Pest-Proofing Food Packaging

No one wants to open their breakfast cereal or pancake mix and find it infested with bugs. Even if these occurrences represent one in a million, they make a lasting impression.

Manufacturers of food, feed, and other processed grain products want to avoid these incidents and provide consumers with high-quality products. That's why ARS entomologist Michael A. Mullen at the Grain Marketing and Production Research Center in Manhattan, Kansas, has been working with food and feed manufacturers since 1989 to help design insect-proof packaging.

"Packaging should protect the commodity from the point of manufacture to the point of consumption," says Mullen. Nine times out of 10, an insect infestation isn't the manufacturer's fault. Often, insects get into packages during transportation or storage in a warehouse.

Like people who fall into two basic personality types—uptight A or laidback B—stored product insects are one of two types. They're either invaders or penetrators.

"The invaders look for opportunities to get inside food containers by searching for cracks, crevices, and holes," says Mullen. "The penetrators simply chew holes in the packages."

Invaders include the red flour beetle, confused flour beetle, sawtoothed grain beetle, Indianmeal moth, and almond moth. Penetrators like the lesser grain borer, cigarette beetle, warehouse beetle, and rice moth can bore through one or more layers of packaging materials.

"There is no perfect package," says Mullen. "Packages are usually tailored to fit the product and designed to last throughout its shelf life. Often, this means that the package will have to provide this protection for more than a year."

Although packages can become infested anywhere along the marketing chain, they are most likely to become infested during long-term storage. Inside warehouses, insects start by attacking vulnerable packaging and later jump to sturdier material.

Most stored-product insects are invaders, entering food and feed packages through seams and closures. They lay their eggs in the tight spaces formed when packages are folded. These spaces give the newly hatched larvae an ideal starting spot to invade. Dry pet foods are usually packaged in bags like these.

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Mullen has been working with several companies that make dry pet food and with others that produce paper bags used for its packaging. In November 1997, ARS and Mullen initiated a cooperative research and development agreement (CRADA) with International Paper of Loveland, Ohio, to improve existing packaging or develop alternative packaging to protect dry pet foods from insect damage.

Other companies that Mullen has had formal CRADAs with include Ralston Purina in St. Louis, Missouri, and Continental Extrusion Company in New Jersey.

Seals and closures can often be improved by changing the type or pattern of sealant glue. A pattern that forms a barrier is usually the most insect resistant. Recently, paper bag manufacturers discovered through working with Mullen that closures on bag bottoms were prone to insect entry and needed reinforcement as much as top closures. Mullen is helping one bag manufacturer expand its customer base from nonfood agricultural products to food products.

Another packaging problem involves smell. Insects are attracted to packages that allow food odors to escape. Certain plastic film overwraps that fit tightly around a package can help prevent insects from smelling its contents. Interior plastic liners like those used in breakfast cereal boxes can be effective, blocking air from carrying aromas outside to hungry insects.

In 1991, Mullen helped to develop an odor neutralizer that can be incorporated into packaging materials. He devised a laboratory choice test allowing insects to choose between a food protected by the odor neutralizer or by only untreated packaging. They chose the food in untreated paper.

"There's really no one thing that makes a package insect proof," says Mullen. "Each additional improvement added to the package design helps keep insects out. All packages provide some protection against invasion. But tightening up the seals and adding a repellent adds even more," he says.

Mullen has developed scientifically proven methods to evaluate packaging materials against insects in the laboratory. He places 32 to 40 of each package type in an environmentally controlled room for about 3 months. These packages are exposed to five species of insects. Each month, the researchers examine packages for holes and flaws in seams and closures. Finally, they open the packages and examine the contents for insect infestations.

Manufacturers rely on these

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Dry pet food is a favorite food of insect pests such as these flour beetles.

findings to improve future package designs or to conduct larger packaging studies. Test results have led to insect-resistant, pesticide-free packages for dry pet foods, raisins, baby cereals, pancake mixes, and breakfast cereals for domestic consumption and export. One company has reported a 75-percent reduction in consumer complaints from insect-related problems.

The food industry is facing increasing restrictions on pesticide use. Insect-resistant packaging can help reduce dependence on insecticidal treatments. This research helps assure consumers of insect-free food and protects manufacturers against loss of goodwill arising from insect-infested packaging.—By **Linda Cooke,** ARS.

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Entomologist Mike Mullen checks seals for signs of infestation after a 3-month test of consumer-size packages.