



Original/Otros

Mites and the implications on human health

Patrícia Vogel¹, Simone Morelo Dal Bosco¹ and Noeli Juarez Ferla²

¹Nutrition Course, Centro Universitário UNIVATES. Lajeado/RS, ²Acarology Laboratory, Museum of Natural Sciences, Centro Universitário UNIVATES. Lajeado/RS – Brazil.

Abstract

Introduction: The infestation by mites of stored products is of great economic importance and public health, with consequences to human health.

Objectives: To describe the mite species associated to food and stored products that cause implications to human health as well as to analyze the loss of quality and nutritional composition of infested food.

Method: Literature review in LILACS-BIREME, SciELO and MEDLINE databases for publications in English, Portuguese and Spanish with the descriptors “mites”, “foods”, “storage mites”, “store product mites”, “dust mites”, “quality control”, “quality foods”, “chemical composition”, “chemistry”, “allergens” and “health”. There were identified 80 articles, but only 55 were related to the objectives of the study. Sixteen references were mentioned in the articles that were found after checked for relevance. **Results and discussion:** The activity of the mites causes loss of sanitary quality, weight and nutritional composition of the infested products, with great economic loss in the grain industry. Inhalation, ingestion or contact of mites, byproducts of metabolism and feces may sensitize susceptible individuals and cause asthma, allergic rhinitis, contact dermatitis, enteritis and lead to anaphylaxis. The monitoring of temperature and humidity is essential for the control of mites, as well as better conservation and hygiene of the units of grain storage.

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Key words: *Mites. Store product mites. Food quality. Chemistry. Allergens.*

ÁCAROS Y LAS CONSECUENCIAS SOBRE LA SALUD HUMANA

Resumen

Introducción: La infestación por ácaros de productos almacenados es de gran importancia económica y de salud pública, con consecuencias para la salud humana.

Objetivos: Describir las especies de ácaros asociados a los productos alimenticios almacenados y que causan consecuencias para la salud humana, así como para analizar la pérdida de la calidad y la composición nutricional de los alimentos infestados.

Método: Revisión de la literatura en LILACS-BIREME, SciELO y MEDLINE bases de datos de las publicaciones en Inglés, portugués y español con los descriptores “ácaros”, “alimentos”, “ácaros de almacenamiento”, “los ácaros del producto de su tienda”, “los ácaros del polvo”, “calidad control”, “alimentos de calidad”, “composición química”, “química”, “alérgenos” y “salud”. Se identificaron 80 artículos, pero sólo 55 estaban relacionados con los objetivos del estudio. Dieciséis referencias fueron mencionados en los artículos que se encontraron después de verificado su relevancia. **Resultados y discusión:** La actividad de los ácaros causan pérdida de calidad sanitaria, el peso y la composición nutricional de los productos infestados, con grandes pérdidas económicas en la industria del grano. La inhalación, ingestión o contacto de los ácaros, subproductos del metabolismo y las heces pueden sensibilizar individuos susceptibles y causar asma, rinitis alérgica, dermatitis de contacto, enteritis y conducir a la anafilaxis. El control de la temperatura y la humedad es esencial para el control de ácaros, así como una mejor conservación y la higiene de las unidades de almacenamiento de grano.

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Palabras clave: *Los ácaros. Ácaros de productos tienda. Calidad de los alimentos. Química. Alérgenos.*

Correspondence: Simone Morelo Dal Bosco.
Center of Biological Science and Health,
Centro Universitário - Univates.
Rua Avelino Talini, 171,
Universitário – Lajeado/RS – Brasil. CEP: 95900-000
E-mail: simonebosco@gmail.com

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Abbreviations

COPD - chronic obstructive pulmonary disease
GM-CSF - colony stimulating factor granulocyte / macrophage
IgE - immunoglobulin E
IL-6 - Interleukin-6
IL-8 - Interleukin-8
MCP1 - monocyte chemotactic protein-1
TNF - α - tumor necrosis factor

Introduction

The prevalence of allergic diseases such as asthma, rhinitis, contact dermatitis and food allergies has increased substantially in recent decades and can be considered a serious public health problem^{1,2}. It is estimated that 10-20% of the world population has asthma, allergic rhinitis or contact dermatitis^{3,4,5} and about 6-8% of children under 3 years old and 2-3% of the general population have some type of food allergy⁶.

In this context, house dust mites and of storage products are an important source of allergens that can sensitize predisposed individuals and may or may not be mediated by immunoglobulin E (IgE)^{3,4,5,7}. The food allergy is defined as an adverse health effect resulting from an immunological response to exposure to a particular food, usually manifested by the production of IgE⁸.

The house dust mites feed basically of dead human tissue, animal dander, fungi, bacteria and pollen of plants⁹. The mites of stored products are more common in rural areas and are found predominantly in grains such as wheat, corn, oats, barley and their byproducts^{10,11}, animal food, hay, straw and in the dust from the processing facilities and grain storage^{12,13}. Sensitization to house dust mites and mites of stored products occurs through inhalation, ingestion or contact with live or dead mites, byproducts of metabolism or feces¹⁴.

In food, the mite infestation causes loss of quality of stored products because the mites feed basically of the germ of the grain¹¹. They also cause losses on nutritional composition¹⁵ and on the stock of seed decreasing the germinative power of the grain¹⁴. In humans, they cause respiratory diseases such as asthma and rhinitis^{9,11} and contact dermatitis^{9,14}. Mites storage can also cause acute enteritis by ingestion of bacteria and fungi which they are vectors¹⁶.

This study aims to discuss the quality and nutritional composition of food infested by mites and describes the implications of the activity of these arthropods on human health.

Method

This work is a literature review. There were searched the LILACS-BIREME, SCIELO and MEDLINE

databases. Scientific papers published in English, Portuguese and Spanish between 2000 and 2014 about house and storage dust mites, quality and nutritional composition of infested food and activity implications of these arthropods on human health were selected. The descriptors “mites”, “foods”, “storage mites”, “store product mites”, “dust mites”, “quality control”, “quality foods”, “chemical composition”, “chemistry”, “allergens” and “health” were used to search the databases. Eighty articles were identified, but only 55 were related to the study objectives. The first analysis of the articles was conducted by the summary and later by the text. Besides these, 16 references mentioned in the articles that have been found were included due to their relevance for the study.

Results and discussion

Evolutionary Theory

Most mites of stored products known currently belong to the suborder Astigmata, but little is known about the evolutionary origin of these mites. It is known that the human being began to stockpile food with the advent of agriculture around 10 thousand years ago, time enough to allow the evolution of a large complex of genres and species in association with humankind, suggesting that the origin of storage mites was independent for each species and occurred in their natural habitat¹⁷.

There are speculations that the Astigmata mites were fungivorous and that adaptations on the *hypopus* stage occurred so that the colonization of other habitats was possible¹⁷. Knülle tried to reproduce in laboratory the conditions that allowed these adaptations and showed that mites isolated in natural environment have a greater genetic heterogeneity to induce a *hypopus* stage than the lineages developed in laboratory in continuous environmental conditions. In particular, for *Lepidoglyphus destructor* (Schrank), a storage mite, the phenotypic expression of *hypopus* stage was determined by the combination of genetic risk with diet quality, i.e., the interaction between genotype and environment ensures a continuous and uninterrupted development of the specie, in favorable environmental conditions for some individuals, providing the survival and the dispersion to other habitats when it deteriorates. The variations in *hypopus* characteristics in the population of this species probably constitute a selective adaptation to such conditions of life, the evolutionary ecology¹⁸. Later, a study of Corente and Knülle demonstrated with experimental results that the decrease in quality of food increased the mortality of mites and induced the *hypopus* stage. The study suggests that it is not the presence of a particular substance that induces the *hypopus* stage, but the lack of a proper nutritional balance whatever the nature¹⁹.

Regarding to the domestic dust mites, Klimov and O'Connor, in a study using phylogenetic analyzes tests, of alternative topology of house dust mite, as well as of reconstruction of ancestral character and irreversibility of parasitism, suggest that the common ancestor of house dust mites would have suffered a permanent reversal from a parasitic lifestyle to a free life²⁰. This would be possible from lineages of free-living mites that specialize more quickly and extinguished more slowly than parasitic lineages²¹. Such evolution would be possible by a combination of characteristics of the common ancestor: tolerance to low humidity, development of powerful digestive enzymes enabling feeding of skin and keratin, and low host specificity with frequent change of hosts²⁰.

In 1979, O'Connor suggested that the mites would have contacted humans for the first time by the soil through nest of birds and rodents¹⁷ and later than the first free-living mites in house dust, that they are nest inhabitants, i.e., inhabited nests of birds or mammals and basically fed of fungus²⁰. Regardless of how it happened, it is known that at some point in the evolution of the mites occurred adaptations so that human colonization and stored food possible became possible, making it important to know the species of synanthropic mites.

Synanthropic species of mites

There are over 48.000 species of mites described in the literature (Arthropoda: Chelicerata: Arachnida: Acari)²², but the synanthropic mites, those living close to human settlements, are of greatest interest to the humankind. From the biological standpoint, a mite takes about 30 days (3-4 weeks) to develop from an egg to become an adult and lives on average four months in ideal conditions of temperature (28°C) and relative air humidity (80%). A female produces 50-80 eggs during its life²³.

Regarding to the allergenicity, mites produce substances with biological activity including hydrolytic and non hydrolytic enzymes, inhibitors of enzymes, regulatory proteins, of storage and of transport varying significantly among different species of mites²⁴. At least 24 groups of allergens are described in the literature, four with protease activity (cysteine, trypsin, chymotrypsin and serine) and three with glycosidase activity (α -amylase and chitinase). In a study by Morales and collaborators, the house dust mites showed higher activity of cysteine, while the storage mites showed considerable increase in the activity of serine²⁵. Stewart suggests that the difference in the expression of protease would be associated with the base of feeding of these mites, the house dust mites would express cysteine to digest skin cells through the hydrolysis of collagen and keratin, whereas mites of stored products would express serine to digest the starch present in grains and derivatives²⁶.

A study of Morales and collaborators demonstrates that the proteases are involved in the pathogenesis of allergy, increasing epithelial permeability and permitting the entry and the distribution of the allergen to the tissues by modulating cell response of the immune system²⁶ and can induce an inflammatory process²⁷. It is believed that contact with small amounts of allergens could induce a immune tolerance²⁴ as well as a long-term ingestion of small amounts of allergens could gradually compromise the immunologic integrity and cause, at given time, a sensitization of the individual^{24,25}. It is known that in predisposed individuals, contact with an allergen can induce an allergic response, mediated or not by IgE²⁴.

A study by Arlian and collaborators describes the capability of house dust mites and or storage to stimulate cytokine secretion²⁸. Another more recent study that evaluated the effect of the extract of stored product mites (*Acarus siro* L., *Chortoglyphus arcuatus* (Troupeau), and *Lepidoglyphus destructor* and *Tyrophagus putrescentiae* (Schrank) on the endothelial cells of the skin showed that endotoxins and proteins present in the extract of storage mites stimulate endothelial cells of the skin to secrete cytokines and express cell adhesion molecules, but this capability varied among species. *Acarus siro* stimulated a secretion of stimulation factor of colonies of granulocyte/macrophage (GM-CSF), interleukin-6 (IL-6), Interleukin-8 (IL-8) and monocyte chemotactic protein-1 (MCP-1). *Chortoglyphus arcuatus* and *Lepidoglyphus destructor* induced the secretion of IL-6, IL-8 and MCP-1, and the levels increased when co-stimulated by tumor necrosis factor (TNF- α). The *Tyrophagus putrescentiae* stimulated the secretion of IL-8 and MCP-1 in response to increasing doses of extract, whereas only stimulated secretion of IL-6 at the highest dose of tested extract⁷.

The synanthropic mites can be divided into two main groups:

1) House dust mites

House dust mites feed primarily of dead human tissue, animal dander, fungi, bacteria and pollen of plants. Carpets, curtains, upholstery, mattresses, bedding and pillows are favorable sites for the habitat of these mites⁹. They cause respiratory diseases such as asthma and rhinitis through inhalation of live or dead mites, feces or byproducts of the metabolism. They can also cause contact dermatitis by contact of human epithelial cells with allergens in the environment^{9,23}.

The main species of house dust mites are *Dermatophagoides farinae* Hughes, *Dermatophagoides pteronyssinus* (Trousseau), *Euroglyphus maynei* (Cooreman) and *Blomia tropicalis* (van Bronswijk, Cock & Oshima)²³. *Dermatophagoides farinae*, *Dermatophagoides pteronyssinus*, *Euroglyphus maynei* belong to the Pyroglyphidae family, while *Blomia tropicalis* belong to the Glycyphagidae family²⁵. *Dermatophagoides pte-*

ronyssinusis more common in Europe, while the *Dermatophagoides farinae* is more common in America¹⁶.

Blomia tropicalis, initially recognized as a storage mite, has become accepted as house dust mite²⁹ as it has been found in homes in both tropical and subtropical countries like Spain, India, Taiwan, Brazil, Colombia, the Philippines, Malaysia and Indonesia^{23,29}.

2) Mites of stored products

Common in urban and rural areas, storage mites are found predominantly in grains such as wheat, corn, oats and barley^{10,11}, animal feed, hay, straw and in dust from processing facilities and grain storage^{12,13}. In Brazil, the foods infested by food storage mites are: grains, seeds, bran, flour, hay, feed, sausage products, meat and dried fish, dried fruits, cheeses and chocolate powder³⁰.

These mites can contaminate processed foods from grains, such as flour, breakfast cereal and mixtures for bakery^{10,23} and they may induce an anaphylactic shock when ingested by susceptible individuals^{12,24}. Studies have already reported the presence of species of mites of stored products in domestic environment as mattresses, bedding, carpets and furniture^{12,13}.

Commonly found storage mite species are: *Acarus siro*, *Chortoglyphus arcuatus*, *Tyrophagus putrescentiae*, *Lepidoglyphus destructor*, *Glycyphagus domesticus* (DeGeer), *Aleuroglyphus ovatus* (Troupeau), *Suidasia medanensis* (Oudemans), *Thyreophagus entomophagus* (Laboulbene)^{12,31}, *Suidasia pontifica* (Oudemans), *Blomia kulagini* (Zakhvatkin) and *Glycycometus malaysiensis* (Fain & Nadchatram)²³. *Lepidoglyphus destructor*, *Glycyphagus domesticus* and *Chortoglyphus arcuatus* mites belong to the Glycyphagidae family and *Tyrophagus putrescentiae* and *Acarus siro* belong to the Acaridae family²⁵.

Implications of mites in stored products, in quality and nutritional composition of foods and human health

Although the stored products may contain allergens of vegetal, animal or microbial³², infestation by mites is one of the main problems associated with grain storage^{33,34} despite the tolerance determined by international organizations be zero or close to zero in mite infestation¹¹.

A study of Thind and Clarke found contamination in 21% of samples of cereals and cereal products purchased in retail stores in the United Kingdom, rising to 38% after being stored for 6 weeks at the home of volunteers. However, due to the limitation of the study, it cannot be said that the products were infested during the storage³⁵.

Palyvos and collaborators, in a study conducted in Greece, determined the species of mites that infested

grains like wheat, corn, oats and barley, manufactured agricultural products, dried fruit and powder residue in cooperatives, stores, silos and mills. A total of 55.5% of the samples tested showed contamination by mites of four orders and 15 distinct families. In the study, Astigmata corresponded to 92.7% of the total of mites and the *Lepidoglyphus destructor* was the dominant species in all of the studied sites studied¹¹.

In the Czech Republic, in a study by Stejskal and Hubert, mites constitute the largest group of plagues collected in units of grain storage, more than insects. The most abundant species were *Acarus siro*, *Acarus farris* (Oudemans), *Tyrophagus putrescentiae* e *Lepidoglyphus destructor*. The study suggests that mites are the most important source of allergens in stored grains and that the control, as a prevention strategy, is still neglected in many countries³⁶.

A study performed in New Zealand by Cotter and collaborators evaluated samples of products derived from grain purchased in shops and gathered in homes. The study didn't find the presence of mites in the samples of products purchased in stores, but four samples of products obtained in houses showed mites representing 7.4% of the total. The four samples that had mites were stored in cabinets for over a month, indicating that storing flour for long periods increases the risk of contamination and that the ideal to prevent contamination would be to store it in the fridge³⁷.

Under favorable conditions of humidity, temperature, type of deposit, storage time¹⁴ and type of product stored³⁸, mites can multiply reaching high densities and cause direct or indirect harm to human beings. Usually, mites of stored products infest products containing large amounts of starch (compound of carbohydrates in plants), or glycogen (which is the compound of storage of carbohydrates in fungi and bacteria)^{38,39}. In grains, for example, they use starch as the main power source, degrading it into glucose by the combined action of α -amylases and α -glucosidase⁴⁰. Some studies have shown that the enzymatic activity of α -amylase and α -glucosidase is present in distinct species of storage mites and that they are able to utilize starch, amylopectin and α -glycosides to obtain energy from grains^{27,38,40}.

For having the ability to feed on starch, mites of stored products can destroy the germ of grains decreasing their quality¹¹. Not only the sanitary quality, but also the nutritional composition of grains is compromised especially in relation to B vitamins and iron¹⁵. Besides the sanitary and nutritional loss, mites may cause loss in quantity (weight) in some cereals. In wheat for example, when a large infestation by mites occur, they attack the endosperm and germ of the grain and they feed on starch, reducing the weight of the grain¹¹.

Another change in stored products caused by the activity of these arthropods is the quite characteristic odor observed in storage units that is caused by the secretion of lipids by mites¹¹. In agriculture they also have importance because they attack the embryo

of some grains causing a significant reduction in the stock of seeds and their germination power¹⁴.

In humans, inhalation, ingestion or contact with live or dead mites, byproducts of metabolism or feces can cause damage to human health, for example, respiratory diseases such as asthma, allergic rhinitis, conjunctivitis¹¹, as well as contact dermatitis¹⁴, episodes of anaphylaxis²⁴ and acute enteritis by the ingestion of food contaminated by fungi and bacteria that the mites may be vectors^{11,16}. However, a study by Hubert and collaborators suggests that 95% of mite allergens are associated with faecal particles related to the digestion process of the mite⁴¹.

Anaphylactic reactions induced by food infested with mites are being increasingly reported, especially in countries where the climatic conditions are favorable for their proliferation²⁴. In 1993, Erben and collaborators observed the first case of systemic anaphylaxis by ingestion of food infested by mites⁴². Years later, a study reported a case of a group of patients who developed generalized allergic reactions after ingestion of foods containing large amounts of mites⁴³. In Brazil, a case report of anaphylaxis by ingestion of cornmeal infested by mites was documented⁴⁴. There was also reported a case by *Blomia freemani* Hughes of anaphylaxis by ingestion of contaminated pancake flour⁴⁵. A study of Posthumus and collaborator estimated the incidence of anaphylaxis in around 0.5 to 2%, mostly by the ingestion of cereals (especially wheat) contaminated by mites and their allergens. The study verified that episodes of anaphylaxis usually occur in patients with allergic rhinitis or asthma, who sensitized to dust mites, develop allergic reactions, mediated or not by IgE after eating wheat flour contaminated by storage mites⁴⁶.

Sensitization to mites of stored products is more common in rural areas and among workers in the grain storage units, bakeries and supermarkets by exposure to mites, and it has been suggested as an occupational disease^{10,47,48,49,50,51}. There has been reported the increase in cases of asthma and allergic rhinitis in fruit farmers and people living near the orchards of citrus, apple and pear^{48,52,53}, contact dermatitis in farmers that grow hop⁴⁹ and gardeners who grow pepper⁵⁴. However, the occurrence of occupational allergy in urban areas among workers in bakeries and supermarkets has also been reported. A study of Storaas and collaborators found that storage mites were responsible for 20% of cases of sensitization of allergic rhinitis in bakery workers⁵⁰. Another study reported that of a supermarket employee that got hives and dermatitis through pork meat, especially ham, infested by *Tyrophagus putrescentiae* in her workplace⁴⁷.

Tyrophagus putrescentiae is prevalent in hot and humid climates⁵⁵. It causes serious economic damages³⁴ as well as the reduction of the nutritional content and of the germination capacity of the seeds¹⁵. It is found in a wide variety of food of high protein and lipid content¹⁶ as, for example, cheese, bacon, egg powder, peanut flour^{56,57,58}. In Spain it has a great economic impor-

tance, because it feeds on the superficial layer of the typical Spanish cured ham^{56,59}, where the humidity and the heat are essential for the maturation process of the product⁵⁶. In Brazil there was reported the presence of *Tyrophagus putrescentiae* in soybean crops in Minas Gerais⁶⁰ and samples of rice and beans sold in bulk in supermarkets in São Paulo⁶¹.

When the *Tyrophagus putrescentiae* mite is ingested through contaminated food, inhaled or handled it can cause diarrhea, urinary tract problems, acute enteritis and allergic reactions^{57,58}. There has also been reported a case of systemic anaphylaxis by the ingestion of food contaminated with the *Tyrophagus putrescentiae* mite^{56,62}. It can also carry spores of bacteria and fungi such as *Aspergillus* spp. and *Penicillium* spp.^{55,57,63}. A study of Franzolin and collaborators demonstrated that the presence of *Aspergillus flavus* contributed to the growth of the *Tyrophagus putrescentiae* mite, which has helped to disperse the spores of fungi in samples from uncontaminated corn⁵⁵.

A study that assessed the prevalence of sensitization by *Tyrophagus putrescentiae* showed that it is higher in elderly subjects compared to young adults, especially in people with chronic obstructive pulmonary disease (COPD) when the prevalence reached 45.8% of the studied population⁶⁴ and that the allergenic of the *Tyrophagus putrescentiae* mite induces histamine release in more than 50% of sensitized individuals⁶⁵.

Acarus siro is a common species in stored grain, with great development in hot and humid climates¹⁶ and high activity of starch digestion⁴⁰. But there was also reported in high concentrations in cheese stored in refrigeration rooms¹¹. In Spain, there has also been demonstrated the infestation of Cabrales cheese by *Tyrophagus neiswanderi* Johnston & Bruce e *Acarus farris*³³.

Regarding to sensitization, Pytelková and collaborators found that the *Acarus siro* is potentially allergenic and there can happen cross-sensitization with house dust mites. In this study, the amino acid sequences of the *Acarus siro* with the *Dermatophagoides pteronyssinus* mite showed 66% of comparability⁶⁶. Another study showed that through the skin test 14% of these sensitized patients to house dust mites were sensitized by the storage mite *Thyreophagus entomophagus* (Laboulbène) concomitantly⁶⁷. A study of Morales and collaborators found that both mites of Pyroglyphidae group as of Glycyphagoidea group had a similar protein sequence; however the enzymatic properties of each species differ significantly from the activity of the proteases²⁵.

Aleuroglyphus ovatus (Troupeau) is also found especially in warm climates, in foods such as wheat grain and its derivatives and preparations with chicken, as well as in dust of storage units, lairs of rodents, chicken coops and barns⁶⁸. *Aleuroglyphus ovatus* like *Acarus siro*, presents great activity on starch digestion and perhaps that is why these two species infest grains and cereals that are one of the major sources of

starch⁴⁰. A study that evaluated the immunogenic sites of *Aleuroglyphusovatus* suggested that both the inhalation as the contact with mites, and eggs as feces would be immunogenic²³. In humans, it is associated to respiratory and contact dermatitis especially in the grain industry workers⁶⁸.

Solomon found in his work that there is competition between species of mites of stored products, and when the population of primary mites grows a lot, it offers food for the secondary mites (which are predatory mites), rising up to almost eliminate the preyed population. In the study he noted that from January to April appeared the predators due to the seasonal increase of summer of the *Tyrophagus putrescentiae* species. According to him, this is a natural and biological sequence of species of mites that infest grains⁶⁹.

A study of Hubert and collaborators evaluated the growth of mites in wheat (*Triticum aestivum* L.) which naturally possesses an inhibitor of α -amylase which protects the grain from attack by arthropods. The study suggests that the quality of the grain is known by affecting the growth of mite populations and that the inhibitory effect of α -amylase on the population density of mites depends on the stored grain, on the species of mites and on the combination of these two factors thus affecting the growth dynamics of mites³⁸. A previous study evaluated the use of bean (*Phaseolus vulgaris* L.) in the controlling of storage mites and in domestic dust, since its use appears to suppress the growth of mites. However, some people have food allergy to beans, turning unfeasible its commercial and in large-scale usage⁷⁰.

Measures of control of stored products mites

The main physical agents that determine the quality of the stored products are air humidity and temperature³⁴. So, it is essential that there is a better control of these variables in the grain storage units because of the sanitary importance that the contaminated by mites represents to humans⁶¹. Foods that have a high water content are more difficult to control and should be monitored more frequently³³. The Brazilian law states that the maximum moisture for flour, cereal starch and bran (15%), potato starch (21%) and manioc starch (18%)⁷¹.

Poorly maintained facilities and the lack of preventive hygiene measures before storage of products can be considered the main reasons for the high presence of mites in these environments¹¹. Therefore, change in the physical factors is a simple and environmentally safe method for controlling infestations of mites on stored food³⁴.

For consumers it is recommended to observe the conditions of hygiene of places of commercialization, as well as to store the grain for a maximum of six months in closed containers in a cool, dry place. And if possible, the grains should be kept in refrigerator (0°C

to 7°C), with humidity not exceeding 12%. The grains should be washed in running water, and the acts of “choose” and sift the grains can spread the mites through the environment⁶¹.

The studies on changes in quality, nutritional composition of food infested by mites and implications on human health are still limited, especially those concerning the nutritional composition. As mites of stored products use starch as an energy source there is loss of quality and nutritional composition, but would it be of utmost importance estimate the loss in order to develop more specific techniques and mechanisms of control. Mites can cause serious implications to human health, but the mechanisms of how this occurs are not well established yet, mainly by the wide variety of species and by cross reaction that seems to exist among some species.

Conclusion

Mites of house dust and of stored product, at some point in evolution, have suffered adaptations so that the colonization of human installations and of stored products would be possible. The activity of mites causes loss of sanitary quality, weight and nutritional composition of the infested products, with great economic loss in the grain industry. The inhalation, contact or ingestion of mites, byproducts of metabolism and mite feces can sensitize susceptible individuals and cause asthma, allergic rhinitis, contact dermatitis, enteritis and lead to anaphylaxis when a large quantity of food infested by mites is ingested. It is, therefore, a serious public health problem.

The prevalence of food allergies has increased substantially in the last years and it is necessary to elucidate whether the allergens involved in sensitization are from the food itself or from mites that are present in these foods. The discovery that some mite allergens are enzymes could help to explain the rapid onset of symptoms after the ingestion of large amounts of allergens present in food; however, more studies are needed to clarify these relations. Furthermore, the study about alterations in the quality, nutritional composition of food infested by mites and implications for human health are still limited, especially those concerning the nutritional composition.

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