

FOOD PACKAGING: MODERN TOOL FOR MANAGING INSECTS IN STORAGE

Moulita Chatterjee¹, Prahlad Sarkar² and Debanjan Chakraborty^{1*}

¹ Assistant Professor, Department of Agricultural Entomology, UBKV, Pundibari – 736165, West Bengal

² Assistant Professor, AINP on JAF, UBKV, Pundibari – 736165, West Bengal

*E-mail ID of communicating author – debanjan.ubkv@gmail.com

Abstract

Protecting our food while in storage is as much important as increasing production of food to ensure food security. Safe storage of food items is really a challenge for almost all warm and humid tropical countries. Faulty storage system, different microbes, various insects and non insect-pests possess great threat in storage. To combat the pest problem particularly in storage, more thrust is to be given on preventive aspects as trying to cure an already infested food will lead to a more complicated situation. Management of stored-grain insect pests is undergoing a rapid transformation now-a-days. Modern insect-resistant packaging is one of such trick that really possesses a great possibility and scope to be explored.

Insects in the grain storage cause huge post-harvest loss of food grains alongwith unscientific storage system, rodents, micro-organisms etc. Nearly 100 species of insect pests of stored products cause economic losses. In India, annual storage losses have been estimated as 14-million tons of food grain worth of Rs. 7,000 crore every year in which insects alone account for nearly Rs. 1,300 crores. Out of these, stored-grain insects alone account for more than 10% post-harvest losses in developing countries like India.

Several measures have been adopted by the farmers, common people as well as by the scientists to ward off these insects. In present scenario, an equal thrust is being given towards production as well as protection of the foodgrains. The framework of integrated management of storage insects has been specially designed to incorporate all the possible tools to manage the insects in storage to ensure food security. Management of stored-grain insect pests is undergoing a rapid transformation from a conventional insecticide-based system to some modern approaches. Modern insect-resistant packaging is one of such concepts that really possess a great possibility and scope to be explored.

The consumers of the present age are really fond of packaged products. A wide range of agricultural or horticultural commodities like grain cereals, pulses, flours, fruits, vegetables, spices, etc along with different grocery items, medicines as well as all the stationery items – attract the customers of all age group if the products are properly packed to maintain highest level of hygiene and quality for a reasonable period of time. The interesting fact is that, the majority of the consumers have the complaints that the packets of rice, flours, pulses as well as pastas, noodles even chocolates and many other products (with the exception of canned food) are susceptible to insect attack.

Insects that commonly infest packaged food are categorized into two categories – penetrators and invaders. Penetrators are those that can chew holes directly into packaging materials. These are most dangerous at the larval stage, though some beetle species can also be dangerous as adults. Insects such as the lesser grain borer, *Rhyzopertha dominica* (Fab.); the cigarette beetle, *Lasioderma serricorne* (Fab.); the warehouse beetle, *Trogoderma* spp.; the rice weevil, *Sitophilus oryzae* (L.); the cadelle, *Tenebroides mauritanicus* (Linnaeus) and the larvae of the rice moth, *Corcyra cephalonica*

(Stainton), are known to be good package penetrators and are capable of boring through one or more layers of flexible packaging materials. Other species are classified as invaders that enter packages through existing openings. Invaders commonly enter packages through openings resulting from mechanical damage, defective seals, or holes made by other insects penetrating the package. The newly hatched larvae of invaders typically cause the serious damage because they are able to fit through holes as small as 0.1 mm wide. Some common invaders include the saw-toothed grain beetle, *Oryzaephilus surinamensis* (Linnaeus); the red flour beetle, *Tribolium castaneum* (Herbst) and the flat grain beetle, *Cryptolestes* spp. The most important invaders are the larvae of the genus *Tribolium* or flour beetles, the genus *Oryzaephilus* or grain beetles and freshly hatched moth larvae. It is to be noted that invaders can become penetrators in certain circumstances, and vice-versa. The larvae are generally classified as invaders, although in certain circumstances, they can be penetrators as well. Both penetrators and invaders exploit package flaws or other existing openings in order to reach a food product.

The main question that can arise in the mind of anyone may be the reason, means and the path of entry of the insects in the packaged products. The easiest answer is that most of the species of stored-product insects infest packaged foods as they found easy source for nutrition to carry out life functions such as finding of food or mate, oviposition as well as to remain protected from chemicals that may be used to kill them. Olfaction is the weapon by which these insects identify the location of the packaged products. Insects, when they get the smell of the food, try to reach it. Any kind of odour coming out from the packet attracts the insects to search an access point for entry. In case of any food package, the insects take advantage of any sort of opening found in the packet to get entry. These openings are the result of chewing of penetrators or as punctures formed due to normal wear and tear during the process of handling. And then the invaders, waiting for these punctures or holes or even very minute gap, also get the chance to enter the packets. These insects, being very small, are able to enter packages through the smallest openings or they also can enlarge these openings to gain access inside the package.

Food products are packed in a wide variety of paper, plastic as well as different materials in combination of the older and the newer ones. Insects changed their strategies to enter the food packages and so the manufacturers had to change their entire packing systems of several items or products. The material and quality of the packets, type of glues or adhesives, system of sealing, providing barriers to prevent exit of the smell of the product and many other features that are continuously being added to create the resistance of the packages against the stored-grain insects.

Paper is still one of the most widely used products and is certainly one of the most easily penetrated materials. Paper offers little resistance to insect penetration although it provides excellent strength and serves as a moisture barrier. On the other hand, paper used with foil and polyethylene to form multiwall packages, performs better than the traditional packaging. Cellophane is one of the oldest materials used as packaging material after normal paper. The desirable physical characteristics of cellophane include transparency, clarity, and heat sealability. Many of these attributes were lacking until nitrocellulose was developed in 1927. Studies on cellophane-wrapped packages have shown that both dry pet food and raisins were very susceptible to penetration by a variety of stored-product insects including the Indianmeal moth, *Plodia interpunctella*, the warehouse beetle, *Trogoderma* spp. and the cigarette beetle, *Lasioderma serricorne*. Polyester (PET), first developed in 1941, has good resistance to insect penetration, but its use in packaging has been limited because of higher cost. At the same time, uses of PET and metalised PET packets are increasing now. Packages prepared for MRE (meals ready to eat) and other similar purpose are also prone to insect

penetration like red flour beetle. Flexible polymer films, even laminates used in packaging can be susceptible to insect attack.

Considering several factors it can be said that plastic has several advantages over other materials for packaging. These ensure that the contained materials remain in their original condition. Plastic packets are colourful, attractive and they are available in different sizes and shapes. Different kinds of materials made by plastic resist infestation by most stored-product insects. Plastic pouches have already become popular. These pouches alongwith zipper made from PET or metal foils, nylon, polypropylene-laminates provide strength, excellent protection (not total) from insect and at the same time these are lesser in weight if compared with other materials.

Use of odour barriers is another trick through which insect infestation can be minimised. Preventing odours of food materials from the food packages is done by several barrier materials. This creates such a condition that the insects fail to trace the food materials even if they are nearer to the food packets. PVDC (Polyvinylidene chloride) and EVOH (Ethylene vinyl alcohol) are two successful odour barriers used in modern day packaging. But even slight fault in the packaging disturbs the performance of these barrier chemicals.

From the above discussion, it is evident that complete resistance or total protection of the packaged products from the insects is not guaranteed or confirmed. Some may think that proper sealing and making the packets completely airtight do the job of complete prevention of insect-entry. But that is partially correct. This leads to other problems like swelling or shrinking of the packages as there comes the changes in temperature or pressure of the air within these. Small holes for ventilation are made in these cases so that the air pressure within and outside of the packets remain same. These vent holes, in several cases, act as improper or partially perfect sealing and result in permitting invasion of insects. To prevent this, again, lengthy and twisting (or zigzag) path for the insects are prepared. In spite of that completely insect-resistant packaging, till date, is not available. There is a huge scope of future research in this area. It will show the way toward improvement of more sophisticated and developed packaging strategies so that packaged foods remains protected as well as the end-users are relieved from attack of any insect.

References

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