St. Clair River Remedial Action Plan

Fish Tainting Evaluation

By

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EXECUTIVE SUMMARY

Fish tainting has not been a recent use impairment in the St. Clair River. A sensory (odour) evaluation test was conducted in May of 1995. Indigenous

walleye were taken above, near, and below the main industrial point sources by electrofishing methods. A smell test was conducted using the triangle test to determine if there was a significant difference in odour between upstream and downstream St. Clair River walleye. The triangle test method involves the presentation of three samples, in which two are the same and one is different. The panelist is required to determine which sample is different. The panel consisted of members of the Binational Public Advisory Committee and other members of the public.

The number of correct responses was not significantly different at the 95% confidence level from the chance of correctly "guessing" the odd sample. The panelists were also requested to identify if the odd sample was an "exposed" (one of several downstream locations) or "control" (Bluewater Bridge or Sarnia Bay area) walleye. The number of correctly identified samples was not significantly different at the 95% confidence level from the chance of correctly "guessing" if the sample was an exposed or control fish. It is concluded that the sensory evaluation panel could not distinguish a noticeable taint in the St. Clair River walleye in those tests where they may have correctly differentiated between the samples from the control and other areas. The panelists' comments generally indicated that they found no difference in odour between the control and other locations, and that the odour of the downstream walleye were not perceived to be objectionable.

1.0 INTRODUCTION

1.1 BACKGROUND

The St. Clair River was designated as an Area of Concern (AOC) by the International Joint Commission (IJC) in 1985. This area is one of seventeen Canadian AOCs in the Great Lakes for which a Remedial Action Plan (RAP) is being developed.

No recent reports of tainted fish or wildlife are on record, however, some anecdotal incidents of fish tainting have been verbally provided by residents of Walpole Island. This beneficial use required assessment in the St. Clair River AOC (OMOEE and MDNR 1991). Official tasting methods and procedures have been established in the USA. Therefore, a controlled study involving a local sensory evaluation panel was planned by the OMOEE and OMNR (OMOEE and MDNR 1995).

In studies conducted by Pollutech, samples were exposed for 24 hours to upstream and downstream St. Clair River water. Results showed no significant difference in rainbow trout flavour and aroma.

In the RAPs effort to delist the St. Clair River as an AOC, a fish tainting evaluation was performed on May 3, 1995. Walleye (*Stizostedion vitreum*) were chosen as a test species due to their importance as a local game and food fish and also because of their availability throughout the river during the time of collection. The collection of indigenous fish samples was desired. These walleye were exposed to possible tainting from water, sediment, and microorganisms, up through the food chain to baitfish and crustaceans.

During the spring of 1995, fifteen anglers that fished the St.Clair River were surveyed. Fourteen indicated they ate the fish they caught and found them comparable with fish from other lakes. One indicated finding some improvement in quality. The results indicated that the taste and odour quality of walleye at all seven sites was good (average). Some anglers indicated that they released larger fish. A common complaint was a seemingly increased number of tumors in fish caught downstream. External tumors are largely attributed to naturally occurring viral infections (OMOEE & MDNR 1995). (Johnson et al. 1990) concluded that the viral skin diseases that causes the visible skin lesions were not likely the result of variable exposure to persistent contaminants.

1.2 STUDY OBJECTIVES

The main objective of the study was to determine if there was a significantly different odor in the flesh of indigenous walleye caught upstream compared to various downstream sites.

A secondary objective was to determine which, if any, further studies need to be conducted in the future.

2.0 METHODS

2.1 WALLEYE COLLECTION

A fisheries survey of the St. Clair River was conducted during the evenings of Aug. 23-26. Fish were captured using electrofishing equipment on a specially equipped boat. Sites included the Bluewater Bridge and Sarnia Bay areas (control sites), Suncor, Stag Island, Talfourd Creek, Cathcart Park, Fawn Island, and above Port Lambton. Sampling locations were established above, near, and below the main industrial point sources. Samples were vacuum sealed and frozen until the smell study was conducted.

2.2 TAINTING EVALUATION

2.2.1 Sample Preparation

The walleye samples were kept partially frozen to minimize the loss of any volatile organic compounds (VOCs). The skinless flesh of all fish from each individual sampling site were cut up and minced together in a blender. The entire fillet was used. Many of the organic compounds associated with tainting accumulate in the lipophilic fat layer and the lateral line. Combining all of the fillets eliminated any odor variability between individual fish.

Aliquots, approximately five grams, were placed in aluminum foil packets. A three digit code was marked on each foil packet for identification: Panelist (A-F), Set Number (1-6), Exposure Site (1-3). The packets were then vacuum sealed in polyethylene bags using a vacuum bag sealer. Three foil packets were sealed in each bag, corresponding to each triangle test set. The Panelist (A-F) and Set Number (1-6) was marked in wax pencil on each bag. Care was taken to keep all samples cool and exposed to as little air as possible. Soap was not used by the investigator preparing the samples prior to, or during, the procedure.

2.2.2 Sensory Evaluation

The assessment of taint was conducted using a sensory evaluation method called the triangle test. This method is currently being advocated by international agencies as the most useful and reliable test for identifying possible tainting in fish (Tidmarsh and Ackman 1986). In the triangle test, three samples are presented to the panelist. Two of the samples are the same, and one is different. The panelist judges which sample he or she believes is different. This is a forced choice method; the panelist cannot abstain from a decision even if he or she does not detect any difference between the samples. The triangle test has the advantage of having a smaller statistical probability of a panelist "guessing" whether a sample is tainted or untainted (i.e. 33%, as opposed to 50% for a test involving the comparison of two samples). Forced choice, three sample tests are

the most sensitive sensory testing methods, and hence are most applicable where the expected difference between samples is slight (A.S.T.M. 1968).

A modified version of the triangle test was used in this study, in which the panelist was further required to state whether the odd sample was tainted or untainted, and provide any comments and/or descriptions for each sample set. This modification was first used by (Cohen et al. 1960).

Six sets of three samples were used to produce a balanced design of every possible presentation order combination of control and exposed fish. Each set consisted of either one sample of exposed fish and two of control fish, or one sample of control fish and two of exposed fish.

The panel sessions were held in the boardroom of the Ministry of Environment and Energy Office in Sarnia on May 3, 1995. Six evaluations were made at one time.

The panelists consisted of four members of the Binational Public Advisory Committee (BPAC) and two public observers. All panelists were non-smokers and regular fish consumers. The panelists had been informed of the background, objectives, and procedures for the tainting study and were requested to participate in the sensory evaluation. The criteria for participation were: a) panelists must like fish; b) panelists should be non-smokers; c) panelists should refrain from eating or drinking (other than water) for thirty minutes prior to the session; and d) panelists should avoid the use of perfume, aftershave or scented soaps on the day of the sensory evaluation.

The sealed samples were placed in 1 Litre beakers containing approximately 600 mL of hot water. The water in these beakers was heated to boiling on the hotplate, and maintained at this temperature for at least twenty minutes. The samples remained in the polyethylene bag from the time of preparation until opened by the panelist for evaluation. This ensured that there was no loss of VOCs prior to the sensory evaluation. Only one packet was removed from the hot water at a time and the evaluation of that set of samples was completed before proceeding to the next set. Completed samples were removed after each evaluation to prevent cross-over of odours between samples.

Panelists were given a dilute lemon solution (approximately the juice of one lemon per 1.3 Litres of water) as a rinsing agent, and unsalted soda crackers were provided to clear the palate between samples. Panelists were requested to evaluate which sample was different from the other two. A decision was required even if they could not tell the difference. Panelists were further requested to indicate whether the odd sample was "tainted" or "untainted", and to provide any comments on the evaluation or odor of the samples. The panelists did not believe any samples could actually be described as "tainted", yet they indicated whether it

was a control or exposed sample. Because of the unknown nature of the compounds in the fish tissue, an odor evaluation only was required.

3.0 RESULTS AND DISCUSSION

3.1 SENSORY RESULTS

For the purpose of this discussion, a "correct response" or "correct judgment" means the panelist correctly determined which sample of the three presented was different from the other two. A "correct identification" means the panelist correctly identified the different sample as a control or exposed fish. Correct identifications are only applicable to those samples that were correctly judged as different (Larmond 1977).

There were 36 triangle tests conducted (six sets evaluated by each of the six panelists). Unfortunately, one panelist did not indicate the odd sample in two separate sets. Of the remaining 34 triangle tests, the "different" sample was correctly identified on 12 occasions, or 35% of the time. Analysis of the results of a triangle test is based on the probability that if there is no detectable difference, the odd sample will be selected by chance one-third of the time (A.S.T.M. 1968; Larmond 1977). A minimum of 17 correct judgments out of the 34 triangle tests indicates a significant difference at the 95% confidence level (Larmond 1977). It is thus concluded that the sensory evaluation panel could not distinguish a difference in odor between the walleye from upstream and downstream in the St. Clair River.

Of the 12 correct responses, 7 samples were correctly identified as either control or exposed fish. A minimum of 10 correct judgments out of 12 in a paired test indicates a significant difference at the 95% confidence level (Larmond 1977). The conclusion is that the sensory evaluation panel could not distinguish a noticeable taint where they may have correctly differentiated between the control and exposed samples.

Table 1. Summary of sensory evaluation results.

Panelist	Test Set No.	Correct Response	Correct Identification	Comments
A	1	No	-	

	2	Yes	Yes	slightly more pungent
	3	Yes	Yes	
	4	No	-	
	5	No	-	
	6	Yes	Yes	
B	1	No	-	
	2	No	-	stronger fish odor
	3	No	-	
	4	No	-	very small difference
	5	No	-	none smelled "off"; only
	6	Yes	Yes	stronger than one another
C	1	No	-	C12 stronger
	2	No	-	C21&C22 stronger
	3	Yes	Yes	C32&C33 stronger
	4	No	-	C42 v. strong fishy
	5	No	-	C51 strongest
	6	Yes	-	C63 v. strong fishy
D	1	No	-	less smelly
	2	Yes	No	less smelly
	3	Void	-	same
	4	No	-	D41 least smelly
	5	No	-	D52 least smelly
	6	Void	-	same
E	1	No	-	
	2	No	-	v. slight difference
	3	Yes	No	
	4	No	-	E43 slightly stronger
	5	Yes	No	
	6	No	-	

Table 1 (cont.)

F	1	No	-	F12 slightly stale
	2	Yes	No	F23 slightly stale
	3	No	-	all v. slightly stale
	4	No	-	
	5	Yes	Yes	

6	Yes	Yes	F63 stale

Panelist F: To me, "tainted" means tasting of some non-fish material, and not just stale fish. Fish deteriorates as to taste very rapidly. I wonder if any differences are masked by the age of the samples, even though it was kept in the freezer.

Correct Response - Odd sample was correctly determined.
Correct Identification - Odd sample correctly identified as control or exposed.
"-" - Identification is not applicable because the sample was not judged correctly.
"Void" - Indicates no odd sample was selected.

Figure 1. Sensory Evaluation Questionnaire

ST. CLAIR RIVER REMEDIAL ACTION PLAN
FISH TAINTING ODOR EVALUATION QUESTIONNAIRE

NAME _____ DATE: May 3, 1995

Species evaluated: Walleye

Six sets of three coded samples are provided below. Each set should be evaluated separately, on the order listed. In each set, two of the three samples are identical, and the third is different.

To evaluate the samples, tear off the end of the foil packet and open it as much as possible. Sniff the contents three times, then fold the end of the packet and re-close the packet. Wait approximately 15 second, and repeat the procedure for the other two samples in the set. Test the samples separately and in the order indicated. Check the odd sample and indicate whether the odd sample is tainted or untainted. Record any additional comments you may have describing the odor of the sample(s) you believe is (are) tainted.

Rinse between each sample with the water provided and take a bite of cracker after smelling each sample.

	Code	Check odd sample	Odd sample is: (check one)	Comments
SET #1	11	_____	Tainted _____	
	12	_____	Untainted _____	
	13	_____		
SET #2	21	_____	Tainted _____	
	22	_____	Untainted _____	
	23	_____		
SET #3	31	_____	Tainted _____	
	32	_____	Untainted _____	
	33	_____		
SET #4	41	_____	Tainted _____	
	42	_____	Untainted _____	
	43	_____		
SET #5	51	_____	Tainted _____	
	52	_____	Untainted _____	
	53	_____		

SET #6	61	_____	Tainted _____
	62	_____	Untainted _____
	63	_____	

4.0 CONCLUSIONS AND RECOMMENDATIONS

The sensory evaluation panel could not distinguish between the exposed and control fish. In addition, the sensory evaluation panel could not distinguish a noticeable taint in those tests where they may have correctly differentiated between the control and exposed samples. The panelists' comments indicate that there was generally no perceived difference in odor between the control and exposed fish. Where differences were noticed, the odor was not thought to be objectionable. In conclusion, there appears to be no tainting potential associated with the downstream sampling locations along the St.Clair River during the period of investigation.

It may be reasonably concluded that the main industrial point sources have not caused "off" odors in the walleye of the areas sampled along the St. Clair River.

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