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## THE FOOD INSECTS NEWSLETTER

MARCH 1989

VOLUME II, NO. 1

### Preliminary Comments on Federal Regulations Pertaining to Insects as Food

<p>Paris M. Brickey, Jr J. Richard Gorham Food and Drug Administration Washington, DC, USA</p> <p>According to the Federal Food, Drug, and Cosmetic Act<sup>5</sup> (FD&amp;C Act), the Food and Drug Administration (FDA) has jurisdiction over foods that move in interstate commerce and foods that are imported. We are not aware of any food products composed of insects that are manufactured within the United States (USA) and offered for sale in interstate commerce. This is not to imply that such products do not or should not exist, only that we have not heard about them.</p> <p>With regard to insects imported as food, however, there does seem to be a small but persistent market in the USA. Although most American consumers do not think of insects as "food," insects fall under FDA's definition of food if that is the proposed usage by the importer [Sec. 201 (f)].<sup>5</sup> If the intended use of the imported insects is as food, then any such product would be subject to all pertinent sections of the FD&amp;C Act under which foods are regulated. In other words, within the limits imposed by the FD&amp;C Act, FDA treats all foods equally, no matter what they consist of or where they come from.</p> <p>The minimum standards are that there must be no filth in food [Sec. 402(a) (3)] and there must be no filth around food [Sec. 402(a) (4)]<sup>5</sup>. (Note: The FD&amp;C Act includes many other standards besides the ones specifically mentioned here.) The fact that a food product consists largely or entirely of insects intentionally processed and packaged for use as human food does not automatically bar it from commercial distribution to the American consumer. Usually, all that FDA requires under the law is that the food, whether imported or manufactured domestically, must be clean and wholesome (i.e. free from filth, pathogens and toxins), must have been manufactured, packaged, stored and transported under sanitary conditions, and must be properly labeled in English (Sec. 403)<sup>5</sup>. (Note: Other requirements might also apply under certain conditions.) For purposes of illustration, we will briefly note a few selected examples of insects imported as food.</p> <p>Insect larvae in bottles of Mexican mescal and tequila. Several wild species of agave harvested by <i>mescaleros</i> are used to produce mescal, but most of that distilled beverage comes from the cultivated forms of <i>Agave angustifolia</i>. Cultivated varieties of <i>A. tequilana</i> are harvested to produce tequila.<sup>1</sup> At some point lost in the distant past, it became the practice of some</p>	<p>Mexican distillers to add an insect larva to each bottle of certain lots of mescal and tequila. Nowadays one can purchase either beverage with or without the larvae.</p> <p>The insect larvae selected for this noble sacrifice are usually from among those associated with agave (<i>maguey</i>) plants and are typically lepidopteran borers within these succulents. A common offering is the <i>maguey</i> worm, <i>Aegiale hesperiaris</i><sup>4</sup> (Megathymidae, Lepidoptera). Also represented have been <i>Agathymus</i> spp. (Megathymidae), species of another genus of obligate, agave-feeding giant skippers. Recently, Steven Passoa and Julian P. Donahue (personal communication) each independently discovered that a kind of larva often found in tequila is the caterpillar of an agave-boring carpenter moth, <i>Comadia redtenbacheri</i> (Cossidae). In Mexico, these larvae are known variously as <i>gusanos rojos</i> (or <i>rosados</i>) <i>del maguey</i>, <i>gusanitos del mezcal</i>, or <i>chilocuiles</i>. Weevil grubs (Curculionidae, Coleoptera) have also been found, especially in "miniatures." (Note: We thank J. P. Donahue, David K. Faulkner and John W. Brown for information about the insect "fauna" of tequila and mescal.)</p> <p>Actual ingestion of the larvae seems to be rare, especially in Mexico. <i>Norteamericanos</i> apparently eat the larvae only sporadically, usually after having consumed the other contents of the bottle (apparently a necessary prerequisite) and/or having become involved in some rite of passage that requires a touch of <i>machismo</i> (or <i>feminismo</i>, as the case may be), as was portrayed in the movie <i>Urban Cowboy</i>. [Note: Are <i>Urban Cowboy</i> and <i>Poltergeist II</i> the only commercial movies that depict deliberate entomophagy?]</p> <p>At one time there was some concern within the FDA that the larval insect in a bottle of mescal or tequila might represent filth in food in violation of Sec. 402(a) (3) of the FD&amp;C Act. But a kinder and gentler interpretation of the law prevailed and it was eventually concluded that since the larvae are added intentionally, they become part of the product and do not constitute insanitation.</p> <p><b>Frozen steamed ant eggs (Formicidae, Hymenoptera) from Thailand.</b> This product was adulterated with animal hairs (human, cat/dog, rat/mouse), feather barbules, mites, and insect fragments [violation of 403(a) (3)]<sup>5</sup>. The product consisted largely of pupae, larvae and some adults, but very few eggs and was therefore misbranded (Sec 403)<sup>5</sup>.</p> <p><b>SEE FEDERAL REGULATIONS, P. 7</b></p>
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### A PROGRAM PROFILE: RESEARCH ON INSECTS AS ANIMAL FEED IN EL SALVADOR

<p>Gerardo Lardé Instituto Salvadoreño de Investigaciones del Café Nueva San Salvador El Salvador</p> <p>The use of insects as food is not a folk tradition in El Salvador despite reports that locusts and cicadas were eaten occasionally by peasants and natives. Nonetheless, in recent years an increasing number of people have been aware of the potential value of insects as a protein-rich feedstuff. In the last ten years, yellow mealworms (<i>Tenebrio molitor</i>; Tenebrionidae) have been reared in plastic boxes containing wheat bran and potato pieces at the National Zoo. There,</p>	<p>In 1982, a villager from Ilobasco in central El Salvador used larvae reared on coagulated blood from slaughterhouses as a supplement feed for about forty impure-breed chickens fed sorghum grains. The medium was contained in eight cylindrical trays made from carved tree trunks.</p> <p>Since 1983, formal research relative to the utilization of coffee pulp as a substrate for rearing larvae has been conducted at the Salvadoran Institute for Coffee Research. A preliminary study was undertaken to identify any promising species able to grow on coffee pulp; in this case, abundance and size were used as criteria to determine the potential of species. Three dipterans were shown to be worthwhile: the green hover fly <i>Ornidia</i></p>
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monkeys and insectivorous birds are given the larvae which supply, in part, the protein needs of those animals. A recent article that appeared in an important newspaper included a photograph in which the former Zoo Director was eating a handful of mealworms; interestingly, after reading the notice some gastronomers were willing to taste the larvae in exotic dishes and some poultry producers to initiate their own production.	<i>obesa</i> (Syrphidae), the soldier fly <i>Hermetia illucens</i> (Stratiomyidae) and the domestic fly <i>Musca domestica</i> (Muscidae). Three other projects ensued with emphasis on the development of methods for mass rearing rather than on biological evaluation of larval protein, namely:  <b>SEE PROFILE, p. 8</b>
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<p><b>EDITOR'S CORNER</b></p> <p>It's time to say "Thank You" for the many nice comments that have been received about <i>the newsletter</i>. These have come both from the U.S. and abroad. If the <i>Newsletter</i> can serve as a means of communication and networking for those who would like to see the food potential of insects seriously explored, it will have served a worthwhile purpose. Almost every researcher who has studied the dietary use of insects in non-European cultures has concluded that we are missing the boat in our steadfast refusal to recognize edible insects as a legitimate food resource (for references and discussion, see DeFoliart 1989, <i>Bull. Entomol. Soc. Am.</i> 35:22-35).</p> <p><b>A Unique Opportunity.</b> The rapidly expanding mailing list and added cost of printing and mailing the comparatively bulky Newsletter Directory planned for July means that the currently invisible means of support for the <i>Newsletter</i> needs some form of augmentation. It would be nice to keep the Newsletter free for awhile longer, and while it is always tempting to claim altruistic motives, the larger truth is that as long as the product is free it takes a lot of pressure off the editor. So we have hit upon an idea. For anyone who can be induced toward an impulse to write a check for \$5.00 to help defray <i>Newsletter</i> expenses, we have created the exalted status of SUSTAINING PATRON. Some will think, "But the <i>Newsletter</i> isn't worth anywhere near \$5.00," a thought that has occurred to the Editor. But that is not the point. Where else can you be listed as a SUSTAINING PATRON for only \$5.00? In making this fantastic offer we sincerely hope, however, that we will not be deluged with hundreds and hundreds of checks, because, so far, in doing research and engaging in other activities related to insects as food, we have not become accustomed to handling large sums of money. If a check is written (U. S. currency only, please), it should be made payable to Board of Regents-University of Wisconsin and designated for <i>The Food Insects Newsletter</i>. If things aren't going well this year and you can't afford PATRON status, you will still continue to receive the <i>Newsletter</i>.</p> <p><b>It Was Predictable.</b> In the November issue of the <i>Newsletter</i>, there was an article stating that imported food insect products could no longer be found in Madison, Wisconsin, and asking about their availability elsewhere in the United States. The <i>Newsletter</i> was hardly in the mail before two students, in separate casual conversation, mentioned a small Asian foodshop here in Madison where they had seen canned silkworm pupae for sale. Sure enough, when Jeff Beehler, a grad student, was dispatched to follow up on this lead, he returned with a sample. The shopkeeper told him that the silkworms are very popular with the Korean community here. The price was \$1.09/100g.</p> <p><b>Good News and Bad News.</b> The bad news first. Joyce Keesy, research specialist in the medical entomology laboratory, who has done an outstanding job in handling the layout and word processing for the <i>Newsletter</i> will be moving to Rockford, Illinois, in April. The good news is that Rockford is only 80 miles from Madison and Joyce plans to return often enough to assist with the <i>Newsletter</i> through the remainder of the year.</p> <p style="text-align: center;">GRD</p>	
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<p>The Food Insects Newsletter</p> <p style="text-align: right;">Page 3</p>	
<p>BOOKS</p>	
<p><i>Chocolate Chirpies! Jumping Jubilee!!</i></p>	
<p><i>Entertaining with Insects. Or: The Original Guide to Insect Cookery</i></p> <p>Ronald L. Taylor and Barbara J. Carter. Woodbridge Press, Santa Barbara, California 93111. 1976. 160 pp. (Paperback, price originally \$3.95; now out of print).</p> <p>This attractive booklet describes 85 recipes that incorporate insects as part of hors d'oeuvres, savories, soups, salads, vegetable dishes, entrées, desserts and candies, breads and pastries, or butters. They carry such enticing names as cricket crisps, cricket rumaki, sautéed bacon- pepper bees, chirping stuffed avocados, cricket pot pie, jumping melon salad, mealworm chow mein, chocolate chirpies, honey bee granola bars, and jumping jubilee (prepared over flaming brandy). The recipes center around the mealworm (a beetle larva, <i>Tenebrio molitor</i>) and the cricket (<i>Acheta domesticus</i>), both of which are commercially available, and the honey bee (<i>Apis mellifera</i>) which can be obtained from your nearest beekeeper friend. Commercial sources are given for mealworms, crickets and praying mantises, as well as instructions for home-rearing mealworms, crickets, bees, and wax moth larvae, among others. Also given are instructions for cleaning and preparing the insects. The last 10 pages of the book are given over to earthworm cookery.</p> <p>According to the authors, the insects are unrecognizable as such in most of the recipes and guests would be unaware of their presence if not told. The authors say, "This of course, is not to advocate 'tricking' your guests. Rather, it simply emphasizes that objections to eating insects have little or nothing to do with their taste or food value. If there is a problem, it arises from what we bring to the insect rather than what the insect brings to us." A section called "Basics"</p>	<p>a Mardi Gras party; Birthday of Rome; Florentine Cricket Festival - a picnic; Indian Independence Day; and the Japanese Moon-Viewing Festival.</p> <p>If insects do not soon gain a foothold in American cuisine, it will not be for lack of exciting recipes from which to choose Taylor and Carter say of their Insect Quiche: "This recipe suggests a whole new dimension in quiche cooking. We're up front about the insects; they're not camouflaged." Of their Siu Mai: "A friend of ours describes [it] as bundles of gustatory excitement.'" Of their Cricket Pot Pie: "Don't be surprised if this dish is picked up by the manufacturers of frozen foods." Finally, of their Egg Foo Yung: "Disguised among the bean sprouts, you will find our addition of mealworms. This is an excellent dish to serve to those who would like to try insects but feel they 'just couldn't.' . . . We regard this creation as our <i>piece de résistance</i>."</p> <p>One of the tastiest of insects, the greater wax moth larva, <i>Galleria mellonella</i>, was not featured in recipes because it was not commercially available at the time. Of this insect, Taylor and Carter say, "If only they were commercially available, we would probably have centered most of our recipes around them. They are our favorite insect. They are thin-skinned, tender, and succulent They would appear to lend themselves to commercial exploitation as snack items. When dropped into hot vegetable oil, the larvae immediately swell, elongate and then burst. The resulting product looks nothing like an insect, but rather like popcorn. Anyone who enjoys the flavor of potato chips, corn puffs, or the like would delight in the taste of fried wax moth larvae. We can imagine them fried as above, salted, packaged in cellophane, and displayed in the supermarket alongside the other snack items."</p> <p>There are now several commercial sources of live wax moth</p>



describes various ways of treating the insects before their application in the recipes. These basic preparations include "basic" cooked insects, dry roasted insects, basic insect flour, pastry, insect broth, insect marinade, garlic butter fried insects, and candied insects, as well as sauteed mushrooms and garlic butter which contain no insects.	larvae: one whose product we have seen is Waxworms, Inc., P.O. Box 333, Cameron, Wisconsin, 54822, USA. In the reviewer's experience, packaged mealworms, crickets and wax moth larvae from bait dealers and pet shops always bear the notation, "Not for human consumption." This is undoubtedly intended to deter all but connoisseurs and to let the latter know that they indulge at their own risk.
Taylor and Carter not only offer 85 recipes, but they have created complete menus for practically every gastronomic occasion, to wit: the cocktail party for 30 and the more intimate party for six; the Bloody Mary brunch and the champagne brunch; the formal lunch and the California lunch; the French dinner and a hearty dinner; the late evening supper (for after the theater); and for such celebratory occasions as the Chinese New Year,	SEE BOOKS, p. 4
<b>EGG FOO YUNG</b> 2 T vegetable oil; 1 medium green pepper chopped; 1 medium onion, chopped; 1/2 cup cooked mealworms, chopped (see below); 1 cup bean sprouts; 1 can (8 oz) water chestnuts, drained and thinly sliced; 3 T soy sauce; 5 eggs; soy sauce  In a frying pan, heat 1 T of vegetable oil. Add green pepper and onion and cook until tender. Stir in mealworms, bean sprouts water chestnuts, and soy sauce. Heat thoroughly and remove from heat. In a bowl, beat eggs until thick. Stir in insect mixture. In a frying pan containing 1 T of heated vegetable oil, pour enough of the mixture to form small patties. Brown on each side. Serve warm with soy sauce.  <i>Cooked Mealworm</i> 1 cup cleaned mealworms; 2 cups water; 1 t salt; 2 dashes pepper; 1 T butter; 1/2 t sage; 2 T onion, finely chopped. Place ingredients in a medium-sized Saucepan. Bring to a boil and allow to simmer for 30 minutes or until tender. (Reprinted by permission of R. L. Taylor, see booklet for accompanying hot soy sauce recipe)	

<p><b>Recently in the popular press:</b></p> <p>This article by John Yeld, which is reprinted from <i>Argus</i> (July 7, 1986), a newspaper in Cape Town, South Africa, was furnished by Warren Rush of the United States Agency for International Development.</p> <p><b>Eat locusts, don't poison them - scientist</b></p> <p>Brown locusts [<i>Locustana pardalina</i>], a major source of protein, should be harvested, not poisoned, says Dr. John Ledger, director of the Endangered Wildlife Trust.</p> <p>Dr. Ledger, an entomologist who worked for the South African Institute for Medical Research for 18 years before joining the trust is trying to interest entrepreneurs and Government officials in a pilot scheme to harvest part of the next outbreak of brown locusts.</p> <p>He believes a valuable spin-off would be jobs for the unemployed.</p> <p>The Department of Agriculture and Economics spent R7-million [Rand 7-million - US \$2.8 million] on the locust war this year, of which R2-million was part of the Government's unemployed relief programme.</p> <p>"Logic says we could use more of that money for the unemployed to harvest this very nutritional source of protein," Dr. Ledger said.</p> <p>"Even if you don't want to eat it you can turn it into animal feed, but don't go and pump thousands of tons of insecticide on it."</p> <p>Ecological imbalances were a "certainty" following the use of insecticides, Dr. Ledger said.</p> <p>"That has been the history of chemical control throughout the world. If it's not locusts, it will be something else whose natural enemies are being destroyed."</p> <p>Dr. Ledger said farmers affected by the locusts needed to follow the example of the citrus industry.</p> <p>Researchers successfully used back-pack apparatus to suck up insects at citrus estates in Zebediela in the Transvaal and the industry stopped heavy spraying when it became clear it was counter-productive.</p> <p>"The logistics are formidable but with the right enthusiasm and direction we could develop appropriate collection methods for brown locusts and the necessary machinery such as hammer mills and roasting units to utilize this resource effectively."</p> <p>The Department of Agriculture and Economics has admitted using 2.4-million kilograms of old stocks of BHC (Lindane), a banned organochlorine insecticide with similar long-term</p>	<p><i>Analytical Services Available ...</i></p> <p>Word from Dr.Piet Steyn, director, is that The Division of Food Science and Technology, CSIR (National Food Research Institute), Pretoria, South Africa, is in a position to offer a host of analytical and bioevaluation services to outside sponsors on a routine basis. Persons interested in information on specific analytical services or on specific bioevaluation studies, including cost, should contact, respectively, Piet van Niekirk or Dr. Ela Johannsen, at Division of Food Science and Technology, CSIR, P.O. Box 395, Pretoria 0001. We thank Dr. J. J. Dreyer for precipitating this information. Dr. Dreyer, who, with A. S. Wehmeyer, conducted an excellent study on the nutritive value of the mopanie caterpillar, <i>Gonimbrasia belina</i>, in comparison with several other South African foods (see <i>S. Afr. J. Sci.</i> 78:33-35, 1982), is now retired from the Division.</p> <div>  </div> <p><b>Research Request Department:</b> I would appreciate assistance in procuring a copy of the following for teaching/research purposes: 1) Clausen, L. W. 1954. <i>Insect Fact and Folklore</i>. New York: Macmillan Co.; 2) Bodenheimer, F. S. 195 1. <i>Insects As Human Food</i>. Dr. W. W. Junk. The Hague.</p> <p>Relevant information on availability, cost, etc. should be directed to:</p> <p>Dr. Babajide Matanmi                  Department of Plant Science                  Obafemi Awolowo University                  Ile-Ife, Nigeria</p> <p><i>The eighth plague returneth!</i></p> <p><b>THE LOCUSTS ARE COMING!</b></p> <p>This is the title of an article by John Ledger in <i>African Wildlife</i> (1987,41(4):201-210), a magazine which is published by The Wildlife Society of Southern Africa. The article might be described as a look at the locust problem in South Africa "up close and personal," to use an expression. Embellished with</p>
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<p>effects as dieldrin, on locusts this year.</p> <p>However, a spokesman said that in future the department would use pyrethroids, an expensive synthetic pesticide which breaks down rapidly.</p> <p>The trust is the "youngest" of the major conservation bodies in South Africa and has 5,000 members, about 500 of whom are from the Western Cape.</p> <p><b>BOOKS</b></p> <p>from page three</p> <p><i>Entertaining With Insects</i> is a totally delightful little book, stylishly illustrated (by John Gregory Tweed) with scenes of happy people of obvious intelligence, class, charm, and substance. Obviously they are happy because of what they have been eating. According to Dr. Taylor, the publisher is considering a reprinting. One would guess that the more inquiries the publisher receives, the more likely he is to do the reprinting. In the meantime, there may be a copy in your library, and as the authors say in their introduction, Bon Appetit!</p>	<p>some excellent photographs, it summarizes South Africa's efforts to deal with the brown locust, <i>Locustana pardalina</i>, over the past two centuries. Dr. Ledger details the history of outbreaks, beginning with the first documented outbreaks between 1797-1808 up to 1986, with information on the severity of the outbreaks, their geographical extent, the specific insecticides and other measures used in combating the bands of young hoppers and swarms of winged adults, and costs incurred. From Ledger's historical account, it appears that the brown locust was in major or minor outbreak in more than 100 of the 190 years between 1797 and 1987.</p> <p>Pre-1900 control measures included, "trampling the hoppers with herds of livestock; smoke and noise to chase locusts from crops, while indigenous people used pits filled with grass to catch hoppers for consumption." Chemical controls were introduced between 1900 and 1910 and included paraffin, soap solutions, carbolic sheep dip and arsenite of soda. Physical</p>
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<p>methods such as pits and screens were also employed to collect hoppers. Sodium arsenite, with and without bait, was the dominant insecticide used from the early 1920's to mid-1940's, with benzene hexachloride and subsequently its gamma isomer (lindane) being dominant from then into the 1980's.</p> <p>During the most recent outbreak, government locust control costs for the financial year April 1985 to March 1986 totaled 28.1 million Rand (=U.S. \$11.24 million). The major costs were for insecticides (R17 million) and subsidy of private vehicles used for control work (R4.9 million). Other control costs included wages to non-government personnel, government transport costs, hire of aircraft (crop sprayers for locust control), and fuel and repair to equipment. As part of the campaign to combat the locusts, the South African Defence Force put national servicemen into the field. Ledger states that "During the winter months of 1986 the locusts rested, the Department of Agriculture marshalled its forces, and environmentalists huffed and puffed about the excess of insecticides strewn over the veld, the need for ecological studies of the brown locust and alternative control measures that should be tried."</p> <p>Dr. Ledger describes with humor the clash of viewpoints that emerged during a "Workshop on Evaluation of the Locust Campaign" held in Pretoria in March, 1987. It was hosted by the Department of Agriculture, but included a mix of outsiders, e. g., academics, chemical industry, environmentalists and farm-</p>	<p>ers' representatives who "did not restrain themselves from offering critical opinions on many aspects of the 'locust campaign". The Space limits our recap to the following excerpt regarding harvest possibilities:</p> <p>The man in the street reads about locusts used for animal feed and for human consumption and wonders whether any potential for locust control could be found in the intensive harvesting of the insects. African tribes have always utilized locusts for food and the famous South African writer and epicure, C. Louis Leipoldt, included a recipe in his <i>Cape Cookery</i> book. . . The logistics of locust harvesting are formidable, but serious thought is being given to the harvesting of krill in the Antarctic, where the problems and severe weather conditions pose far greater constraints than in the Karoo!</p> <p>During discussion time, the idea of locust-harvesting was dismissed as a nice thought by well-meaning city-dwellers, but totally impractical and of no real meaning in locust control. "Not so," said Harold Braack, Warden of the Karoo National Park near Beaufort West. He described experimental work to collect locusts with industrial vacuum cleaners, which worked very well. The locusts were sent to an animal feed company in Cape Town which processed them, turned them into pellets and sent them back to the Karoo where farmers fed them to sheep with good preliminary results, indicating high nutritional value.</p> <p>Relative to the use of vacuum devices for harvest, T. Braack et al. (1987, <i>African Wildlife</i> 41(4):211) note that they must be used after the hoppers, or adult fliers as the case may be, have settled and clustered for the night on vegetation. The locusts are too active and skittish to be approached during the day.</p>

# BOOMING NEW INDUSTRY: Everybody is trying to build a mechanical "bug catcher"

<p>Several efforts to build a mechanical "bug catcher" have come to our attention during the past year. The motivating force in the two most sophisticated efforts is the need to reduce the use of pesticides wherever possible, but the development of such equipment is also of interest for the possible large-scale harvest of insects as food and animal feed. The so-called "Bug Vac" was developed specifically to deal with lygus bugs in California strawberry fields. Strawberry growers currently spend about \$90 million per year on pesticides. The Bug Vac is basically a system of hydraulically-driven vacuum fans and suction hoses mounted on a tractor. It covers four rows at a time and currently costs \$17,000 to \$20,000 per machine. Interestingly, Bug Vac is a "selective predator;" it sucks up the lygus bugs which live on new berries high on the plant while leaving largely untouched the riper fruit and beneficial insects, including ladybugs, which live deeper inside the plant foliage. The lygus bugs are pulverized and spit out as mulch.</p> <p>The "Father of the Bug Vac" is Ed Show, a University of California-Davis graduate and, since 1972, a research entomologist with Driscoll Strawberry Associates. Also involved is Tim Driscoll, president of Escalon Berry Farm, who managed 500 acres with Bug Vac (three of them) in 1988 and will expand that to 1,000 acres in 1989. According to</p>	<p>alone was not enough to dislodge the insects which were under leaves or well down in the plant. Thus, the Beetle Eater has both blowing and sucking power. Air traveling at about 300 mph as it comes out of the blower tubes blasts up under the plants, and, as the insects are dislodged, they are sucked into a vacuum tube, pulverized by the fan blades and blown back onto the field. The machine requires only a 60-hp tractor. The Beetle Eater, unlike the Bug Vac, is not selective. Szyal estimates that it gets 85% to 90% of all the insects in the crop, and he says, "We think it'll compete effectively with chemicals in many different crops... Interest has been tremendous by everyone who's seen it work." More information can be had by contacting James Szyal, 88 N. Main Street, Florence, Massachusetts, 01060, USA.</p>
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"Bug Catcher", p. 6



<p>Driscoll, Bug Vac in combination with IPM (integrated pest management) has reduced chemical expenses by 75% and already has paid for itself. Show will have two dozen new model machines in the field this year and thinks the concept may spread to lettuce and broccoli which have insect problems similar to those of strawberries. More information on the Bug Vac can be had by consulting the article by R. S. Street in <i>Agrichemical Age</i> 33(3):38-39, 1989.</p> <p>Working from the opposite coast is the "Beetle Eater," designed in Massachusetts by Jimmy Szynal for use in potato fields. The interesting thing about the Beetle Eater, which was described in a recent issue of <i>Farm Show</i>*, is that Szynal found that suction</p>	<p>We want to thank Warren Rush (US AID) for a copy of this Unclassified Department of State Incoming Telegrwn, dated July, 1986:</p> <p>Subject: Locust and grasshopper treat - Burundi.... Criquet migrateur [migratory locusts] began entering Burundi in May and June from Tanzania on the east They are now to be found in Ruyigi, Kankuzo, Muyinga, Ngozi, and Kayanza Provinces. No alarming damage has been reported to date. The only defensive measures reportedly taken to date by local residents in affected areas has been to gather them up and eat them.</p>
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TENEBRIONIDAE AND QUINONES

<p>Easy availability has made the yellow mealworm, <i>Tenebrio molitor</i> Linn. (Family Tenebrionidae), one of the insects most commonly recommended for inclusion in recipes in the West (see recipe, p. 3). It has been valued and reared by zoos, aquaria, etc. as food for birds, fish, and a variety of small animals since at least the 17th Century (Cotton 1929, <i>USDA Tech. Bull. No. 95</i>, and others). The larva of another tenebrionid, the confused flour beetle, <i>Tribolium confusum</i> du Val, is also sometimes suggested for use in recipes, although less often.</p> <p>Tenebrionids have a bad reputation, and deservedly so, as pests of meal and flour and other stored and packaged cereal foods. As opposed to merely aesthetic reasons for rejecting insects or insect parts in food, tenebrionid-infested food products may represent a true toxicological hazard to the consumer. It is important for this reason to note that it is the adult beetles, not the larvae, that pose the problems.</p> <p>Ladisch <i>et al.</i> (1967, <i>Nature</i> 215:939-940., 1968, <i>Proc. Pa. Acad. Sci.</i> 42:87-91, and earlier publications by this group) reported benzoquinone secretions from the adult beetles of all of several genera and species of Tenebrionidae tested, and experimental results with mice suggested that these compounds are both acutely toxic and carcinogenic. Wirtz and Fruin (1982, <i>J. Food Protect.</i> 45:1084-1086) reported mutagenicity, using the <i>Drosophila melanogaster</i> sex-linked recessive lethal test. Wirtz <i>et al.</i> (1978, <i>Comp. Biochem. Physiol.</i> 61B:25-28) found very low concentrations in newly eclosed adults of <i>Tribolium confusum</i> and <i>T. castaneum</i> (Herbst) (&lt;2.0 ug/insect), but that each 30-day adult could probably contribute 35-46 g p-benzoquinone to infested commodity. Flour merely exposed to quinone vapors binds 350 ppm of it within 60 min according to Ladisch (1965, <i>Proc. Pa. Acad. Sci.</i> 39:36). In addition to quinones, Howard <i>et al.</i> (1986, <i>Insect Biochem.</i> 16:757-760) and Howard and Mueller (1987, <i>J. Chem Ecol.</i> 13:1707-1723) have recently reported that <i>Triboliwn</i> adult secretions (from <i>T.</i></p>	<p><i>castaneum</i> and <i>T. brevicornis</i> (LeC.)) contain ketones that are potent inhibitors of insect and mammalian prostaglandin synthetases. Prostaglandins are local cell hormones which, in vertebrates, have been shown to modulate adenylate cyclase activity and facilitate ion transport, nerve transmission, platelet aggregation, and gastrointestinal function.</p> <p>From the foregoing it seems apparent that tenebrionid larvae reared as food should be allowed no contact with the adult beetles or with flour or meal previously infested by them. Ladisch <i>et al.</i> (1967) found a distinctly lower quinone concentration in the ebony strain of <i>T. confusum</i> (ave. of 2.4 g/insect) than in the wild type (57.8 g/insect), but bread baked from flour previously infested with the ebony strain was found by Smith <i>et al.</i> (1971, <i>J. Stored Prod. Res.</i> 6:307-316) to have a distinctly offensive taste and odor. Whether <i>T. confusum</i> larvae reared in such flour would be similarly affected is uncertain as there appears to be no pertinent experimental data.</p> <p>Quinones appear to be much less a problem in <i>Tenebrio molitor</i> than in <i>Tribolium confusum</i>. Ladisch <i>et al.</i> (1967) state that quinones were detected in <i>T. molitor</i> adults, but they give no data on concentration, which suggests that the concentration was probably lower than that detected in the ebony strain of <i>T. confusum</i> Smith <i>et al.</i> (1971) state that they have encountered no evidence in the literature that <i>Tenebrio molitor</i> causes any adverse effects on the taste or baking qualities of flour or other food products. In fact, they reported that in bread baked from flour previously infested by <i>T. molitor</i> larvae, certain properties such as volume, evenness of bake, and aroma exceeded that of the controls!</p> <p>Additional comment or longer contributions are invited on this subject and on the general subject of toxicological and allergenic hazards posed by insect defensive secretions and sequestered chemicals in insect families that include edible species.</p>
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<p>"Bug Catcher" from page five</p> <p>We have no information on the weight of lygus bugs per 100 acres of California strawberries or of potato beetles and their larvae per 100 acres of potatoes. The mass of insects obtainable in either instance is probably too low to warrant bagging them for use as high-protein chicken feed, even as a spin-off benefit.</p> <p>from running a piece of heavy equipment through a cultivated crop. The interesting point is that people are attempting to develop mechanical harvesters as one way of reducing pesticide application. Similar thinking applied to some larger insect pests, and especially those that aggregate in nature, such as migratory locusts, Mormon crickets, and armyworms, might indeed yield multiple benefits from a single expenditure of fossil-fuel energy: crop protection, reduced pesticide use and a food or animal feed product. People of non-European origin have frequently applied this principle on their own, using</p>	<p>muscle energy (see DeFoliart 1989, <i>Bull. Entomol. Soc. Am.</i> 35:22-35, for a recent example in Thailand). There is no readily apparent reason why the use of western technology should automatically invalidate the principle.</p> <p>According to D. L. Gumm (1960, <i>Ann. Rev. Entomol.</i> 5:279300), the individuals in a single swarm of <i>Schistocerca locusts</i> in Africa can weigh up to 30,000 metric tons. Food that flies or hops, on this scale, would probably overwhelm the local muscle generated harvest capability in most localities insofar as any effective crop protection is concerned. Thus there could be a great future for someone who wants to play with the problem of developing a better Bug Vac or Beetle Eater - one that is light, highly mobile and adapted for sucking clustered locusts from their nightly resting places.</p> <p>*The article from <i>FarmShow</i> was sent in by Milton Bliss of Hartford, Wisconsin, USA</p>
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**Federal Regulations**

from page one

Canned silkworm pupae (*Bombyx mori: mori*: Bombycidae, Lepidoptera) from South Korea. Since the label information was written entirely in the Korean language, the product was in violation of Sec. 403 (misbranding).<sup>5</sup>

An incident reported several years ago from Kenya highlights the fact that insects destined to be used as human food must be treated with the same care as other kinds of food, if problems are to be avoided. In this case, termites (Isoptera), apparently mostly reproductives, were collected, stored in closed plastic bags, and transported 400 kilometers by land at ambient temperatures. Five of six people who then ate the termites died of botulism.<sup>3</sup>

Insects, whatever their habitat, generally carry large numbers of microorganisms, some of which may be pathogenic. Since the spores of *Clostridium botulinum* are widely distributed in soils,

it is easy to understand how this tragedy in Kenya occurred. The point is that all foods, and certainly those composed largely or entirely of insects, must be harvested, stored, prepared, packaged and distributed under protocols that will prevent the proliferation and persistence of pathogens and toxins.<sup>2</sup>

**REFERENCES**

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- 3 Nightingale, K. W. and E. N. Ayim. 1980. Outbreak of botulism in Kenya after ingestion of white ants. *British Medical Journal*. 281(20-27 Dec): 1682-1683.
- 4 Stehr, F. W. (ed.). 1987. Immature Insects. Dubuque, IA: Kendall/Hunt.
- 5 U. S. Department of Health and Human Services. 1986. Federal Food, Drug, and Cosmetic Act, as Amended, and Related Laws. HHS Publication no. (FDA)86-1051. Rockville, MD: Food and Drug Administration.

**Program Profile**

from page two

**Monospecific production of larval protein with adult populations of *Ornidia obesa* housed in confinement.** (Approved November 1984.) This project does not yield relevant data because green hover flies rapidly died when caged, and it was not possible to find an artificial diet adequate for adults.

**Large-scale production of larval protein in a coffee pulp bed.** (Approved August 1985.) In this study, a prototype of a rearing unit after an idea from the University of Georgia was operated for two consecutive years. Certain modifications on the original design were made, and a further evaluation has been planned. Relationships between larval populations and abiotic factors as well as the behavior of migrating larvae were topics of particular interest. In addition, the growth of *O. obesa* larvae on coffee pulp maintained in petri dishes under more controlled conditions was studied.

**Acceptance of coffee pulp-based rations by yellow mealworm larvae.** (Approved December 1987.) The main objective of this project is to determine whether or not yellow mealworms can feed on dried coffee pulp. If so, this residue would be an alternative to wheat bran.

By July 1988, planning was underway for another project in which the evaluation of polyethylene bags as substrate containers was proposed as well as a comparison between ensiled and coffee pulp since ensiling is a good method for preserving waste materials on a long-term basis.

In 1986, larvae of the domestic fly were used in pond-fish culture by a biologist from the Centre for Fisheries Development. The larvae, raised on pig manure, were contained in an open-top box with a bottom of wire screen which was placed over water. When migrating out to pupate, the larvae dropped to the water where they were eaten by fish (*Tilapia* sp. and *Cichlasoma* sp.). In view of the promising results, two undergraduates from the National University became enthusiastic to do their dissertation on this topic. Late in 1988, this work was underway. Larvae production was scheduled for feeding trials, and a mathematical function descriptive of larvae-rearing patterns served to estimate the biological yield in terms of protein conversion and the substrate's potential.

There is a need to investigate other topics related to food insects. At least one of these, the use of insects in fresh-water shrimp culture, is also being considered in El Salvador.

[Editor's note: Mr. Larde's research on the use of fly larvae for recycling coffee pulp waste has been published in three reports, copies of which are presumably obtainable from the author.]