

Repellency of Some Phenylphenols and Related Compounds to House Flies¹

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ABSTRACT

Phenylphenols and related compounds were investigated as repellents to *Musca domestica* L. Biphenyl and 4-chloro-2-phenylphenol were the most active of the single com-

pounds tested. A mixture of these 2 compounds with phenol, *o*-phenylphenol, and 6-chloro-2-phenylphenol was more repellent than any of the single components.

During field tests of a disinfectant composed of a mixture of technical grade sodium salts of substituted phenylphenols (Mizuno et al. 1958, 1959), it was observed that fewer flies visited garbage cans and latrine buckets treated with the disinfectant than those not treated. Brief laboratory and field tests confirmed the original observation of repellency of this mixture to house flies, *Musca domestica* L. A more intensive laboratory study was undertaken to determine the relative effectiveness of the mixture and of its components, and also of some related compounds singly and in combination.

MATERIALS AND METHODS.—Tables 1 and 2 list the compounds and mixtures studied. The method used to determine repellency of these chemicals to house flies was essentially that of LaBrecque and Wilson (1959), with several modifications. The standard at-

tractant was a partially hydrolyzed casein (Edamin T[®]) mixed with water in a ratio of 1:1 by weight. Five g of the mixture were placed in the bottom of an electrolytic beaker 11.4 cm high by 4.5 cm diam. A wire screen was placed above the attractant to prevent the flies from coming into contact with it, since Dethier (1955) reported that under similar conditions flies that were allowed to feed on sugar produced a volatile substance or substances attractive to the flies. Only female flies were counted, since LaBrecque and Wilson (1959) reported that Edamin T was more attractive to females than to males, and we observed that the response of females to the attractant was more consistent. If fewer than 5 ♀ were caught in the control trap, the test was discarded.

One-half ml of an acetone solution of each test chemical was applied to half of an 11-cm filter paper. The acetone was allowed to evaporate for 30 min, then the paper was formed into a funnel which was inserted into the beaker and fastened to the rim with

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Table 1.—Effectiveness of some phenolic compounds as repellents to house flies.

Compound	Melting point (°C)	No. replicates/concn ^a	Lowest effective concn (μg/cm ²)	Regression coefficient ^b
Biphenyl	69.5–70.5	6	6.8	–7.664
4-Chloro-2-phenylphenol	36.8–37.2	4	26.9	–13.153
Phenol	39.8	3	26.9 ^c	–2.123
<i>o</i> -Phenylphenol	57.7–58.2	6	53.8	–10.137
2-Chloro-4-phenylphenol	73.0–75.0	8	53.8	–5.428
6-Chloro-2-phenylphenol	75.4–75.5	3	215.2 ^d	
<i>p,p'</i> -Biphenol	278.0–281.0	6	215.2 ^d	
<i>o,o'</i> -Biphenol	108.0–110.0	4	215.2 ^d	
<i>p</i> -Phenylphenol	166.0–167.0	3	215.2 ^d	

^a 1 replicate at each concentration consists of duplicate tests performed on 1 day.

^b Regression of mean number of flies trapped on log concentration.

^c Lowest concentration tested.

^d No effective repellency at this concentration.

cellophane tape. The chemicals were evaluated at concentrations on the filter paper of 215.2, 107.6, 53.8, 26.9, 13.5, 6.8, 3.4, and 1.7 μg/cm². Only the more active chemicals were tested at the lowest concentrations. A funnel treated with solvent acted as the control.

The house flies were reared in Chemical Specialties Manufacturers Association (CSMA) medium. Approximately 100 flies of mixed sexes were placed in cages (38.1×27.9×25.4 cm), and were starved for 3–5 hr before the test to aid in obtaining a more uniform response. Traps with chemically treated funnels and those treated with the solvent were placed into each cage for 30 min. The trapped flies were anesthetized with CO₂, sexed, and counted. Each test was duplicated on each day; each concentration of chemical was tested on 3–8 different days. The tests were conducted in a room held at 72±1°F and 63±5% RH.

RESULTS AND DISCUSSION.—Unequal numbers of replications among concentrations of the same compound were accounted for by a least-squares analysis from which adjusted means were generated (Harvey 1960). Tables 1 and 2 give results. The lowest effective concentration is given for those compounds and mixtures which were repellent. The chemical was considered repellent when the mean number of flies in the test trap was less than the mean number in the control trap less the least significant difference. Also listed are

regression coefficients from a linear regression of the adjusted means just cited and the logarithm of concentration (Yates 1934).

6-Chloro-2-phenylphenol, *o,o'*-biphenol, *p,p'*-biphenol and *p*-phenylphenol did not repel flies at the highest concentration tested (215.2 μg/cm²). Data on phenol showed it to be an effective repellent at deposits between 26.9 and 215.2 μg/cm², but its least effective concentration could not be determined from the available data. The most effective compounds were biphenyl, 4-chloro-2-phenylphenol, and phenol (Table 1). Mixture 1 (Table 2) appeared to be more effective than any of the components for which least effective concentrations were calculated, but we were unable to demonstrate synergistic effects. Mixture 2 (Table 2), a commercial mixture of technical grade sodium salts of 3 phenols with 1% of undefined related compounds, gave a lowest effective concentration of 26.9 μg/cm². This was doubled (53.8 μg/cm²) when a mixture of the pure phenols was made on the same percentage basis. The pure sodium phenates were not available for comparative evaluation. Repellency to house flies among the compounds tested cannot be correlated with the chemical moieties of the biphenyl ring with the hydroxyl group attached, or with the hydroxyl group alone.

In tests on the duration of repellency according to the methods of LaBrecque and Wilson (1959), Mix-

Table 2.—Effectiveness of 3 mixtures of some phenolic compounds as repellents to house flies.

Mixture	No. replicates/concn ^a	Lowest effective concn (μg/cm ²)	Regression coefficient ^b
Mixture 1			
29.1% <i>o</i> -Phenylphenol			
31.6% 6-Chloro-2-phenylphenol			
8.2% 4-Chloro-2-phenylphenol			
20.9% Phenol			
10.2% Biphenyl	5	1.7	–6.482
Mixture 2			
28.8% Sodium <i>o</i> -phenylphenate			
14.6% Sodium 6-chloro-2-phenylphenate			
40.3% Sodium 4-chloro-2-phenylphenate			
1.0% Other chlorinated sodium phenates	3	26.9	–9.601
Mixture 3			
34.4% <i>o</i> -Phenylphenol			
17.4% 6-Chloro-2-phenylphenol			
48.2% 4-Chloro-2-phenylphenol	3	53.8	–8.469

^a 1 replicate at each concentration consists of duplicate tests performed on 1 day.

^b Regression of mean number of flies trapped on log concentration.

ture 1 was effective for 7 days (USDA 1960). Biphenyl, 4-chloro-2 phenylphenol and Mixtures 1, 2, and 3 have been patented as repellents for house flies (Shambaugh et al. 1966 a,b).

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