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Scombrotoxin and scombrotoxin-like poisoning from canned fish

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SUMMARY

A number of scombrotoxin poisoning incidents which have recently occurred in the UK following the consumption of canned fish have been investigated. Symptoms are described and the relationship between the histamine content of incriminated samples and toxicity is discussed.

INTRODUCTION

Scombrotoxin poisoning generally results from the ingestion of fish of the families *Scomberesocidae* and *Scombridae* which include tuna, bonito and mackerel. The onset of symptoms occurs within 10 minutes to two hours of consuming the toxic fish. Not all symptoms are necessarily present in every case; in general, the victims complain of a sharp or peppery taste in the mouth, and flushing of the facial and neck area appears with a feeling of heat and general discomfort. The flushing is often followed by a severe headache and cardiac palpitations may occur. Other symptoms include dizziness, faintness, itching, burning of the mouth and throat, rapid and weak pulse and an inability to swallow. Many incidents in the UK have involved gastro-intestinal symptoms including diarrhoea and nausea without vomiting (Gilbert *et al.* 1980). In severe cases respiratory distress has been reported.

Toxic factor

Scombrotoxin poisoning is not a microbial infection or intoxication, it is caused by a 'toxin' or toxins which accumulate in the flesh of the fish during storage. Historically scombrotoxin poisoning has been associated with high levels of histamine in the fish flesh, and indeed it has been suggested that histamine itself is the toxic factor. Histamine is produced in fish by the action of bacterial decarboxylase enzymes on the amino-acid histidine, which is found in abundance in the free state in dark-fleshed fish but not in most other varieties (Ferencik, 1970).

Whilst it is generally true that toxic fish have high levels of histamine this is not always so, nor do fish with high levels always cause poisoning. Other species of fish can attain high levels of histamine but are not implicated in toxic episodes as regularly as the scombroid fish. Other foods such as cheese and meat products can also have high levels (Ienistea, 1971; Taylor, Leatherwood & Lieber, 1978; Prete, Amodio & Mowtanoro, 1979). The 'toxin' is heat stable; canned fish have caused poisoning and smoke processing appears to have no effect on either its production or destruction. Although the symptoms are essentially those of histamine poisoning there is ample evidence that scombrotoxin poisoning is not an allergy. However, ingested histamine in combination with some other substance could be responsible.

Incidence of scombrotoxin poisoning

Whilst the precise cause of scombrotoxin poisoning is not known, some useful conclusions can be drawn from an examination of case histories and available information. Most of the published information comes from the USA and Japan, where scombrotoxin poisoning is more common and where most investigations have been carried out (Arnold & Brown, 1978). In the UK the incidence has only reached a significant level and indeed has only been documented since 1978 (Cruickshank & Williams, 1978). This undoubtedly is a result of the increased consumption of mackerel, chiefly as smoked products. Properly preserved fish are safe to eat whether fresh or processed such as by smoking. Some degree of spoilage is necessary for the accumulation of 'toxin' though spoiled fish do not necessarily cause poisoning. The histamine concentration in the fish flesh can be a useful indicator of spoilage and hence is of value in assessing any potential hazards.

Since 1978 incidents of scombrotoxin fish poisoning have been sporadic and most, involving mainly smoked mackerel, have already been reported elsewhere (Gilbert *et al.* 1980). During 1980, however, the number of incidents has decreased and the pattern has changed from being mainly associated with chilled smoked mackerel to freshly opened canned products such as tuna, mackerel, sardines, pilchards and anchovies. While some of these products are not scombroid fish they have, nevertheless, been shown to contain high levels of histamine and have resulted in symptoms similar to scombrotoxin poisoning.

MATERIALS AND METHODS

Clinical and epidemiologial information from 26 incidents of scombrotoxin fish poisoning was brought to our attention, and in most instances samples of canned fish (remnants or unopened cans from the same batch) were sent for histamine analysis.

Histamine was determined by the simplified procedure of Taylor, Lieber & Leatherwood (1978), based on spectrofluorimetric measurement after reaction with *o*-phthalaldehyde.

Table 1. *Symptoms associated with scombrotoxin poisoning from canned fish: data from 26 incidents affecting 71 people*

Symptoms	Number of incidents
Rash – bright red	14
Hot flush and sweating	13
Burning in mouth – peppery taste	12
Nausea	8
Vomiting	8
Headache	4
Diarrhoea	4
Stomach pain	4
Swelling or soreness of the tongue	3
Dizziness	2
Swelling of face	1

RESULTS

Table 1 lists the frequency of symptoms described in each incident and highlights those most consistently reported – rash, hot flushing and sweating, and burning mouth sensation. From any one episode the symptoms of all patients tended to be similar, and hence scoring is presented by incident rather than by individual.

Between March 1979 and March 1980 26 incidents involving canned fish were reported (Table 2). The variation in the levels of histamine detected in samples of fish from these incidents is wide, however the sample examined was not always from the original incriminated material, and variation between different fish and between samples from the same fish can be considerable.

DISCUSSION

Because of variation within and between samples it is difficult to interpret the results accurately. The results (Table 2) do not indicate any pattern or relationship between histamine values and toxicity. Nevertheless, where the same or similar batches have consistently high values for histamine levels (incidents 7, 15, 21 and 22), we consider that these were due to deficiencies in handling and processing. In incidents 4, 5, 16, 18, 23 and 24, from which remnants of fish were available, the histamine levels were low. However, in incidents 4 and 5 many of the typical symptoms of scombrotoxin poisoning were not present, and in incident 18 only one person in a works canteen was involved. It is therefore possible that these incidents had some other cause. We consider that in the case of scombroids, where there has been a consistent association of high levels of histamine in a large proportion of previously incriminated samples, fish with histamine values in excess of 20 mg/100 g of muscle are likely to be toxic whereas those with 5 mg/100 g are not (Gilbert *et al.* 1980). Where samples have values between these levels there must be some doubt as to their wholesomeness. Further sampling will elucidate the range of values within any batch and a judgement will have to be made depending on the proportion of samples with high histamine levels. Although there have been

Table 2. *Scombrotoxin poisoning from canned fish*

Incident number	Date	Canned fish incriminated	Number ill	Number at risk	Histamine content (mg/100 g fish)	
					Remnants from meal	Samples from same batch
1	Mar. 1979	Mackerel (UK)	4	?	—	1·4
2	May 1979	Sardines (Morocco)	1	1	—	—
3	Aug. 1979	Pilchard/sardines (Morocco)	1	?	—	290
4	Oct. 1979	Mackerel (UK)	1	?	1·25	—
5	Jan. 1980	Pilchards (UK)	1	1	1·7	—
6	Feb. 1980	Bonito/tuna (Thailand)	1	1	—	2·5
7	Apr. 1980	Tuna (Taiwan)	1	1	> 1000	450
8	Apr. 1980	Tuna (Fiji)	1	1	—	4
9	May 1980	Sardines (Morocco)	27	36	—	83–100
10	May 1980	Mackerel (UK)	1	1	—	1
11	May 1980	Tuna (Taiwan)	3	3	—	—
12	May 1980	Sardines (Morocco)	1	1	—	1·2
13	June 1980	Sardines (Morocco)	6	26	—	15–150
14	Oct. 1980	Tuna (Peru)	4	4	105	—
15	Nov. 1980	Tuna (Malaysia)	2	2	290	5–85
16	Nov. 1980	Tuna (Japan)	2	2	2·8	3·6
17	Nov. 1980	Skipjack tuna (Japan)	1	1	—	5·0
18	Nov. 1980	Tuna (Taiwan)	1	?	3·5	—
19	Nov. 1980	Tuna (Taiwan)	1	2	—	5·2–6·5
20	Dec. 1980	Sardines (Morocco)	2	2	72	—
21	Dec. 1980	Anchovies (Spain)	1	1	68	2·3–306
22	Jan. 1981	Sardines (Morocco)	3	3	300	220
23	Jan. 1981	Tuna (Solomon Islands)	1	1	2·0	
24	Feb. 1981	Tuna (Japan)	1	1	1·6	—
25	Feb. 1981	Tuna (Thailand)	1	1	26·00	10–25
26	Mar. 1981	Tuna (Philippines)	2	2	640·00	2–30

— = Not tested.

incidents involving fish with levels in the 5 to 20 mg/100 g range, the lower the levels the less likely the sample is to be toxic. Because of this difficulty the advice given to mackerel processors by Torry Research Station is based on what can be achieved by good manufacturing procedures. When mackerel is allowed to spoil in ice, the level of histamine does not rise much above 5 mg/100 g of fish (Murray unpublished results) even when it becomes unfit to eat. Storage at higher temperatures, especially above 10 °C (Park *et al.* 1980) results in high levels of histamine, and production has been shown to be exponential. It can therefore be said that levels of histamine over 5 mg indicate that the fish has been unnecessarily exposed to higher temperatures, and the higher the level the more abuse there has been. The aim in processing should therefore be to have no more than 5 mg/100 g in the finished product.

Whilst there are sufficient data on mackerel and tuna to give this advice this is not the case with other species. More information is required on the normal

histamine levels and changes during spoilage in these cases. Even with mackerel it must be stressed that the level of 5 mg/100 g is only a guide in the light of experience. A more accurate understanding of the role of the toxic components and perhaps the development of better tests are still required.

In Sweden an ordinance (Anon, 1980) came into force on 1 July 1980 revising the maximum tolerances of contaminants in some foods; in fish products the level for histamine is 20 mg/100 g. This figure may be the result of an investigation of canned imported tuna carried out by Lönberg, Movitz & Slorach (1980), who reported that scombrotoxin poisoning was always associated with high levels of histamine in the contents of suspect cans. High levels were more often found in cans imported from Malaysia, Taiwan and Thailand than in those from the other countries studied.

Incidents involving non-scombroid fish

Samples from outbreaks in the UK involving non-scombroid species (see Table 2) giving 'scombrotoxin-like' symptoms have been found to contain high levels of histamine. Recently a 'scombrotoxin-like' incident occurred involving semi-preserved canned anchovies where the level of histamine was found to be 60 mg/100 g. Follow-up samples of cans of the same batch proved to contain from 2·3 to 30 mg/100 g.

There is little information available on the level of histamine to be expected in this type of product as it has seldom been associated with toxic episodes in the country. The product is a semi-preserve, and is made in a traditional manner part of which involves a maturation process which normally contributes to the flavour of the product, as with some cheeses, but which could easily result in the formation of histamine. It is therefore, at this time, difficult to be certain what level of histamine in this product is likely to be associated with the development of toxic symptoms. When random samples of eight cans of anchovies, not implicated in any incident, taken from four different shops were examined for histamine, four of the cans each contained approximately 20 mg/100 g. This would be considered as quite high had they been mackerel products.

It is evident that a study of fish products in which histamine may be formed during normal processing needs to be carried out before meaningful values are suggested for the non-scombroids.

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