# Improved bait for wasp control

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# Abstract

Alternatives to freezing as a method of storing bait for wasp control were investigated by determining the shelf-life, attractiveness, palatability, and toxicity to wasps of previously canned sardine catfood containing 0.5% sulfluramid after re-canning, bottling, vacuum-packing, irradiation, or the addition of preservatives, antioxidants, or antibiotics.

Re-canned sardine catfood containing 0.5% sulfluramid, autoclaved at 125°C, remained in good condition for at least 6 months. Re-canning did not reduce bait attractiveness or palatability to wasps in the laboratory or field. Re-canned toxic sardine catfood had a similar impact to previously frozen toxic sardine catfood on wasp survival in the field. Bottled sardine catfood pasteurised at 100°C also remained in good condition for at least 6 months. Bottling did not affect bait palatability to wasps in caged colonies. Vacuum-packing sardine catfood and pasteurising at 80°C did not stop the bait going rancid at room temperature. However, vacuum-packing followed by gamma irradiation could keep sardine catfood in good condition for at least 6 months. One of the four preservatives (boric acid) and all four antioxidants tested (ascorbic acid, BHT, EDTA, and tannic acid) were not repellent to wasps in the field. The two antibiotics tested (streptomycin and chloramphenicol) both repelled wasps.

Re-canning is the most suitable alternative to freezing sardine catfood bait for wasp control if cost-effective commercial canning facilities can be found. Bottling is less suitable because of the fragility of bottles in the field. Vacuum-packing followed by pasteurisation is not a suitable alternative to freezing bait, but vacuum-packing followed by irradiation may be. Preservatives and antioxidants may be suitable alternatives to freezing baits if they can be shown to prolong the shelf-life of baits. The two antibiotics tested are not suitable for use in wasp baits, although other antibiotics may be.

# 1. Introduction

Improved methods of storing previously canned sardine catfood to which poison had been added for the control of wasps (*Vespula* species) were investigated by Manaaki Whenua – Landcare Research, Christchurch, for the Department of Conservation, Wellington, in January–June 1994.

# 2. Background

Sardine catfood containing either sodium monofluoroacetate (1080) or sulfluramid is currently used by DoC for control of the introduced common wasp (*Vespula vulgaris*) and German wasp (*V. germanica*) in problem areas on the DoC estate (Spurr 1991, 1993). The New Zealand Pesticides Board has registered 1.0% 1080 Wasp Paste for use by DoC staff, and has given Finitron Wasp Bait (containing 0.5% sulfluramid) a limited sales experimental use permit for general use. Both baits are stored frozen in approx. 400 g cartridges and thawed before use. Frozen bait is both difficult and costly to store and transport. This project sought to develop an improved method of storing bait for wasp control on the DoC estate.

Sardine catfood has a field-life of only 1–2 days before it either putrefies or dessicates and becomes less attractive to wasps. The use of an inert matrix and slow-release attractant could overcome this problem. This project investigated the digestibility of a commercially-available inert polymer granule.

# 3. Objectives

- To determine the shelf-life, attractiveness, palatability, and toxicity to wasps of previously canned sardine catfood containing 0.5% sulfluramid after re-canning, bottling, vacuum-packing, irradiation, or the addition of preservatives, antioxidants, or antibiotics.
- To determine whether wasp larvae will digest polymer granules coated with sardine catfood.
- To determine the effect of the best toxic bait identified above on wasp survival in the field.

# 4. Methods

## 4.1 RE-CANNING

Toxic bait was prepared by opening 400g cans of sardine catfood (Wonder Cat brand), emptying the contents into a container, adding 0.5% sulfluramid, and blending the mixture for 30 seconds using a hand-held mixer. Non-toxic bait was prepared in the same way, without the addition of sulfluramid. The bait was refrigerated overnight, then re-canned into 400 g tear-top cans and autoclaved at 125°C for 15 minutes. A subsample of cans was autoclaved a second time to determine whether the duration of heating affected sulfluramid toxicity.

Shelf-life was determined by opening re-canned bait after 1, 78, and 112 days and inspecting the contents for visual and olfactory deterioration.

Bait palatability and toxicity were determined initially using a laboratory larval bioassay. Each bioassay consisted of four radial sections of wasp comb, each containing 20–50 late instar larvae. The larvae were fed 2 g of bait 3 times on the day combs were extracted from nests in the field. They were then kept in an incubator at 28–30°C. The number of larvae successfully entering pupation and emerging as adults was monitored for 25 days. Separate bioassays were conducted using toxic and non-toxic bait re-canned for 1, 78, and 112 days. Each bioassay compared re-canned baits with freshly mixed toxic and non-toxic baits.

Bait attractiveness and palatability to wasps in the field were determined by putting known weights (approx. 40 g) of non-toxic re-canned or thawed frozen sardine catfood in bait stations in blocked random order 10 m apart along roadsides in Mt Thomas Forest, Canterbury (n=10 for each bait type). Two additional baits of each type were protected under insect netting so we could correct for the weight of bait lost by dehydration. The numbers of wasps collecting each bait type were counted 3 times at half-hour intervals to determine the attractiveness of the baits to wasps. The amount of bait remaining after 3 hours was weighed and corrected for the weight lost by dehydration to determine the palatability of the baits to wasps.

## 4.2 BOTTLING

Non-toxic bait was prepared in the same way as in section 4.1 and then put into 30 ml universal bottles. Some bottles were sealed and some were also pasteurised at 50° or 100°C. Bottles were stored at 30°C, room temperature, or in a refrigerator (approx. 4°C). Samples were opened after 25, 103, and 213 days and inspected for visual deterioration and rancid smells. The attractiveness and palatability of bottled and fresh sardine catfood was compared after 103 days of storage by offering known weights of bait to four caged colonies of *V. vulgaris* and re-weighing the bait after 6 hours. The difference in weight of bait was expressed as the mean ± the standard error.

## 4.3 VACUUM-PACKING

Forty 35–40 g samples of non-toxic sardine catfood were vacuum-packed into CN530V heat-resistant barrier bags, and dipped for 2–5 seconds in an 80°C water bath to shrink the bags. Twenty bags were pasteurised at 80°C for 15 minutes. Half of each heat treatment was stored at room temperature and half refrigerated (at approx. 4°C) (n=10 for each treatment). Five non-refrigerated samples of each treatment were opened after 7 and 14 days, one refrigerated sample of each treatment was opened after 7 and 14 days, and two after 28, 59, 91, and 129 days. All samples were inspected for visual and olfactory deterioration.

## 4.4 IRRADIATION

A commercial irradiation firm was contacted for information about the feasibility and likely results of irradiating sardine catfood containing sulfluramid.

## 4.5 PRESERVATIVES, ANTIOXIDANTS, AND ANTIBIOTICS

Four readily available preservatives (boric acid, sodium acetate, sodium metabisulfite, and sodium nitrite), four antioxidants (ascorbic acid, butylated hydroxytoluene (BHT), ethylenediaminetetraacetic acid (EDTA), and tannic acid), and two antibiotics (chloramphenicol and streptomycin) were each mixed with sardine catfood at two concentrations; a concentration similar to that used in the literature (often for human food) and a concentration 5 or 10-fold higher. For each chemical, weighed amounts of the two bait concentrations and a control (bait without additives) were randomly placed in the foraging cages of four captive colonies of *V. vulgaris*. After at least 4 hours the baits were removed and reweighed. The results for each concentration were expressed as the mean difference from the control ± the standard error.

Three chemicals showing low repellency, one showing high repellency (to verify laboratory results), and one not tested in the laboratory were tested for palatability to wasps in the field in the same way as for re-canned bait.

## 4.6 POLYMER GRANULES

Polymer granules were cut into small pieces using a scalpel. Larvae were then fed granules subjected to the following treatments (n=20 for each):

- untreated;
- dipped into sardine catfood;
- soaked in acetone, air-dried then dipped into sardine cat-food;
- soaked in acetone containing 0.5% sulfluramid, air-dried then dipped into sardine catfood.

Palatability was determined by recording whether larvae ate the granules. The number of larvae successfully entering pupation and emerging as adults was recorded 25 days later.

## 4.7 EFFECTIVENESS OF POISON-BAITING WITH THE BEST BAIT IDENTIFIED ABOVE

Wasps in the poison area in Mt Thomas Forest were pre-fed with non-toxic canned sardine catfood in 65 bait stations, 10 m apart, for 3 days, then given sardine catfood containing 0.5% sulfluramid re-canned 4 months previously (the best bait identified above) for as long as they would collect it (March–April 1994). The poison bait was left out for 13 days, but wasps probably collected it for only 2–3 days. Wasps in the non-poison area, about 1 km away, were given

only non-toxic canned sardine catfood. Wasps in a third area in Ashley Forest were pre-fed with non-toxic bait in the same way as wasps in Mt Thomas Forest, but then were given thawed previously frozen sardine catfood containing 0.5% sulfluramid for as long as they would collect it.

The effectiveness of poison-baiting was determined by counting the instantaneous number of wasps collecting bait from bait stations and the number of wasps/minute leaving or entering nests within 50 m of bait stations in the poison and non-poison areas 1, 2, and 3 days before and 7 and 13 days after poison-baiting. The percent reduction in wasp numbers in each poison area was obtained from the formula:

$(1 - ((NP_{pre} / NP_{post}) \times (P_{post} / P_{pre}))) \times 100$

where NP = mean of counts in the non-poison area and P = mean of counts in the poison area.

# 5. Results

## 5.1 RE-CANNING

Re-canning and autoclaving at 125°C did not affect the palatability of baits or toxicity of sulfluramid to wasp larvae in the laboratory bioassay. Larvae ate all the bait they were fed, and for those fed bait containing 0.5% sulfluramid the number pupating and emerging as adults was reduced by about 93% (Fig. 1). Re-canned bait had a slightly different smell after being autoclaved twice. Storing re-canned bait for up to 112 days before opening the cans did not alter bait palatability or toxicity (Fig. 2).

In the field trial, similar numbers of wasps were attracted to both previously re-canned and previously frozen sardine catfood (0.83 vs 0.50 wasps/bait, respectively), and a similar amount of each bait type was collected by wasps (3.28 g vs 3.10 g, respectively).

## 5.2 BOTTLING

Sardine catfood sealed in bottles pasteurised at 100°C remained in good condition after 213 days of storage at room temperature. Other treatments showed mixed results (Table 1). Bottled bait in good condition and retaining its original smell was as attractive and palatable as fresh bait to caged foragers (mean consumption 1.4 ± 0.4 g cf. 1.1 ± 0.2 g). However, when bait became rancid it was less attractive to wasps (mean consumption 0.7 ± 0.1 g).

## 5.3 VACUUM-PACKING

Both pasteurised and non-pasteurised vacuum-packed bait stored at room temperature became rancid within 14 days. However, pasteurised and non-

pasteurised vacuum-packed bait stored at 4°C showed no signs of deterioration after 129 days.

FIGURE 1. PERCENT OF WASP LARVAE PUPATING AND EMERGING AS ADULTS AFTER BEING FED SARDINE CATFOOD RE-CANNED FOR 1 DAY WITH AND WITHOUT 0.5% SULFLURAMID (VERTICAL LINES REPRESENT STANDARD ERROR OF THE MEAN).



FIGURE 2. PERCENT OF WASP LARVAE PUPATING AND EMERGING AS ADULTS AFTER BEING FED SARDINE CATFOOD RE-CANNED FOR 112 DAYS (CLEAR BARS) OR FRESHLY MIXED (SOLID BARS) WITH AND WITHOUT 0.5% SULFLURAMID (VERTICAL LINES REPRESENT STANDARD ERROR OF THE MEAN).

TABLE 1. EFFECT OF BOTTLING ON CONDITION OF SARDINE CATFOOD (GOOD OR RANCID) (N = NUMBER OF BOTTLES TESTED).

| BOTTLE TYPE | PASTEURISATION TEMPERATURE | STORAGE CONDITIONS | BAIT CONDITION ON DAY OPENED | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | N | Day Good | 25 Rancid | Day Good | 103 Rancid | Day Good | 213 Rancid |
| sealed lid | none | room temp | 4 | 1 | 1 | - | - | 1 | 1 |
| | 50°C | room temp | 7 | 1? | 1 | 1 | 2 | 1 | 1 |
| | | fridge | 4 | 2 | 0 | 1 | 0 | 1 | 0 |
| | | 30°C | 4 | 1? | 1 | - | - | 0 | 2 |
| | 100°C | room temp | 4 | 2 | 0 | - | - | 2 | 0 |
| unsealed lid | 50°C | room temp | 4 | 1 | 1 | - | - | 0 | 2 |

## 5.4 IRRADIATION

The only gamma irradiation plant in New Zealand does not normally irradiate food but would consider irradiating sardine catfood containing sulfluramid. The catfood would need to be vacuum-packed before irradiation to prevent oxidation making the bait rancid during storage at room temperature. Irradiated vacuum-packed bait should remain in good condition for 6–12 months (G. Bernie, Pitman Moore, pers. comm.).

## 5.5 PRESERVATIVES, ANTIOXIDANTS, AND ANTIBIOTICS

The caged colonies of wasps removed only small amounts of sardine bait, making separation into repellent and non-repellent treatments difficult (Table 2). EDTA, butylated hydroxytoluene (BHT), tannic acid, and ascorbic acid appeared to be least repellent, and chloramphenicol appeared to be most repellent. Boric acid was not tested because the activity of the colonies became too low. EDTA, tannic acid, ascorbic acid, chloramphenicol, and boric acid were selected for field trials.

In the field trial, 1% boric acid, 1% tannic acid, 1% ascorbic acid, and 1% EDTA did not repel wasps, and baits containing these chemicals were collected by wasps in similar amounts to bait without additives (Table 3). However, 1% chloramphenicol and 5% ascorbic acid repelled wasps and/or reduced the amount of bait eaten.

## 5.6 POLYMER GRANULES

Polymer granules were not eaten by larvae. They remained in the cell with the larvae or were discarded into a neighbouring cell. Those dipped in sardine catfood were not discarded until the sardine had been eaten from the outer surface.

TABLE 2. PERCENT DIFFERENCE IN WEIGHT OF SARDINE BAIT CONTAINING PRESERVATIVE, ANTIOXIDANT, OR ANTIBIOTIC REMOVED BY CAGED COLONIES OF WASPS.

| ADDITIVE | CONCENTRATION (%) | MEAN % DIFFERENCE FROM CONTROL | STANDARD ERROR OF DIFFERENCE |
|---|---|---|---|
| EDTA | 1 | +0.10 | 2.90 |
| | 5 | −2.78 | 2.37 |
| Butylated hydroxytoluene | 1 | −0.23 | 1.94 |
| | 10 | −1.91 | 1.76 |
| Tannic acid | 0.1 | −1.85 | 4.77 |
| | 1 | −3.48 | 7.07 |
| Ascorbic acid | 1 | +4.76 | 3.00 |
| | 10 | −6.36 | 0.37 |
| Sodium metabisulphite | 1 | −3.12 | 3.53 |
| | 10 | −4.54 | 3.43 |
| Sodium nitrite | 1 | −4.08 | 3.63 |
| | 10 | −5.24 | 2.09 |
| Sodium acetate | 1 | −4.04 | 0.96 |
| | 10 | −9.73 | 4.09 |
| Streptomycin sulfate | 0.1 | −7.94 | 2.99 |
| | 1 | −9.03 | 3.75 |
| Chloramphenicol | 0.1 | −9.38 | 8.22 |
| | 1 | −16.47 | 10.04 |

TABLE 3. NUMBER OF WASPS PER BAIT AND AMOUNT OF BAIT EATEN BY WASPS IN RELATION TO TYPE AND AMOUNT OF PRESERVATIVE, ANTIOXIDANT, OR ANTIBIOTIC IN BAIT, MT THOMAS FOREST (MEANS JOINED BY LINES ARE NOT SIGNIFICANTLY DIFFERENT).

| ADDITIVE (CONCENTRATION) | NUMBER OF WASPS PER BAIT | AMOUNT (g) EATEN |
|---|---|---|
| boric acid (1%) | 0.90 | 6.59 |
| tannic acid (1%) | 0.73 | 3.29 |
| no preservative | 0.50 | 3.10 |
| ascorbic acid (1%) | 0.40 | 3.02 |
| EDTA (1%) | 0.40 | 2.64 |
| chloramphenicol (1%) | 0.23 | 1.62 |
| ascorbic acid (5%) | 0.13 | 2.70 |

FIGURE 3. PERCENT OF WASP LARVAE PUPATING AND EMERGING AS ADULTS AFTER BEING FED SARDINE-COATED POLYMER GRANULES WITH AND WITHOUT 0.5% SULFLURAMID.

The larvae fed toxic polymer granules coated with sardine catfood had a lower pupation success than those fed non-toxic granules coated with sardine catfood (Fig. 3).

## 5.7 EFFECTIVENESS OF POISON-BAITING WITH RE-CANNED TOXIC SARDINE CATFOOD

Re-canned toxic sardine catfood and previously frozen toxic sardine catfood had a similar impact on both the number of wasps collecting bait and the number of wasps flying in and out of nests (Table 4).

TABLE 4. PERCENT REDUCTION IN NUMBER OF WASPS COUNTED ON BAITS AND FLYING IN OR OUT OF NESTS AFTER POISON-BAITING WITH 0.5% SULFLURAMID IN SARDINE CATFOOD THAT HAD BEEN RE-CANNED OR FROZEN BEFORE USE.

| TYPE OF BAIT STORAGE | % REDUCTION IN NUMBER OF WASPS/BAIT AFTER 7 DAYS (NO. OF BAIT STATIONS) | % REDUCTION IN NUMBER OF WASPS/MIN/NEST AFTER 13 DAYS (NO. OF NESTS) |
|---|---|---|
| Re-canned | 88.9 (49) | 79.0 (10) |
| Frozen | 89.7 (25) | 72.9 (2) |

# 6. Conclusions

Re-canned sardine catfood containing 0.5% sulfluramid and autoclaved at 125°C has a shelf-life of at least 6 months. Re-canning did not reduce bait attractiveness, palatability, or toxicity to wasps in the field. Re-canning is a suitable alternative to freezing sardine cat-food baits if cost-effective commercial canning facilities can be found.

Bottled sardine cat-food pasteurised at 100°C also has a shelf-life of at least 6 months. Bottling did not affect bait palatability and, although not tested, probably would not affect bait toxicity. Bottling is less suitable than canning as an alternative to freezing sardine catfood baits because of the fragility of bottles in the field.

Vacuum-packing sardine catfood then pasteurising at 80°C did not stop the bait from becoming rancid at room temperature. Thus, vacuum-packaging followed by pasteurisation is not a suitable alternative to freezing bait. However, vacuum-packing followed by irradiation may be.

One preservative (boric acid) and four antioxidants tested (ascorbic acid, BHT, EDTA, and tannic acid) were not repellent to wasps in the field. However, neither the shelf-life nor field-life of baits containing these chemicals was tested. The two antibiotics tested (streptomycin and chloramphenicol) both repelled wasps and are not suitable for use in baits. However, other antibiotics may be suitable.

# 7. Recommendations

- Re-canning should be adopted as the method of choice for storing sardine catfood containing sulfluramid for wasp control, if cost-effective.
- Research should now focus on determining whether preservatives and antioxidants increase both the shelf-life and field-life of baits.

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