Flavor of Meat from Animals Treated with Malathion, Ronnel, or Co-Ral

JENNIE L. BROGDON, MARY E. KIRKPATRICK, and ELSIE H. DAWSON

Human Nutrition Research Division, U. S. Department of Agriculture, Washington 25, D. C.

Flavor of selected meat cuts from treated and untreated pork and beef animals was determined. Insecticide treatment of pork animals consisted of 1.0% of malathion. For beef animals, three treatments were used—0.5% of malathion, 100 mg. of ronnel per kg., and 0.5% of Co-Ral. The flavor of meat from malathion-treated animals and ronnel-treated animals did not differ significantly from the flavor of meat from corresponding control animals. The flavor of rib cuts, round steak, and kidney from Co-Ral–treated animals was not affected by the treatment. Although the flavor score for liver from animals treated with Co-Ral differed significantly from that of control animals, the panel recorded the off-flavor as slight.

Numerous studies on control of insects and cattle grubs [*Hypoderma lineatum* (De Vill.) and *H. bovis* (L.)] affecting livestock through the use of various systemic insecticides and phosphorus compounds have been conducted in recent years (*1*, *6*, *12*). However, few studies reporting the effect on flavor of meat from use of such insecticides are in the literature.

Reported herein are results of flavor tests conducted to determine if treatment of pork animals with malathion and beef animals with malathion, ronnel (Dow ET-57), or Co-Ral (Bayer 21/199) affected the flavor of selected meat cuts.

Experimental Procedures

Insecticide Treatments. One Yorkshire hog was sprayed with malathion [*S*-[1,2-bis(ethoxycarbonyl)ethyl]*O*,*O*-dimethyl phosphorodithioate] to control body lice. Two applications of 1.0% of malathion were made using 650 ml. of spray for the first application and 750 ml. for the second application 1 week later. The treated hog and an untreated litter mate were maintained on grain with a commercial supplement. Both animals were slaughtered 3 days after the second malathion treatment. They were approximately $2^1/_2$ months old. Malathion residues were determined and analytical results have been reported (*8*).

The beef animals used in the tests were average range cattle from the Kerrville, Tex., area. They were yearling Herefords from a government herd. Care was taken to select animals of comparable age, weight, and condition for each experiment. Control and treated animals were kept under identical conditions, and after slaughter the carcasses were aged for 1 week.

In the malathion study, cuts were evaluated from one steer sprayed with 0.5% of wettable powder malathion, one steer sprayed with 0.5% of emulsifiable concentrate malathion, and two steers sprayed with water (control animals). Sprays were applied once a week for 16 weeks at the rate of 1 gallon of spray per animal, enough to wet the hair thoroughly to the skin. During this period, the animals were maintained on a fattening ration. The steers were slaughtered 3 weeks after the final spraying.

Ronnel [*O*,*O*-dimethyl *O*-(2,4,5-trichlorophenyl) phosphorothioate] was applied in emulsion form as an oral drench to one heifer at a concentration of 100 mg. per kg. A second heifer was untreated. The animals were on pasture with grain supplement. Both animals were slaughtered 5 weeks after the ronnel treatment. History of treatment and grub infestation of these two animals (identified as numbers 1345 and 1375) has been reported (*9*).

One steer and one heifer were each sprayed with 0.5% of Co-Ral [*O*-(3-chloro-4-methylumbelliferone) *O*,*O*-diethyl phosphorothioate] made from a 25% wettable powder. The control animals, one steer and one heifer, were sprayed with water. Sprays were applied at the rate of 1 gallon per animal. The animals were sprayed once every 2 weeks until a total of seven applications were made. Diet consisted of alfalfa and sorghum hay with a grain mixture of corn, oats, and cottonseed meal with bone meal and salt supplied in adequate quantities. Animals were slaughtered 4 weeks after the last spray treatment.

Palatability Evaluations. The cuts selected from each of the animals in a particular study were as follows:

Pork, malathion.	Rib chops, center ham slices, and bacon strips.
Beef, malathion.	Two-rib roasts, ground chuck (25% of fat), ground round (25% of fat), and liver.
Beef, ronnel.	Steaks (one arm, one porterhouse, two sirloins) and roasts (one rib, one blade, one arm).
Beef, Co-Ral.	Two- or four-rib roasts, round, liver, and kidney.

The meat cuts tested in each study, with the exception of ham slices, were held at 0° F. until prepared for palatability evaluations. The hams were cured and refrigerated whole until center slices were removed, the day before taste testing.

Oven cooking was the method selected, since temperature could be better controlled and duplicated from day to day. All cuts were completely thawed before cooking. No seasonings of any kind were added to the meat. Treated samples were cooked in a separate oven from untreated samples. Unless otherwise indicated, cuts were cooked on lightly greased racks in aluminum broiler pans.

Pork rib chops were cooked in foil-covered glass baking dishes for 25 minutes at 350° F. Ham slices were baked in covered 2-quart glass casseroles for $1^1/_2$ hours at 350° F. Bacon strips were baked 9 to 11 minutes in 400° F. ovens.

Beef rib roasts, similarly prepared for malathion, ronnel, and Co-Ral studies, were cooked, uncovered, at 325° F. until an internal temperature of 70–71° C. was reached. Other beef cuts used in each study were prepared as follows:

Malathion Treatments. Ground chuck and ground round were cooked in

muffin tins as individual meat patties, each about 3.5 ounces ready-to-cook weight, at 450° F., until an internal temperature of 71° C. was reached.

One-pound samples of liver were sliced into pieces approximately 1/4 inch thick and cooked in 2 ounces of hydrogenated vegetable shortening for 15 minutes at 400° F.

Ronnel Treatments. Steaks were cooked for 20 to 25 minutes at 450° F. After 15 or 17 minutes, they were turned to the other side to allow uniform cooking.

Co-Ral Treatments. Slices of round were prepared as ground patties. Since cooking time may be a factor in development or persistence of off-flavor rib cuts adjacent to those used as roasts were also prepared as patties which required short cooking time in comparison to the long time used for roasts. Trimmed lean round or rib meat was ground, weighed into 30-gram portions, and molded into patties with the aid of plastic sampling boxes, $1^3/_4 \times 1^3/_4 \times {}^5/_8$ inches deep. The use of ground rib and round meat was advantageous in that it provided more uniformity of sample for taste panel evaluation.

Approximately 1 pound of liver, cut into three slices each 1/4 to 3/8 inch thick, comprised a panel sample. Kidneys were cut in half, the fat and core were removed and one half kidney was cooked to serve the palatability panel at each session.

Patties were baked at 350° F. for 20 minutes; liver slices and half-kidneys were baked at 400° F. for 16 and 20 minutes, respectively. Midway in the cooking period each piece was turned to the other side.

Each cut was evaluated in a separate experiment according to the following plans:

The panel members were laboratory staff of the Human Nutrition Research Division experienced in evaluating foods exposed to agricultural chemicals during production and selected on the basis of their threshold sensitivities to agricultural chemicals and food flavors (*4*, *5*, *10*). They were instructed to evaluate flavor only. To avoid as much as possible the influence of characteristics other than flavor, each individual member received treated and untreated meat samples from the same portion of a particular cut. In preliminary judging sessions, panel members obtained experience in evaluating flavor and became familiar with the natural flavor of a specific cut of meat. Evaluations were conducted so that no person could observe the reactions of any other.

Flavor was evaluated on five-point rating scales on which 5 represented no off-flavor; 4, slight off-flavor; 3, moderate off-flavor; 2, strong off-flavor; and 1, very strong off-flavor.

Analysis of variance followed by the *t* test (*11*) was applied to data.

Table I. Mean Scores[a] for Flavor of Meat from Control Animals and Animals Treated with Malathion: Selected Pork Cuts and Selected Beef Cuts

	Pork Cut[b]					Beef Cut[c]			
	Rib Chops		Ham						
Treatment	Lean	Fat	Lean	Fat	Bacon	Rib roasts	Chuck, ground	Round, ground	Liver
Control, untreated	4.3	4.0	4.0	3.4	4.6	4.4	4.1	3.9	4.5
Malathion emulsion concentrate	4.7	4.6	4.2	3.2	4.8	4.6	4.4	3.6	4.3
Test difference[d]	0.5	0.6					0.7	0.7	
Control, untreated						4.4	4.1	3.9	4.5
Malathion wettable powder						4.1	4.1	4.0	4.1
Test difference[d]						0.7			0.8

[a] Score of 5 represents no off-flavor; 4, slight off-flavor; 3, moderate off-flavor; 2, strong off-flavor; and 1, very strong off-flavor.

[b] Means were based on 20 scores (5 judges × 4 replications).

[c] Means for control animals were based on 48 scores for liver (8 judges × 3 replications × 2 animals) and 32 scores for muscle cuts (8 judges × 2 replications × 2 animals). Means for treated animals were based on 24 scores for liver (8 judges × 3 replications) and 16 scores for muscle cuts (8 judges × 2 replications).

[d] The difference between two means is significant at the 5% level, if it equals or exceeds the test difference [*t* test (*11*)].

Table II. Mean Scores[a] for Flavor of Selected Beef Cuts from Untreated Animals and Animals Treated with Ronnel

	Steaks[b]		Roasts[b]	
Treatment	Lean	Fat	Lean	Fat
Control, untreated	4.4	3.4	4.2	3.5
Ronnel	4.0	3.5	4.7	3.7
Test difference[c]	0.7		0.7	

[a] Score of 5 represents no off-flavor; 4, slight off-flavor; 3, moderate off-flavor; 2, strong off-flavor; and 1, very strong off-flavor.

[b] Means were based on 20 scores for steaks (5 judges × 4 replications) and on 15 scores for roasts (5 judges × 3 replications).

[c] Difference between two means is significant at the 5% level, if it equals or exceeds the test difference [*t* test (*11*)].

Results

Malathion treatment was not associated with off-flavor in meat from treated hogs or treated cattle (Table I). Lean meat from malathion-treated animals received mean flavor scores similar to scores for meat from untreated animals. Fat on rib chops from malathion-treated hogs received a significantly higher flavor score than did the fat on chops from untreated hogs. However, fat of pork chops from the untreated animals had no appreciable off-flavor. The lean of the cured ham was slightly off-flavored and the fat was moderately off-flavored in samples from both untreated and treated animals. Bacon had little or no off-flavor in any of the samples.

Ronnel treatment of beef animals did not adversely affect flavor, since mean scores for fat and lean meat of roasts and steaks from untreated animals were not significantly different from corresponding scores for meat from treated animals (Table II). These results were substantiated at the Oregon Agricultural Experiment Station where palatability evaluations of liver, rib roasts, pot roasts, round steak, and sirloin steak indicated no adverse effects on flavor attributable to ronnel treatment (*13*).

Co-Ral treatment of animals did not affect the flavor of rib cuts, round steak, or kidney (Table III). Although the mean flavor score of 4.3 for liver from treated animals was significantly lower than the score of 4.6 for liver from untreated animals, the off-flavor was only slight. These conclusions apply only to the flavor of cuts from animals treated with the amounts of Co-Ral used in this experiment—that is, to animals treated with seven applications of 0.5% of Co-Ral at 14-day intervals.

Meat and Treatment	Experimental Design and Reference	Replications for Each Cut	Characteristics Judged	Panel Members
Pork, malathion	Randomized block (*3*)	4-bacon, rib-chops, and ham slices	Flavor of meat and fat	5
Beef, malathion	Split plot (*11*)	3-liver 2-rib, round, and chuck	Flavor of meat	8
Beef, ronnel	Randomized block (*3*)	4-roasts 4-steak	Flavor of meat and fat	5
Beef, Co-Ral	Split plot–rib cuts (*11*) 2 × 2 Latin square — liver, kidney, and round (*7*)	12 12	Flavor of meat	4

Table III. Mean Scores[a] for Flavor of Selected Beef Cuts from Untreated Animals and Animals Treated with Co-Ral

Treatment	Rib Roasts[b]	Rib Patties[b]	Round Patties[b]	Liver[b]	Kidney[b]
Control, untreated	4.7	4.5	4.5	4.6	4.7
Co-Ral	4.4	4.3	4.5	4.3	4.6
Test difference[c]	0.8			0.3	

[a] Score of 5 represents no off-flavor; 4, slight off-flavor; 3, moderate off-flavor; 2, strong off-flavor; and 1, very strong off-flavor.
[b] Means were based on 48 scores (4 judges × 6 replications × 2 animals).
[c] Difference between two means is significant at the 5% level, if it equals or exceeds the test difference [*t* test (*11*)].

The similarity in the mean scores for rib roasts and rib patties representing long and short cooking periods, respectively, indicated that cooking time was not a factor in flavor quality. Scores of 4.3 or above indicated that only slight off-flavors were present.

Results of the Co-Ral study are in general agreement with studies carried out at the University of Pittsburgh in which flavor evaluations indicated no off-flavors in round steak from beef animals treated with 0.25% of Co-Ral or in liver from beef animals treated with 0.5% of Co-Ral (*2*).

These investigations should be considered exploratory in nature because of the limited number of animal replicates. Further research is needed before definite conclusions can be drawn. Results should be interpreted in connection with other research on this subject.

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FOOD ADDITIVES ANALYSIS

Turbidimetric Determination of the Extractability of Polyethylene Food Packaging Film in Vegetable Oil

DELWIN P. JOHNSON and FRANK E. CRITCHFIELD

Development Department, Union Carbide Chemicals Co., Division of Union Carbide Corp., South Charleston, W. Va.

The extractability of polyethylene food packaging film in vegetable oil is determined by the amount of turbidity produced when the extract is treated with a mixture of ethyl and isopropyl alcohols. The turbidity, in nephelos, is applied to a calibration curve prepared with standard hexane solutions obtained by digesting the film in this solvent at various temperatures. The extractability of polyethylene in vegetable oil at 57° C., as specified by the Food and Drug Administration, coincides with the extractability of the polymer in hexane at 37° C.

Polyethylene, like other materials used in the food packaging industry, must meet certain specifications regarding migration of components into the contents of the food package. The migrating species of polyethylene has been identified as primarily short chain polymer and is thus referred to as the low molecular weight fraction (LMWF) of the polymer.

Because of difficulties encountered in determining the migrating substances directly in a food commodity, certain simulated food solvents, including water, 3% acetic acid, and vegetable oil, have been used for migration studies. Solvents were chosen to represent the different classes of foods. Other solvents such as ethyl alcohol may also be required, depending on the proposed use of the material under study.

Conditions for studying the extractability of a packaging material were proposed by Food and Drug Administration scientists (*1*). Briefly, the material—in the form of a thin film—is exposed to solvents at the ratio of 0.5 sq. inch per ml. The mixture then is digested at 57° C. for 1 week, after which the solvent is removed and analyzed for extracted substances.

Analysis of aqueous and alcoholic extracts generally involves evaporation of the solvent and a gravimetric measurement of the residue. Variations of this technique have been applied, but in