

FLAVOR STUDIES OF RARITAN BAY FISH

by

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Performed under Contract

to

INTERSTATE SANITATION COMMISSION
10 Columbus Circle
New York City, New York

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The flavor of fishes in the lower Hudson River, New York Bay, Raritan Bay, and adjacent waters, has long been characterized as "oily" or "kerosene-like." In fact, countless persons will not eat a fish taken north of Shrewsbury Rocks on the New Jersey coast or west of East Rockaway Inlet on the south shore of Long Island.

This does not mean that many other persons do not find such fish entirely palatable. In fact, the late Dr. Thurlow Nelson used to tell an interesting story about the oysters of New York Bay and how these shellfish -- shortly before they were exterminated by pollution in this area -- were sent to a mid-western city whose inhabitants had apparently never tasted "untainted" oysters.

These oysters from New York Bay were known in the trade as "Standard Oilers," and when this source of supply was finally gone, oysters from an "untainted" source were substituted. There was an immediate complaint: The new oysters, it seems, were "off flavor!"

Fish Flavor and Environment

While the flavor of fish flesh has long been held to be influenced by the conditions of the fish's environment -- "muddy," "algae," "oily," etc. -- scientifically determined correlations and measurements of such claims are rather recent and many are unpublished.

Surber, et. al. (1962) referred to several of these unpublished reports, and in their own researches revealed that fish could be tainted by outboard motor exhaust wastes as related to gas and oil consumption.

The Problem Stated

The present researches were designed with a two-fold purpose: (1) to determine whether kerosene could impart a flavor to fish that is similar in essence to that which is characteristic of fishes in Raritan Bay, etc., and (2) to determine -- if such a flavor could be imparted experimentally -- whether such a flavor could be indistinguishably matched in strength with that which exists in Raritan Bay, etc. fishes.

PRELIMINARY PROCEDURES

Preliminary experiments were first conducted on wild brook trout in "city" water that was treated with kerosene as high as 20 ppm and after the trout had remained in this water for several days. These fish were then fried in corn oil and tasted by four persons, who will be referred to in this report as the "Department Panel."

These experiments were then followed by similar experiments, except that a very small amount of kaolin was admixed with the kerosene before treatment of the water and exposure by the fish.

Control tests were maintained throughout for comparative taste testing.

PRELIMINARY RESULTS

The results of these preliminary experiments revealed that wild brook trout in "city" water, after being exposed to as much as 20 ppm of kerosene for several days, failed to reveal any detectable tainting to the Department Panel.

On the other hand, after the small amount of kaolin had been admixed with the kerosene, a taint was so evident and strong that -- at 20 ppm -- it almost caused nausea on the part of one panel member. Further experiments revealed that as little as 1 ppm of kerosene, admixed with kaolin, was detectable on the part of the panel members; further, that the taste was comparable, in essence, to the "oily" taste of harbor fish.

FURTHER PROCEDURE

The next series of experiments was designed to determine: (1) the time required to endow a fish with the "kerosene" or "oily" flavor; and (2) the time required to eliminate this objectionable taste.

This series was conducted on fluke, Paralichthys dentatus, in 180 gallon tanks at the Sandy Hook Marine Laboratory of the U. S. Fish and Wildlife Service, with an uncontaminated water supply from a saltwater well.

Taste testing was performed by the Department Panel, and by the organoleptic panel of the Department of Food Science at Rutgers, the State University.

FURTHER RESULTS

The results of these experiments (see Table 1) revealed

that approximately one week of exposure was necessary in order to eliminate or impart the flavor of the "oily" or "kerosene" taste, which was objectionable to both the Department Panel and the Food Science Panel.

For example, Report No. 2 by the Food Science Panel finds no objectionable taste either in fresh frozen fluke from Vineyard Sound, Massachusetts, or in "purified" fluke from Raritan Bay held in the Sandy Hook Marine Laboratory tanks for seven days. On the other hand, the "oily" taste was detected by the Department Panel after only three days of "purification."

Again, in Report No. 1, Raritan Bay fluke were considered to be poorer than Raritan Bay fish that had been "purified" for seven days.

It might be mentioned in passing that ancillary experiments with bluefish have revealed that the Food Science Panel's taste acuity is so sharp that it can determine a significant difference between a large and medium-sized bluefish taken the same day in the same area, even though the difference was very slight.

FINAL PROCEDURE

Final experiments consisted in attempting to match, in degree of "strength," the "oily" taste of Raritan Bay fish with treated fish that had been first "purified" for seven days.

RESULTS OF FINAL PROCEDURE

While this was repeatedly possible for the Department Panel with "purified" fish that had been exposed to 1 to 3 ppm of kerosene with kaolin, the Food Science Panel was always able to detect a significant difference even though this was repeatedly considered as "slight." (See Reports Nos. 3, 4 and 5.)

COMMENTS AND CONCLUSIONS

Flavor, or taste, per se, is not something that lends itself to the methods of scientific measurement. Yet preferences and differences in taste do not seem to be inscrutable by this method.

The present researches, for instance, have revealed that as little as 1 ppm of kerosene, admixed with a very small amount of kaolin, can -- within a week -- impart to fluke and striped bass a flavor that -- in essence -- is similar to that which is present in these fish as they occur in Raritan Bay and adjacent waters.

These researches further indicate that the strength of this flavor can be also matched -- insofar as many persons are concerned -- by this experimental treatment; and that a highly sensitive, organoleptic panel can only detect a slight difference, even though such a detected difference is highly significant in statistical measurement of probability.

The importance of particulate matter as a "carrier"

or "transfer" agent has also been clearly demonstrated by these researches, although the quantitative relationship has not been measured. It might be mentioned that the waters adjacent to New York Harbor are far more turbid than any of the waters of these experiments at any stage.

Since the results of the flavor testing indicate that the intensity, or strength, of the oily taste in Raritan Bay fish varies somewhat, it seems unlikely that an experimental treatment could be conducted which could not be distinguished from the "control" by the Food Science Panel -- except, perhaps, only after a large number of trials.

REPORT No. 1.

Flavor Evaluation Report on Fluke

Two samples of fluke were submitted to the Food Science Department on July 5, 1962, for flavor evaluation. Evaluations were made on July 6, 1962.

Samples were evaluated using a triangle test technique. In this test two samples are alike and one is different. Judges are asked to select the like samples; to indicate the degree of flavor difference; and to rate both the like and odd samples on a preference scale.

The results of the evaluations are as follows:

Number of triangle tests	22
Number of correct separations	17
Number correct required for significance at 0.1%	15
Separations significant	0.1%
Degree of flavor difference	Slight - Moderate
Flavor preference:	
Sample A	Poor - Fair
Sample B	Fair - Good

Sample A fish had been caught in Raritan Bay on July 4, 1962. Sample B fish had been caught in Raritan Bay on June 28, 1962 and held alive in tanks of unpolluted water until July 4, 1962.

The difference between fish was very highly significant. Sample A had a less desirable flavor than B.

7/10/62

Elizabeth F. Stier

REPORT No. 2.

Flavor Evaluation Report on Fluke

Two samples of fluke were submitted for flavor evaluation. One sample was a "purified" one and the second had been caught off Martha's Vineyard, Massachusetts.

Samples were evaluated using a triangle test technique. In a triangle test two samples are alike and one different.

Judges were asked to pair the like samples, to indicate the degree of flavor difference, to indicate whether either the odd or like samples had undesirable flavors, and to rate both odd and like samples on a preference scale.

The results of the flavor evaluations are as follows:

Triangle tests	20
Number correct	15
Separations significant	0.1%
Flavor difference	Slight
Flavor preference ratings	
Purified	Fair
Massachusetts	Fair

The samples were significantly different from each other, but the degree of difference was slight. There was no flavor preference of one sample over the other.

7/23/62

Elizabeth F. Stier, Ph.D.
Assistant Research Specialist

REPORT No. 3.

Flavor Evaluation Report on Fluke

Three samples of fluke were submitted to the Food Science Department for flavor evaluation. One sample which was used as the labeled reference standard had been caught in Raritan Bay. The other two samples had been treated with either 3 ppm or 6 ppm of kerosene mixed with kaolin.

Samples were evaluated using a multiple comparison procedure. The judges indicated the degree of difference between the reference standard and the test samples and rated each sample for preference. Flavor data were analyzed by an analysis of variance and the least significant difference between panel scores calculated. The reference standard, the Raritan Bay fluke was also included among the test samples as a coded sample. Two replicate evaluations were made.

The results of the flavor evaluations are as follows

<u>Sample</u>	<u>Panel Score</u>	<u>Rating to Reference</u>	<u>Panel Preference</u>
3 ppm kerosene	2.95	Different	Slightly poorer
6 ppm kerosene	3.80	Different	Poorer
Raritan Bay (ref.)	1.45	--	Comparable

Panel = 10 judges
Separations significant = 0.1%
LSD = 1.29

Both the test samples were significantly different from the reference standard. The two test samples were also considered poorer in flavor than the reference. While the difference between the two test samples was not significant, significance is approached.

9/13/62

Elizabeth F. Stier

REPORT No. 4.

Flavor Evaluation Report on Striped Bass

Two samples of striped bass were submitted to the Food Science Department for flavor evaluation. The "central" sample had been caught in Raritan Bay and the "treated" sample had been held in water containing 1 ppm of kerosene.

Samples were baked in a 350° oven and broken into bite size pieces for evaluation using a triangle test technique. Judges were asked to select the pair, indicate the degree of flavor difference, and rate the samples on a preference scale of from very poor to excellent.

The results of the flavor evaluations are as follows:

Number of triangle tests	20
Number of correct separations	15
	(14 required at this level)
Significance of separations	0.1%
Degree of flavor difference	
between odd and like samples	Slight
Preference ratings	
Control	Good
Treated	Fair

The sample separation was very highly significant. The degree of difference between samples was slight. Panel preferred the control over the treated sample.

10/15/62

Elizabeth F. Stier

REPORT No. 5.

Flavor Evaluation Report on Fluke

Two samples of fish were submitted to the Food Science Department for flavor evaluation. One sample was an untreated control, the second sample had been treated with 2 ppm of kerosene. Samples were evaluated on July 31, 1963.

Samples were prepared for evaluation by baking. After cooking samples were flaked with a fork and evaluated using a triangle test technique. Judges were asked to select the like samples, to indicate the degree of difference between the odd and like samples, to indicate whether either the odd or like samples had an undesirable flavor, and finally to rate the odd and like samples for flavor preference on a scale of from excellent to very poor.

The results of the flavor evaluations are as follows:

Number of triangle tests	24
Number of correct triangle tests	19
Separation of samples significant therefore	0.1% level
Degree of flavor difference between test samples	Slight-Moderate
Flavor preference ratings	
Control	Good
Treated	Poor to Fair

September 5, 1963

Elizabeth F. Stier

REPORT No. 5.

Flavor Evaluation Report on Fluke

Two samples of fish were submitted to the Food Science Department for flavor evaluation. One sample was an untreated control, the second sample had been treated with 2 ppm of kerosene. Samples were evaluated on July 31, 1963.

Samples were prepared for evaluation by baking. After cooking samples were flaked with a fork and evaluated using a triangle test technique. Judges were asked to select the like samples, to indicate the degree of difference between the odd and like samples, to indicate whether either the odd or like samples had an undesirable flavor, and finally to rate the odd and like samples for flavor preference on a scale of from excellent to very poor.

The results of the flavor evaluations are as follows:

Number of triangle tests	24
Number of correct triangle tests	19
Separation of samples significant therefore	0.1% level
Degree of flavor difference between test samples	Slight-Moderate
Flavor preference ratings	
Control	Good
Treated	Poor to Fair

September 5, 1963

Elizabeth F. Stier

Table 1 Cont'd.

7	Aug. 9 1962	Aug. 16 1962	7	To compare Raritan Bay fish with fish held in 0.5 ppm kerosene + kaolin and 1.5 ppm kerosene + kaolin after 7 days of "purification."	Department Panel - 1.5 ppm kerosene + kaolin fish had a slightly oily taste, none detected at .5 ppm.
8	Sept. 12 1962		6	To compare Raritan Bay fluke, with 6 ppm kerosene + kaolin, and 3 ppm kerosene + kaolin after 7 days of "purification."	Food Science Dept.- Both samples were significantly different from the reference standard 0.1% level. While the difference between the 2 test samples is not significant, significance is approached.
9	October 15, 1962 first week		4 *Striped bass	To compare Raritan Bay samples, with fish treated 1 week in 1 ppm kerosene + kaolin after 7 days of "purification"	Food Science Dept.- The sample separation was significant (0.1% level). The degree of flavor difference slight. Raritan Bay fish preferred.
10	July 31 1963	Aug. 7 1963	4	To compare Raritan Bay fish with fish held at 2 ppm kerosene + kaolin after 7 days of "purification"	Food Science Dept.- Significant at the 0.1% level. Degree of difference slight to moderate. Raritan Bay fish preferred.
11	Sept. 1963		4	To compare Raritan Bay fish with fish held at .6 ppm kerosene + kaolin after 7 days of "purification"	Department Panel - No off-flavor detected in treated fish.

Literature Cited

Surber, Eugene, W., and John N. English, and Gerald N. McDermitt. 1965 "The Tainting of Fish by Outboard Motor Exhaust Wastes as Related to Gas and Oil Consumption." Biol. Problems in Water Pollution, 3rd Seminar, Aug. 13-17, 1962. Public Health Service Pub. No. 999-WP-25. Env. Health Ser. pp. 170-176.