Off-flavor in Canned Olives

tests show application of certain insecticides to olive trees will produce musty flavor in the fruit

Reese H. Vaughn and Hudson T. Hartmann

Benzene hexachloride—lindane and B.H.C.—applied to olive trees before harvest will result in a moldy, musty off-flavor in the canned olives, according to the results of tests initiated in July 1953.

Investigation of the first of three outbreaks of off-flavor in canned ripe olives —which have occurred during the past 10 years in olives grown in widely separated areas in California—revealed nothing which might explain the off-flavor. However, during the investigation of the second outbreak, circumstantial evidence was found which indicated that the undesirable flavor detected in the olives could have resulted from drift of benzene hexachloride—an insecticide applied by airplane dusting to a cotton field adjacent to an olive grove. In the meantime, experience with benzene hexachloride as an insecticide for protection of other crops, such as carrots, tomatoes, potatoes, peaches, walnuts, and so forth, had shown that the application of this compound resulted in the appearance of a moldy, musty taste in the crops so treated.

Early in 1953, the third of the outbreaks of the same moldy, musty off-flavor occurred. It was suspected that insecticide residues of the benzene hexachloride type were involved. This time more concrete evidence of the presence of an insecticide was obtained by biological assay.

To verify or refute this suspicion, a test was established—at the University's Wolfskill Experimental Orchard at Winters—to determine if applications of benzene hexachloride to trees would result in off-flavors in the processed fruits.

Effect of Type of Application of Lindane and B.H.C to Trees on Presence of Off-flavor in Canned Green-ripe olives.

Sample	Application	Off-flavor*
	Treated with Lindane	
1	Pruning cuts	Slight moldy off-flavor
2	Foliage spray	Definite moldy off-flavor objectionable
3	Soil under tree	Pronounced moldy off-flavor very objectionable
	Treated with B.H.C	
4	Pruning cuts	Definite moldy off-flavor objectionable
5	Foliage spray	Pronounced moldy off-flavor very objectionable
6	Soil under tree	Strongest moldy off-flavor most objectionable
7	None (control)	No off-flavor

* Based on results of tasting panel composed of individuals known to be sensitive to this off-flavor.

Four-year-old trees of the Manzanillo variety were used. The following treatments were given to separate trees on July 14, 1953, using wettable powders of commercially available preparations:

Lindane

25% gamma isomer of benzene hexachloride

Treatment *1*—Applied to soil under trees at the rate of one pound per acre, followed by irrigation.

Treatment *2*—Foliage spray—applied at a concentration of one pound per 100 gallons.

Treatment *3*—Painted on fresh pruning cuts, using a solution containing one-eighth pound per gallon.

B.H.C

10% gamma isomer of benzene hexachloride—40% other isomers of benzene hexachloride

Treatment *1*—Applied to soil under trees at the rate of two pounds per acre, followed by irrigation.

Treatment *2*—Foliage spray—applied

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extensive brush associations showed much contrast.

Allowing the customary five sheep as the equivalent of one cow in forage requirements, the percentage difference in grazing capacity was in favor of sheep. This ratio holds up rather well for each of the four seasons after burning. A better ratio would be six or seven sheep to an animal unit month for ranges of this kind.

The incoming vegetation in the areas studied after burning consisted largely of annual grasses and forbs and of numerous sprouts of chamise, oaks, and ceanothi. Usually, the forage was most abundant the first two years after burning. By the end of the fourth year, brush had reoccupied most of the area.

The best grazing season proved to be about March 15 to June 1. After early summer the animals were inclined to travel extensively and consequently lost in condition.

Pure chamise lands are generally so low in forage production after burning that they are unprofitable for livestock grazing. Their usefulness is mainly that of watershed protection and as game range. Mixed chaparral lands also are low grade for grazing, and only the more productive areas — economically considered—are worthy of burning. The much more restricted woodland-chaparral areas produced the most and the best forage. Much of the sprout growth was palatable until fairly late in the summer.

The study demonstrated the importance of developing and carrying out a post-burn plan of range improvement, such as fencing, water development, reseeding where needed, and sometimes of reburning to destroy incoming brush.

Comparison of Grazing Capacity for Sheep and for Cattle on Three of the Most Common Types of Brushlands in Northern California After Controlled Burning.

Dominant cover	Yrs. after burning	Grazing capacity (acres per AUM)		Difference	
		Sheep	Cattle	Actual	%
Chamise	1	2.4	3.1	0.7	22.6
	2	2.5	3.4	0.9	26.5
	3	4.5	5.5	1.0	18.2
	4	7.0	8.3	1.3	15.7
Mixed chaparral	1	2.15	3.0	0.85	28.3
	2	1.8	2.3	0.50	21.7
	3	2.4	3.0	0.60	20.0
	4	4.55	5.9	1.35	23.7
Woodland chaparral	1	1.55	2.2	0.65	29.5
	2	1.50	2.0	0.50	25.0
	3	1.65	2.2	0.55	25.0
	4	2.40	3.0	0.60	20.0

Arthur W. Sampson is Professor of Forestry, Emeritus, University of California, Berkeley.

L. T. Burcham is Senior Range Technician, Range Improvement, California Division of Forestry, Sacramento.

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at a concentration of two pounds per 100 gallons.

Treatment *3*—Painted on fresh pruning cuts, using a solution containing one-fourth pound per gallon.

Control—No treatment.

Fruits were harvested from each tree on October 19, 1953, when they were at the straw-colored stage. They were processed immediately by the green-ripe method and canned orchard run with semicommercial equipment.

On July 8, 1954, canned samples of olives representative of each treatment were opened for examination. Tasting was done by a panel of individuals known to be sensitive to the off-flavor and under conditions where the identity of each sample was unknown to the panel.

The results, shown in the table on page 13, demonstrate that either lindane or B.H.C. applied to the trees before harvest of the olives results in a moldy, musty off-flavor in the canned olives. The results are in agreement with observations made with other crops.

About 40% to 50% of humans are insensitive to this moldy, musty off-flavor development in food crops, including olives. To detect contaminated fruit, personal sensitivity to the off-flavor developed in olives by the benzene hexachloride type of insecticide must be established.

Reese H. Vaughn is Professor of Food Technology, University of California, Davis.

Hudson T. Hartmann is Associate Professor of Pomology, University of California, Davis.

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GOPHERS

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but the differences were generally not statistically significant because of too few tests. Increases in kill were often too small to justify the added cost of materials. Manufacturer's recommendations with respect to dosage were followed and included in experiments involving graded dosages.

In methyl bromide tests, the suggested dosage of 10 cubic centimeters per burrow gave no kills in 14 burrows. The minimal lethal field dosage for methyl bromide, as indicated by the present study, lies between 10 and 20 cubic centimeters per burrow. Seemingly, a practical limit was reached at 20 cubic centimeters per burrow with a 51% kill as increasing the dosage level to 30, and 40 cubic centimeters per burrow yielded no significant increase in kill.

With carbon bisulfide, calcium cyanide powder and the nitrocellulose film bomb, doubled dosages increased the kills but did not bring mortality even close to practical levels.

Dosages should be established in relation to the air volume inside the burrow, and that volume widely varies—depending on the size of the gopher, type of soil, cover crop, and size and age of the burrow itself. The dosage of gas that might kill a gopher in a small new burrow in the garden would likely have no toxic effect in a long-established system in a cultivated field. Even in the same field, burrows vary greatly in size; nine excavated in an alfalfa field had tunnel volumes ranging from one to eight cubic feet with an average of 3.9 cubic feet.

Operational Difference

The operational principles in gassing and poisoning gophers are diametrically opposed, which probably accounts for the difference in results. When gas is the lethal agent, it must seek out its victim wherever it happens to be or go in its extensive tunnel system; but with poison baits, the victim must find the lethal agent.

Success in poisoning with baits may be attributed to high acceptance of baits by gophers who seem to be attracted to almost any object dropped into their burrows—even clean paraffin blocks are taken. Gophers are easily lured by any poisoned bait, such as a piece of carrot or other root vegetable.

Compared to poison baits, the cost of poison gases is excessive, even more so when labor and equipment costs are added. Cost of materials is almost negligible in poisoning—about a half cent per burrow—whereas gases cost many times that amount without giving the desired results. More time is needed, too, for gassing a burrow than for poisoning; gassing takes three or four minutes per burrow as compared to two minutes on the average for poisoning. The cost differential between gassing and poisoning would become even greater if calculated on the basis of kill.

Milton A. Miller is Associate Professor of Zoology, University of California, Davis.

Some tests reported in the foregoing article were conducted by James T. Rogers, Jr., a senior student in zoology, working under the direction of Professor Milton A. Miller. Dan Evans, Ray Meek, and Joseph Keeler, undergraduate students, and G. Victor Morejohn, a graduate student, assisted in the field work.

The compressed air apparatus for blowing calcium cyanide powder mentioned in the above report was developed by William Batzner, U. S. Bureau of Reclamation, Boise, Idaho.

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Kills of Gophers with Poison Gases and Poison Baits with Cost of Treatments.

Treatment	Dosage per burrow	Cost of materials per burrow	Number of burrows tested	Percentage kill ± S. E.
		cents		%
Methyl bromide	10 cc.	3.4	14	0
(CH_3Br)	20 cc.	6.7	47	51 ± 7.3
	30 cc.	10.1	30	50 ± 9.1
	40 cc.	13.4	57	58 ± 6.5
Carbon bisulfide	45 cc.	2	11	18 ± 11.6
(CS_2)	90 cc.	4	15	26 ± 11.8
Chloropicrin (CCl_3NO_2)	40 cc.	33	25	48 ± 10
	Soil dry:			
Calcium cyanide powder	¾ oz.	4.7	25	16 ± 7.3
[$Ca(CN)_2$]; generates HCN when wet	1½ oz.	9.4	10	20 ± 12.7
	Soil wet:			
	¾ oz.	4.7	10	20 ± 12.7
	1½ oz.	9.4	20	30 ± 10
Cyanide bomb; generates HCN when ignited	1 bomb	13.3	29	14 ± 6.4
Nitrocellulose film bomb;	1 bomb	12	25	44 ± 9.9
generates NO-NO_2 mixture	2 bombs	24	24	54 ± 10.2
Strychnine alkaloid on carrot. Toxic control	50 mg. on two 7-gm pcs.	0.57	114	80 ± 3.8
Unpoisoned carrot. Nontoxic control.	two 7-gm pcs.	0.25	18	6 ± 5.6*
No gas. Nontoxic control.	--	--	12	0

* *Normally, burrows treated with clean bait are plugged indicating no kill; but in these tests, one of eighteen so treated remained open indicating natural death, or capture of the occupant by a predator, or abandonment of the burrow by the gopher during the experiment.*