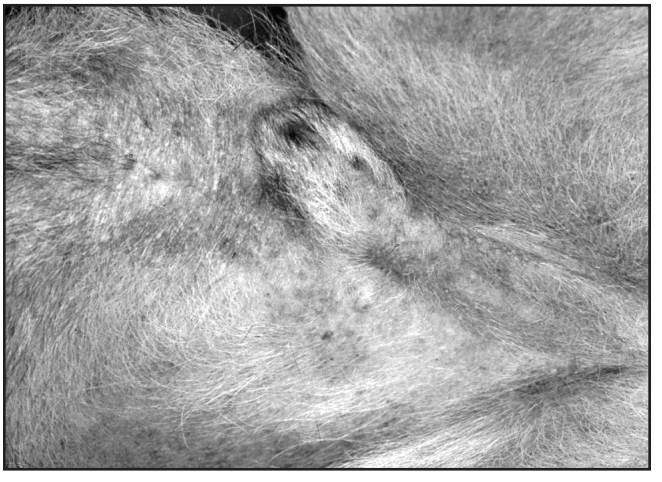

Figure 3. The ventral abdomen and medial thighs showing mild alopecia, hyperpigmentation, erythema and papules.

ventral neck. Underlying allergies, including adverse reactions to food, are common diseases that predispose animals to yeast infection. Topical and oral therapy may be necessary to correct the yeast infection and will also control any pruritus associated with the *Malassezia* infection.

2. An appropriate food for an elimination trial should include limited numbers of ingredients, particularly protein sources. The protein sources should be novel (not ingredients that the patient has been exposed to previously). The food should avoid excessive levels of protein, should be free of excessive levels of biogenic amines, have increased levels of omega-3 fatty acids and be nutritionally appropriate for long-term feeding of adult dogs (including phosphorus and sodium). **Table 31-5** lists selected commercial veterinary therapeutic foods that meet many of these criteria.

   The elimination food should be gradually introduced over several days as the current food is discontinued. The pet owner should feed only the elimination food for up to three months. For this patient, the table food, biscuit snacks, rawhide chews and flavored heartworm medication should also be discontinued. A nonchewable heartworm medication can be used. The client should keep a daily diary to record the clinical progress and degree of pruritus, as well as any other foods, table scraps, treats or snacks given in addition to the elimination food (**Figure 31-6**).

   The client should be instructed to watch for a marked (at least 50%) decrease in the pruritus. Periodic reexamination by the veterinarian will help monitor the patient's progress and help reinforce the feeding restrictions.

3. Otitis externa is a frequent clinical presentation with atopic dermatitis and adverse food reactions. One study found that many dogs with adverse food reactions presented with only ear problems and no other dermatologic disease. Food allergy and food intolerance should always be suspected in dogs with chronic or recurrent otitis externa. Although otitis externa is usually bilateral, some patients may present with unilateral otitis.

   Diagnosis of otitis externa is best accomplished with otoscopic examination and impression smears of aural exudate. Underlying allergies often predispose the animal to chronic or recurrent otic bacterial and yeast infections.

Progress Notes

Flea combing revealed no fleas or flea dirt; skin scrapings were also negative. Impression smears of the affected areas revealed few cocci or neutrophils. No *Malassezia* spp. were present. Intradermal allergy testing revealed no reactions to any of the inhaled allergens that were tested.

Food and Feeding Method

A commercial dry food composed of lamb meal and rice was initiated and fed exclusively for six weeks. The food dosage was calculated to maintain the dog's current body weight and optimal body condition.

Reassessment

The pruritus decreased dramatically over several days. After minimal pruritus was noted for one week, one of the previously fed dog foods was given for seven days. By the third day, there was a significant return of the pruritus at all of the previously affected sites. The elimination food was reinitiated and the pruritus resolved in 10 days.

After the pruritus decreased, individual food ingredients were added to the elimination food for up to seven days each. These challenge ingredients were derived from the list of foods and ingredients that had been fed previously. The ingredients included beef, chicken, corn, wheat, eggs and milk. Marked pruritus occurred when beef was fed and moderate pruritus when corn was fed. The final diagnosis was an adverse reaction (food allergy or food intolerance) to beef, corn and possibly other ingredients that were not tested. The commercial food used in the elimination trial was continued because it was complete and balanced for maintenance of adult dogs.

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CASE 31-3

Protein-Losing Enteropathy in a Dog

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Patient Assessment

An eight-year-old, male English setter was referred with the primary complaints of diarrhea and weight loss of six months' duration. The diarrhea had been continuous over this period but varied in severity. The feces were very liquid, increased in volume and pale yellow. No fecal blood or mucus had been seen. The dog defecated four to five times per day. The owner classified the weight loss as moderately severe. There had been no vomiting. The dog's appetite and demeanor remained normal. Past treatments included a variety of antibiotics and gut protectants to which there had been no response. Physical examination revealed a thin (body condition score [BCS] of 2/5), bright, alert dog that weighed 27 kg. The remainder of the physical examination was normal.

The problems identified were chronic small bowel diarrhea with associated weight loss. Diagnostic procedures included fecal flotations, fecal culture, serum trypsin-like immunoreactivity, complete blood count, serum biochemistry profile, gastroduodenoscopy, endoscopic pinch biopsy of the stomach and duodenum, quantitative bacterial culture of the small intestine and rectal mucosal biopsy.

The most significant laboratory abnormality was panhypoproteinemia (albumin 1.51 g/dl [reference range = 2.2 to 3.5 g/dl]; globulin 2.39 g/dl [reference range = 2.2 to 4.5 g/dl]). Endoscopic findings included mildly increased duodenal mucosal granularity and friability. Results of histopathologic examination of gastric biopsy specimens showed a very mild lymphocytic gastritis; duodenal and rectal histopathologic results included mild to moderate lymphocytic-plasmacytic enteritis and colitis. Results of quantitative bacterial culture of the small intestine were normal. The tentative diagnosis was mild inflammatory bowel disease (IBD) and protein-losing enteropathy.

Assess the Food and Feeding Method

The dog ate a variety of moist and dry commercial foods fed free choice before and during the diarrheic episode. The dog's water intake was increased but there had been no polyuria.

Questions

1. What are the key nutritional factors to consider for this patient?
2. Calculate the energy requirements for this patient.

Answers and Discussion

1. The ideal food for dogs with chronic small bowel-type diarrhea should: 1) be highly digestible, 2) be free of gluten (gliadin), 3) have a limited number of protein sources to which the dog has not been recently exposed (novel proteins), 4) be isoosmolar and 5) avoid excess fat and lactose.

   Protein requirements increase in patients with protein-losing enteropathy because of excessive protein loss. Excess fat should be avoided during gastrointestinal (GI) dysfunction because malabsorbed fatty acids and bile acids cause secretory diarrhea.
2. The patient's resting energy requirement (RER) calculated at the current weight (27 kg) would be approximately 880 kcal/day (3,682 kJ/day), but that would increase to 1,000 kcal/day (4,184 kJ/day) for the patient's ideal body weight of 30 kg. To calculate this dog's daily energy requirement (DER) to achieve optimal body condition, the factor used to multiply times the RER must be greater than that used in calculations for normal mature dogs. The DER would be 1,600 to 2,000 kcal (6,694 to 8,368 kJ).

Therapy Including Feeding Plan

The dog was initially treated with prednisone for five weeks (60 mg twice daily for 14 days; then 40 mg once daily for 14 days; then 20 mg once daily for one week) but the feeding plan was not modified. At five weeks, the dog was reexamined. Its body weight remained constant despite an improved appetite. The diarrhea had improved to a "cow pat" consistency. Albumin (2.58 g/dl) and globulin (2.91 g/dl) concentrations had improved markedly. When the dog was reexamined endoscopically, scattered shallow erosions were visible in the gastric antrum; these were attributed to the prednisone therapy. Histopathologic examination of biopsy specimens taken from the small intestine during endoscopy showed that the prednisone therapy had had little effect. The histologic diagnosis remained mild to moderate lymphocytic-plasmacytic enterocolitis.

When the dog was discharged after the five-week recheck, the owner was instructed to prepare a homemade food of chicken and rice with added vitamins and minerals. Food dosage was calculated to achieve optimal body condition. Within three days of this food change, the dog's stools became firm and remained normal thereafter. Nine months later, the dog's body weight had improved to 31 kg and the BCS was 3/5. Serum albumin and globulin levels were 2.71 g/dl and 4.21 g/dl.

Further Discussion

This case suggests that protein-losing enteropathy can accompany food sensitivity. Protein exudation into the bowel has been demonstrated during GI type I hypersensitivity responses in laboratory animals and may occur in clinical patients.

The lack of complete response to prednisone emphasizes that corticosteroids often will not control the clinical signs of food-sensitive patients without concurrent feeding of a suitable hypoallergenic food. This case also illustrates how closely food sensitivity can mimic the clinical and histologic findings of idiopathic IBD.

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CASE 31-4

Pruritus and Dermatitis in a Labrador Retriever

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Patient Assessment

A nine-year-old neutered male Labrador retriever was examined for chronic recurrent episodes of pruritus and dermatitis. The dog had been treated for acute pyotraumatic dermatitis ("hot spots") around the face four months previously and had a chronic lesion of acral lick dermatitis ("lick granuloma") on the left metatarsus. The owner was concerned about face rubbing, excessive licking and scratching, skin redness and an overall dull coat. The only other significant medical problem was bilateral hip osteoarthritis.

The dog weighed 39 kg and had a body condition score of 4/5. Physical examination revealed multiple subcutaneous lipomas and evidence of moderately severe acute inflammation in the bilateral axillary and inguinal regions. Moderate inflammation was noted in the interdigital region of the right forefoot and in the perianal area. The initial evaluation of these problems included skin scrapings (negative) and interdigital skin cytology (no abnormal findings).

Assess the Food and Feeding Method

The dog had been fed a commercial dry food with lower fat and calorie content for the past year to help manage its overweight condition (Exclusive Reduced Fat Chicken & Rice Adult Formula[a]). Dry food was offered twice daily and a commercial canine treat was offered occasionally. The dog would also sometimes eat food available for other pets in the household. The dog had lost approximately 4.5 kg with this feeding regimen.

Questions

1. What additional diagnostic tests would be helpful for this patient?
2. What dietary changes may help manage the pruritus and dermatitis in this patient?

Answers and Discussion

1. Underlying allergic disease such as atopic dermatitis, flea allergy or food allergy could cause the pruritus and dermatitis seen in this patient. Labrador retriever dogs are at increased risk for atopic dermatitis and adverse food reactions. These allergic conditions often occur concurrently in the same patient and the clinical signs often mimic one other. Atopic dermatitis is primarily a clinical diagnosis; intradermal and in vitro allergy testing is used to confirm reactions to individual allergens and determine specific therapy (e.g., hyposensitization injections [allergy shots] or allergen avoidance [environmental control of house dust mites]). There was no evidence of past or current flea infestation on the patient. An adverse reaction to food is best confirmed with an elimination food trial using novel- or hydrolyzed-protein ingredients.
2. Allergic skin disease such as atopic dermatitis and/or adverse food reaction was strongly suspected in this dog. Enhanced dietary levels of omega-3 fatty acids may help control inflammation, clinical signs and improve skin barrier function. In general, it is more convenient and cost effective to deliver these nutrient enhancements as part of a food rather than using supplements. Use of foods containing novel or hydrolyzed protein sources is important in patients with suspected or confirmed food allergy.

Progress Notes

The food was changed to one with novel protein ingredients and enhanced levels of omega-3 fatty acids. The owner chose to offer both dry (Prescription Diet d/d Potato & Venison Formula Canine[b]) and canned (Prescription Diet d/d Venison Formula Canine[b]) formulas divided into two equal meals (two cups plus one-half can per meal). No treats were offered during an eight-week feeding trial and the owners were asked to eliminate access to food for other household pets.

An examination four weeks after changing the food revealed no inflammation in the axillary regions and less inflammation in the inguinal and interdigital areas. The owner thought there was noticeable improvement in the dog's overall coat condition. An examination eight weeks after changing the food revealed no inflammatory skin lesions and the acral lick dermatitis lesion was healed. The owner thought there was moderate overall improvement in the dog's condition and that it was more active and felt better. A recommendation was made to continue the venison-based foods with higher levels of omega-3 fatty acids. Food dosage calculations were based on an obese-prone dog in an effort to also manage the overweight condition. The owner was also given a recipe for making homemade treats from the canned venison food.

Endnotes

a. PMI Nutrition, Henderson, CO, USA.
b. Hill's Pet Nutrition, Inc., Topeka, KS, USA.