

ALLERGENIC COMPONENTS OF STORED AGRO PRODUCTS

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The increasing occurrence of allergies in the developed countries and greater interest in food safety has drawn attention to the presence of allergens in agro products during storage. Stored agro products can contain allergenic contaminants of plant, microbial, or animal origin. Several stored-product insect and mite species were confirmed as sources of allergens. The most important are storage mites because they cause occupational asthma by inhalation and anaphylactic reactions when ingested in high numbers. The urine of rats and mice can be a significant source of allergens that are mainly present as large airborne particles. Stored moulds are also confirmed as potential source of allergens. However, it is likely that the major problem resulting from the presence of moulds in food will be due to the toxic effects of mycotoxins, rather than allergenic effects. The adoption of good management and processing technique can help to minimise the risk.

Key words:
allergenic effects, contaminants, food, storage pests

Problems that occur in grain and grain products during storage include the whole spectrum of hygiene hazards: chemical treatment and chemical residues, mycotoxins, and potential allergy problems. The condition of stored grain is determined by a complex interaction between grain, macro- and micro-environment, and a variety of organisms including microorganisms, insects, mites, and rodents which may attack it. Grain provides an abundant source of nutrients, and the natural consequence of the type of ecosystem described above will normally be spoilage (bio-deterioration) of the grain. Reliable studies indicate that post-harvest losses of major food commodities in the developing countries are enormous. A conservative estimate is that they reach

tens of millions of tons a year valued billions of dollars. The usual and the readiest way is to measure the loss as a reduction in weight of food available for consumption – the so called quantitative loss. However, losses in quality are more difficult to define, but may be equally or even more important than quantitative losses, especially if the deterioration and the contamination of stored grain with organisms, their metabolites, allergens, and excrements renders the food unsuitable for consumption by humans and animals. In the developing countries the contamination of foods prior to consumption is a serious problem, especially where the need to eat may outweigh food safety.

The purpose of this paper is to give an overview of published data about the contamination of agro products with allergens during the storage.

Contaminants of agro products during storage

The presence of arthropod pests in the urban environment results in a variety of medical problems. It is well known that arthropods are renowned vectors of bacterial and viral infections, and a cause of food poisoning. Furthermore, arthropods secrete or excrete allergens causing atopic and insect-venom allergy (1, 2).

The increasing occurrence of allergies in the developed countries and greater interest in food safety have drawn attention to the presence of allergens in agro products during storage. The association between sensitivity to arthropod allergens and atopic diseases is strong. According to a review paper published by *Van Lynden-Van Nes and co-workers* (3), arthropods are partly responsible for up to 80% of disease cases (Table 1).

Table 1 *Prevalence of sensitisation (in %) for arthropod allergens in allergic patients in different area of Western Europe and North America (3)*

Arthropod allergens	United Kingdom	Netherlands	Scandinavia	Mediterranean	North America
House dust mites	80	80	2-27	15-49	24-78
Storage mites	>30	65-70	6-45	10	12
Cockroaches	10	10	10	10	7-69

During the last couple of years several researchers investigated the causes of respiratory symptoms in workers in grain and processing industry. The association between respiratory symptoms and occupational exposure was confirmed by various tests. Stored agricultural products can contain allergenic contaminants of plant (grain dust), microbial (moulds), or animal origin (insects, mites, and rodents) (4). The most important are storage mites because they cause occupational asthma by inhalation and anaphylactic reactions when ingested in great quantities. Unfortunately, there is still no data that allow estimation of average and maximal daily intake of allergenic mites or suggest what levels might be safe.

CONTAMINANTS OF PLANT ORIGIN

Pollen from oil seed rape has been recognized as a cause of allergic sensitisation (5). However, it appears that the problem can be even worse after this crop has been harvested, as *Suh and co-workers* (6) report that a case of IgE-mediated occupational asthma in the animal feed industry could be associated with oil seed rape dust.

Zuškin and co-workers (7) described workers exposed to cocoa dust extract and flour dust who ran a high risk for developing allergic sensitisation. *Gomoshinskii and co-workers*, (8) found out that the levels of IgE antibodies against rice, wheat gluten, and maize were elevated in several of 130 children suffering from food intolerance.

Respiratory problems in bakery workers are some of the most frequently reported occupational problems (9). A group of nearly 200 bakers showed a significant correlation between sensitisation to wheat flour, rye flour, and soybean flour and alpha-amylase, asthma case history, and inhalation challenge tests.

Contaminants of microbial origin

Epidemiological data showing the importance of allergic contaminants of microbial origin are still limited. *Sander and co-workers* (10) suggested *Aspergillus oryzae* as a cause of occupational allergy and a possible food allergen. *Heaney and co-workers* (11) attributed a case of asthma in a brewery worker to a grinding of malt contaminated with *Aspergillus niger*. It is likely that the main health problems resulting from the presence of moulds in food will be due to the toxic effect of mycotoxins, rather than allergenic effects (4).

Contaminants of animal origin

The significance of allergenic contaminants of animal origin is well recognised. There is an accumulating body of recent literature reports of severe allergic reactions, including anaphylaxis, attributed to the ingestion of storage mites. To date, anaphylactic reactions have been observed after ingestion of four species of mites: *Tyrophagus putrescentiae* (12), *Deramatophagoides farinae*, *Tyrophagus entomophagus* (13), and *Suidasia* spp. (14). *Armentia and co-workers* (15) reported that skin prick tests and radio-allergo-sorbent tests (RAST) showed sensitisation among 50 workers to house dust mites *D. pteronyssinus* and *D. farinae* (56%), storage insects *Tenebrio molitor* (50%), various species of storage mites including *Lepidoglyphus destructor* and *T. putrescentiae* (both 38%), and the oriental cockroach *Blatta orientalis* (36%). *Bernton and Brown* (16) implicated *Plodia interpunctella* as a source of allergens, *Yourkova and co-workers* (17) and *Herling and co-workers* (18) *Sitophilus granaries* (L.), *Moscato and Dellabianco* (19) and *Andrist and co-workers* (20) *Ephestia kuehniella*, and *Rijckaert and co-workers* (21) and *Turner and co-workers* (22) *Liposcelis bostrychophila*. *Towney and co-workers* (23) and *Hage-Hamsten and co-workers* (24) found out that not only body extracts, but also faeces can be an important source of allergens.

Macan and co-workers (25) analysed a medical history questionnaire, skin prick test (SPT) and specific immunoglobulin E (sIgE) to storage mites *L. destructor* and *T. putrescentiae* performed on 26 male paper mill workers and 36 postmen. They discovered that paper mill workers manifested a significantly higher frequency of positive test

results to *L. destructor* and *T. putrescentiae* than did the postmen. Paper mill workers manifested significantly greater mean skin reactivity to *T. putrescentiae* than to *L. destructor* while the postmen did not manifest such difference. Respiratory symptoms were found in 40% of paper mill workers to *L. destructor*, and in 53.8% to *T. putrescentiae*. All postmen with sensitivity to *L. destructor* and 83.3% with sensitivity to *T. putrescentiae* had respiratory symptoms. The study results addressed the necessity to monitor sensitisation to mites and to establish methods for identification and quantification of mites in the working and general environment.

Gordon and co-workers (26) reported that rats were the source of allergens, especially their urine. They studied animal rearing facilities and demonstrated that rat and mouse urinary allergens were mainly present as large airborne particles.

CONCLUSIONS

Some cases of apparent sensitisation to agro products during storage are caused by the presence of allergenic contaminants. Contaminants include various species of storage mites, insects, rodent urine, and moulds.

Storage mites probably contribute the most to the overall load of allergens on workers and consumers. Unfortunately, there are no data which allow estimation of average and maximal daily intakes of allergenic mites or which can suggest a safe level of consumption.

Methods are urgently needed to measure allergenic contaminants in various agro products and to identify and eradicate the sources of contamination.

The presence of contamination of agro products and the possibility to avoid it must be properly addressed. The adoption of good management and processing can help to minimise the risk.

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Sažetak

ALERGENI U POLJOPRIVREDNIM PROIZVODIMA TIJEKOM USKLADIŠTENJA

Na poljoprivrednim proizvodima tijekom čuvanja u različitim skladišnim objektima pojavljuje se niz rizičnih situacija poput kontaminacije grinjama, insektima, glodavcima, plijesnima, nedostatne higijene, uporabe opasnih i toksičnih pesticida, razvoja mikotoksina i alergena. Problemi su osobito naglašeni u zemljama u razvoju gdje su zalihe hrane nedostatne i zbog potrebe za jelom zanemaruju se potencijalne i stvarne opasnosti koje takva hrana može imati za ljudsko zdravlje. Smatra se da dobar sustav integrirane zaštite robe poljoprivrednog podrijetla može znatno smanjiti potencijalnu i stvarnu opasnost nastalu onečišćenjem tijekom čuvanja u skladištima.

Porast pojava alergije u razvijenim zemljama i želja da se poveća sigurnost hrane usmjerila je pozornost znanstvenika na mogući razvoj alergena na uskladištenoj poljoprivrednoj robi i u njoj tijekom čuvanja. Istražujući moguće uzroke pojave respiratornih simptoma u radnika zaposlenih u žitarској i mlinarskoј industriji, brojnim testovima i u objavljenim radovima potvrđena je uska povezanost između profesionalnih bolesti i kontaminacije uskladištene robe i radnog prostora grinjama, insektima, glodavcima i plijesnima. Uskladišteni proizvodi mogu sadržavati alergijska onečišćenja biljnog, mikrobiološkog i životinjskog podrijetla. Utvrđeno je da su grinje najvažniji onečišćivači robe i proizvođači alergena. Uzrokuju astmu kad se unose u organizam disanjem. Osobito su opasne kad se u velikom broju unose u organizam s hranom jer izazivaju anafilaktičke reakcije. Premda su kao izvori alergena potvrđene i neke skladišne gljivice (*Aspergillus oryzae* i *A. niger*), smatra se da su njihovi mikotoksini znatno opasniji problem.

Kao izvori alergena navode se ove skladišne grinje i insekti: grinje *Dermatophagoides farinae*, *Lepidoglyphus destructor*, *Tyrophagus putrescentiae*, *Tyrophagus entomophagus* i *Suidasia spp.*, insekti *Tenebrio molitor*, *Sitophilus granarius*, *Plodia interpunctella*, *Ephestia kuehniella*, *Liposcellis bostrychophila* i *Blatta orientalis*. Izmet artropoda kao i mokrača štakora i miševa jednako su važni izvori alergena.

Ključne riječi:

alergijski učinci, onečišćenja uskladištene hrane, skladišni štetnici

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