SCOMBROID (HISTAMINE) POISONING

THE ORGANISM/TOXIN

Scombroid poisoning occurs when raw scombroid fish is temperature abused allowing bacterial growth to occur with concomitant toxin production. Similar toxins can also be produced in other foods, notably cheese and other fermented foods. While histamine poisoning is well known and is by far the most important form, a range of different related toxins, known as biogenic amines, can cause disease. However, the actual nature of the toxin(s) is controversial.

BIOGENIC AMINE PRODUCTION AND ITS CONTROL

Many types of bacteria are capable of producing the biogenic amines regarded as causing histamine poisoning. Also, the enzymes responsible (decarboxylases), once produced, may still be active even if the bacteria that produced them are subsequently controlled. Control of biogenic amine production is best summarised by food type.

Fish: Histamine food poisoning is most often associated with a particular group of fish, including the scombroid fish, that have high free levels of the amino acid histidine (i.e. not contained in proteins) in their flesh.

Fresh scombroid fishes do not contain free histamine, and amines are only produced during temperature abuse and spoilage. For example storage of mackerel for 18 days at 0^{o}C resulted in little histamine formation, but high levels were found after only 5 days storage at 10^{o}C levels.

Scombroid fish can have a 14 day safe shelf life at 0^{o}C if chilled quickly (meaning reducing the internal temperature to 10^{o}C or less in 6 hours), but this reduces to only 7 days at 4.4^{o}C (these times include time on the boat). The fish should not be exposed to temperatures >4.4^{o}C for more than 4 hours after the initial chilling.

Vacuum packaging is not an effective means of retarding the production of amines.

Salting may result in the selection of salt tolerant bacteria that may also produce amines.

Preservatives, or other interventions that inhibit the growth of bacteria, will also inhibit the production of amines.

Fish will store indefinitely if frozen.

Cheese: Biogenic amines are produced during ripening as the casein is slowly degraded by enzymatic activity to release free amino acids which may act as substrates for decarboxylation.

The use of pasteurised milk, hygienic practice and the use of starter cultures with low decarboxylase activity assist in the prevention of amine formation.

Ripening at warm temperatures, as is practiced in Swiss style cheese production, has the potential to allow the formation of biogenic amines.

The addition of proteolytic enzymes to decrease ripening times releases free amino acids from proteins and in some circumstances this results in increased amine concentrations in some circumstances (i.e. where raw milk is used as an ingredient).

Long ripening periods (>6 months) also contribute to the potential for amine production.

pH during ripening is also important with lower pH resulting in less amine formation.

Meat: Amines can accumulate during the production of fermented meat products. Foods such as salamis should be made from good quality raw ingredients. Frozen ingredients of suitable quality can be thawed at 5^{o}C for 3 days when a starter culture is used. Short fermentations and the use of appropriate starter cultures used under optimum conditions assist in reducing amine formation (possibly by the rapid decrease in pH that results).

In fresh meats amine production is correlated with spoilage, so minimising the possibility of intoxication occurring as the consumer is alerted to the poor quality of the food. However, new packaging technologies might erode this safeguard. Levels of tyramine toxic to those on monoamine oxidase inhibitor (MAOI) drugs have been demonstrated in beef stored at +2 and –2^{o}C for 100 days, and in pork stored at -1.5^{o}C for up to 13 weeks in preservative packaging.

Fermented Vegetables: Hygienic practice and the use of starter cultures with low decarboxylase activity assist in the prevention of amine formation.

THE ILLNESS

Incubation: Ranges from several minutes to several hours. Mean incubation period around 1 hour.

Duration: Normally lasts for a few hours but can last for days.

Symptoms: *Histamine.* May include rash, localised skin inflammation, nausea, vomiting, diarrhoea, abdominal cramps, low blood pressure, headache, tingling, flushing and severe respiratory distress. The most consistent sign is a flushing of the face and neck causing heat and discomfort, which can appear similar to sunburn.

Tyramine. This acts indirectly to increase blood pressure by narrowing peripheral blood vessels and increasing the output from the heart. Other symptoms include dilation of the pupils, swelling of the eyes and

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tear production, salivation, increased respiration and blood sugar concentration.

Toxins: The actual nature of the toxin is the subject of much debate, at least in fish. The biological effects of histamine are reported to be increased in the presence of other spoilage products, as fish containing a level of histamine seem to be more toxic than the same amount of histamine administered orally by itself. Another theory suggests that an unknown toxin from spoiled fish actually mediates the release of histamine from the body's cells. Whatever the actual toxin(s) involved, biogenic amines in food are at least indicators of the presence of these toxin(s).

At Risk Groups: All consumers are at risk, although there may be sub-groups of different susceptibilities. People on MAOI therapy who consume tyramine are susceptible to hypertensive crisis. The enzymes that these drugs inhibit are those that remove these toxins in healthy individuals.

Long Term Effects: Rarely, cardiac and respiratory complications occur.

Dose: The situation regarding a toxic dose is unclear (not least because the chemical(s) responsible is not known). Approximately 100 mg/100g histamine is considered to be toxic, but a number of incidents have involved foods containing less than 5 mg/100g histamine. A limit commonly used is 30 mg/100g, although the FDA have a limit of 50mg/100g. Another scheme states that <5mg/100g is safe to eat, 5-20mg/100g is possibly toxic, 20-100 mg/100g is probably toxic and >100 mg/100g is toxic and unsafe for human consumption.

For tyramine a toxic dose of 10-80 mg has been suggested.

NZ Incidence: Data are not recorded since scombroid intoxication is not a notifiable disease (except under acute gastroenteritis), but outbreaks and cases do occur.

Treatment: Administration of antihistamines for histamine poisoning.

SOURCES

Fish: Scombroid fish are the most likely to be involved with histamine poisoning. These include Kahawai, mackerel, tuna, bonito, and butterfly kingfish. Other fish species also implicated include sardines, pilchards, anchovies, herring and marlin.

A survey of New Zealand smoked fish found 8/107 samples had histamine levels in excess of 5 mg/100g and of these eight only two exceeded 20 mg/100g. Another survey identified four of 91 samples containing >10 mg/100g histamine and two of the samples (smoked trevally and smoked warehou) contained 100 mg/100g or more.

Fermented fish products may contain appreciable levels of histamine, but there is no association between consuming this sort of food and disease.

Meat: Fermented meats may contain sufficient toxin to pose a theoretical risk to human health

Cheese: Cheeses involved in outbreaks include Gouda, Swiss, Cheddar, Gruyere and Cheshire.

Alcoholic Drinks: A case has been described where a person on MAOI therapy became symptomatic after the consumption of 250 ml beer. Yeasts do not form amines and so the amines in beer are derived from the raw materials or are due to microbial contamination during fermentation. The presence of amines in wine (mostly red) has also been reported.

Fermented Vegetables: Commercial sauerkraut (fermented cabbage) can contain appreciable levels of amines, although the level is usually below what can be regarded as toxic.

Other Fruits and Vegetables: Some fruits can contain appreciable levels of amines, for example raspberry juice has a relatively high tyramine concentration. Amines are also present in a variety of vegetables. Levels will generally be below that regarded as being toxic.

Soy/Asian Food Products: High levels of amines have been measured in some soy sauces (inyu), fermented black soybeans (toushi) and fermented soybean curd (sofu).

OUTBREAKS AND INCIDENTS

Outbreaks:

New Zealand

Kahawai: 3 cases (histamine content 200 mg/100g).

Overseas:

Blue Marlin: 28 cases among 57 exposed, 13 hospitalised. Control measure failure: temperature abuse.

Tuna: 7 cases, three hospitalisations (histamine content 2000mg/100g). Control measure failure: likely temperature abuse.

Western Australian Salmon: 7 cases, one hospitalisation (histamine content of two samples tested 60 and 245 mg/100g).

Fried White Tipped Mackerel: 41 cases, all hospitalised. Control point failure: temperature abuse.

Kingfish: 2 cases.(histamine content 600 mg/100g).

Smoked Mackerel: 4 cases (histamine content 300 mg/100g). Control point failure: temperature abuse.

Tuna Burgers and fillets: 5 outbreaks involving 20 cases (histamine content up to 325 mg/100g in burgers). Control point failure: inadequate refrigeration, failure to clean and sanitise grinder between preparation of burgers.

Swiss Cheese: 6 cases (histamine content 187 mg/100g). Control point failure: abnormally long storage period and possible intermittent temperature abuse.

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ADEQUATE PROCESSING GUIDELINES

N.B. These guidelines have been derived from published information. Industry is advised to ensure that processing steps they are using are adequate to meet their particular food safety objectives.

Fish	**Temperature**	**Time***
For fish (not tuna >20lb), not exposed to >28.3°C temps Chill fish rapidly in seawater or brine to Chill fish in ice	 ≤ 10°C 0°C	 within 9 hours within 12 hours
For tuna >20lb, or fish exposed to >28.3°C temps Chill fish rapidly to	 ≤ 10°C	 within 6 hours
Hold fish at	-18°C 0°C 4.4°C 10°C 21°C	No limit up to 14 days up to 7 days up to 3 days 0 days
Add appropriate level of preservative to store fish safely		
Cheese: Use pasteurised milk, hygienic practice and appropriate starter cultures in cheese manufacture		
Meat: Use appropriate starter cultures in fermented meat production		
Vegetables: Use appropriate starter cultures in fermented vegetable production		

* times given include the time on the boat

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