A large outbreak of scombroid fish poisoning associated with eating yellowfin tuna (*Thunnus albacares*) at a military mass catering in Dakar, Senegal


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**SUMMARY**

On 26 November 2010, an outbreak of scombroid fish poisoning occurred in the French Armed Forces in Dakar, Senegal. This chemical intoxication, due to high histamine concentration in fish, is often mistaken for an allergic reaction. A case-control study was undertaken including the 71 cases and 78 randomly selected controls among lunch attendees. The usual symptoms for scombroid fish poisoning were observed in cases, i.e. flushing (85.9%), headache (83.1%), rapid/weak pulse (59.1%) and diarrhoea (47.9%). Symptoms occurred from within a few minutes to up to 3 h following the meal. Most patients quickly recovered with antihistamine and/or symptomatic treatment. Tuna was the only food item positively associated with illness (odds ratio 3.63, 95% confidence interval 6.3–210.0), with the risk of illness increasing with the quantity of fish consumed. No bacterial contamination was found in leftover food, but histamine concentration in tuna was found to be 4900 mg/kg, almost 50-fold higher than the concentration allowed by European regulations. This report is unique because of the large size of the case series – to our knowledge, the largest event of scombroid fish poisoning ever reported – and the chemical and bacteriological analyses results obtained on leftover food.

**Key words**: Hygiene – food, outbreaks, veterinary epidemiology, zoonotic foodborne diseases.

**INTRODUCTION**

Scombroid poisoning or histamine fish poisoning is a foodborne chemical disease associated with fish consumption. Most cases have been observed with fish belonging to the Scombridae family (e.g. tuna, mackerel), although non-scombroid fish species may also be implicated (e.g. sardines, herring) [1]. These fishes share high levels of free histidine in their muscle tissues. Histamine is generated from free histidine by a bacterial enzyme histamine-decarboxylase, usually following time-temperature abuse [1]. Bacteria such as *Pseudomonas, Klebsiella, Enterobacter, Escherichia or Clostridium* may be responsible for this transformation; they either constitute normal flora in the fish or come from contamination during handling. Although
histamine formation is best controlled by preventing
time-temperature abuse, it is known that some bac-
teria have the ability to form elevated concentrations
of histamine at temperatures as low as 0–5 °C [2].
Scombroid fish poisoning is probably underestimated
since symptoms can easily be misclassified as allergic
reactions. However, it ranks among the most promi-
nent seafood intoxications and is reported world-
wide [3].

On 26 November 2010, a large number of French
Armed Forces soldiers in Dakar (Senegal) became ill
with symptoms resembling an allergic reaction within
2 h after eating lunch at the military catering facility.
Most cases experienced clinical manifestations like
flushing (on the face, neck and trunk) pruritus or
headache. Due to the large number of patients and the
rapid onset of symptoms after lunch, a foodborne
disease was quickly suspected. On the basis of clinical
manifestations and fish consumption during lunch,
scombroid fish poisoning was considered. A case-
control study was undertaken in order to describe this
outbreak, identify its source and quickly implement
prevention measures. In this report, the authors
summarize the steps and the main results of the in-
vestigation.

SUBJECTS AND METHODS

Attendees of the incriminated lunch were eligible for
this study. Those who reported at least one of the
following clinical manifestations (flushing, headache,
diarrhoea) within 72 h after lunch were classified as
cases. A similar number of controls were randomly
selected from the attendees at the lunch that did
not report any clinical manifestations. For all cases
and controls, food items eaten during that lunch
were recorded as well as past history of allergy and
current treatments. Data were collected using a semi-
structured questionnaire. For cases, clinical manifesta-
tions (including their onset, duration and recovery)
as well as treatment prescribed were also recorded.
In addition, stools samples were taken from six case-
patients who experienced diarrhoea and were anal-
ysed at the Institut Pasteur de Dakar (Senegal).

Chemical and bacteriological analyses were per-
formed on a single 100-g sample of each food item
on the lunch menu that had been stored as recommended.
The quantification of sulphate-reducing anaerobic
bacteria, coagulase-positive staphylococci and salmo-
nellae was assessed at the Institut Pasteur de Dakar.
Histamine, cadaverine and putrescine concentrations
in the tuna were assessed twice on the same sample by
high performance liquid chromatography (Hitachi,
LaChrom Elite®, Japan) in the ANSES laboratory [4].

Data were analysed using Stata software
(StataCorp., USA). Qualitative data were compared
using Pearson’s χ² test, or Fisher’s exact test when
required, while quantitative data were compared
using Student’s t test or non-parametric tests. A mul-
tivariate analysis (logistic regression) was per-
formed to identify factors related to illness. A P value
of ≤0.05 was considered as significant.

RESULTS

In total, 71 of the 237 lunch attendees met the case
definition (66 presenting at the medical facility and a
further five identified in the randomly selected con-
trols). This corresponded to an attack rate of 30·0%.
Seventy-eight controls were selected randomly from
those that attended the suspected lunch. This group
mainly comprised young and healthy adults (age
range 19–56, median 32 years); the majority were
male (136/149). Cases were significantly younger than
controls (30·2 vs. 34·8 years, P = 0·001), but were
similar in all other respects (gender, allergy history,
chronic medications).

The most frequently reported symptoms were a
sensation of warmth, flushing, headache, weakness,
rapid/weak pulse and diarrhoea (Table 1). In all
patients, symptoms began during or shortly after
lunch (median 1 h, range 0–180 min) (Fig. 1). Of the
71 cases, 66 patients were managed at the medical fa-
cility of the French Armed Forces in Dakar; 60 of
whom received treatment. Four of the five remaining
cases self-medicated. Most patients were prescribed
anti-allergic treatment: antihistamine 52/71 (73·2%) and/or
corticoids (9·9%). According to the symptoms
they experienced, patients were also prescribed para-
cetamol (29/71, 40·8%), ractecodotril (12/71, 16·9%),
diosmectite (14/71, 19·7%) or phloroglucinol (3/71,
4·2%). Clinical manifestations were sufficiently severe
in some cases to require hospitalization (16/71
patients, 22·5%) and/or perfusion (with Ringer’s lac-
tate and/or HEA Voluven® (Lab. Fresenius Kabi,
France) in 14 (19·7%) patients. Most patients recov-
ered within a few hours after onset of clinical
manifestations, with the most seriously affected re-
covering the following morning.

During the lunch, three different fishes were offered
as main course: tuna (130 portions), shark (90) and
salmon (40), respectively. Tuna was the only food
item found to be positively associated to illness [Pearson’s $\chi^2 = 43.1$, $P < 10^{-6}$, odds ratio (OR) 36.3, 95% confidence interval (CI) 6.3–210.0]. On the contrary, shark was found to have a protective effect ($P < 0.001$, OR 0.1, 95% CI 0.03–0.4). None of the other food items served was significantly related to illness (Table 2).

In addition, of the 107 attendees who ate tuna, individuals who ate more than one piece of tuna were 3.6 times more likely to become ill than those who ate one piece or less (multivariate analysis, $P = 0.003$). However, the time between consumption and the onset of symptoms was not related to the amount of tuna eaten ($P = 0.18$). Stool samples of cases were negative for pathogenic bacteria or parasites.

**Environmental investigation**

The bacteriological analyses of the control meal food items, performed at the Institut Pasteur de Dakar were all negative. Conversely, mean histamine concentration measured was 4900 ± 145 mg/kg, almost 50-fold higher than the concentration allowed by European regulations (100 mg/kg) [5]. Putrescine concentration was 282 ± 1 mg/kg and cadaverine 300 ± 7 mg/kg.

**DISCUSSION**

This study found that 71 members of the French military forces in Dakar had scombroid fish poisoning due to the high quantity of histamine present in the tuna they consumed. This is, as far as we know, the largest scale scombroid fish-poisoning outbreak ever

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**Table 1. Scombroid fish poisoning in Dakar (Senegal): main clinical manifestations with frequencies observed in 71 cases, in the 72 h following the incriminated meal**

<table>
<thead>
<tr>
<th>Clinical manifestations</th>
<th>% of cases (n)</th>
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<tbody>
<tr>
<td><strong>Dermatological</strong></td>
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<tr>
<td>Flushing</td>
<td>85.9 (61)</td>
</tr>
<tr>
<td>Pruritis</td>
<td>28.2 (20)</td>
</tr>
<tr>
<td><strong>Gastrointestinal</strong></td>
<td></td>
</tr>
<tr>
<td>Diarrhoea</td>
<td>47.9 (34)</td>
</tr>
<tr>
<td>Abdominal pain</td>
<td>35.2 (25)</td>
</tr>
<tr>
<td>Nausea</td>
<td>23.9 (17)</td>
</tr>
<tr>
<td>Difficulty in swallowing</td>
<td>12.7 (9)</td>
</tr>
<tr>
<td>Vomiting</td>
<td>5.6 (4)</td>
</tr>
<tr>
<td>Mouth swelling</td>
<td>5.5 (4)</td>
</tr>
<tr>
<td><strong>Neurological</strong></td>
<td></td>
</tr>
<tr>
<td>Headache</td>
<td>83.1 (59)</td>
</tr>
<tr>
<td>Dizziness</td>
<td>42.2 (30)</td>
</tr>
<tr>
<td>Tremor</td>
<td>33.8 (24)</td>
</tr>
<tr>
<td>Tearing/conjunctiva congestion</td>
<td>21.1 (15)</td>
</tr>
<tr>
<td><strong>Cardio-respiratory</strong></td>
<td></td>
</tr>
<tr>
<td>Rapid/weak pulse</td>
<td>59.2 (42)</td>
</tr>
<tr>
<td>Malaise</td>
<td>36.6 (26)</td>
</tr>
<tr>
<td><strong>General</strong></td>
<td></td>
</tr>
<tr>
<td>Warmth sensation</td>
<td>87.3 (62)</td>
</tr>
<tr>
<td>Weakness</td>
<td>70.4 (50)</td>
</tr>
<tr>
<td>Dyspnoea</td>
<td>19.7 (14)</td>
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</tbody>
</table>
The diagnosis of histamine poisoning is usually based largely on a history of the food eaten by the patient immediately before onset of illness. Clinical differential diagnosis with allergy is easier if more than one person is affected in a group of people consuming the contaminated fish or if patients have not had a reaction to that fish before [7]. If the symptoms are appropriate, the onset time is reasonably short, and the patient has eaten a type of food potentially implicated in cases of histamine poisoning, the diagnosis can be confirmed by detecting high levels of histamine in the implicated food, meal leftovers or a similar product obtained from the same source [8].

In this outbreak, classic symptoms of scombroid poisoning, e.g. flushing, headache, dizziness and diarrhoea were observed. In scombroid poisoning, clinical manifestations usually occur within an hour after ingestion of the contaminated meal and last for several hours [9]. In this outbreak, the epidemic curve, by time to onset of clinical manifestations, showed two consecutive peaks, probably because some attendees slept after lunch and only felt ill when they awoke. The intensity of symptoms was highly variable; from no notification until the patients were asked to complete the questionnaire, to so intense that they needed hospitalization or perfusion procedures. As previously reported [1], recovery occurred within 1 day. In the present outbreak, first-line treatment included symptomatic H1 receptor antagonists as recommended in the literature [1, 9]. Other authors propose the use of H2 antagonists in order to improve outcome. Here, corticoids were also prescribed even though their use is not recommended for treatment of scombroid fish poisoning.

Bacteriological investigations did not demonstrate any contamination, probably because they was performed on the cooked food items in the control meal. On the other hand, histamine is thermostable; once it is produced its concentration is not modified by cooking. European Union regulations stipulate that the critical level of histamine is 100 mg/kg for raw fish [5]; in the USA a more conservative level of 50 mg/kg is used [10]. In the present outbreak, chemical contamination was confirmed since histamine concentration was 4900 mg/kg, far above the concentration allowed by regulations (CE no. 1441/2007, 5th December 2007). As reported previously [11], this study also found the amount of fish consumed to be related to the risk of development of clinical manifestations. This dose–response effect is another strong argument for a causal link between tuna consumption and illness. Although histamine has been recognized as a causative agent in scombroid fish poisoning [12], many studies have failed to reproduce clinical manifestations after oral challenge with histamine. On the basis of animal experiment models, bioamines have been considered as potentiators since they are able to reduce histamine catabolism [8] or increase the amount of histamine absorbed in the gastrointestinal tract [1, 9]. In the current study, the presence of cadaverine and putrescine reported in the incriminated tuna could have contributed to the pathology.

Since no traceback documents were available it is conceivable that the tuna had been fished some time before it was claimed to have been, or that it had not been properly stored after fishing. Fish production in Senegal includes two different sectors: the industrial sector, dedicated to export trade and the artisanal sector which supplies the local market. While the

<table>
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<th>Table 2. Scombroid fish poisoning in Dakar (Senegal): number and percentage of cases and controls reporting consumption of food items (n = 149)</th>
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<tbody>
<tr>
<td><strong>Food item</strong></td>
</tr>
<tr>
<td>Tuna</td>
</tr>
<tr>
<td>Carrot</td>
</tr>
<tr>
<td>Shark</td>
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<tr>
<td>Rice</td>
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<td>Sauce</td>
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<tr>
<td>Salmon</td>
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<td>Yogurt</td>
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<td>Chocolate mousse</td>
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OR, Odds ratio; CI, confidence interval.
* Fisher’s exact test.
The industrial sector is relatively well controlled concerning sanitary risks, the latter is more clearly deficient in terms of cold chain management, traceability, handling hygiene, etc. Since scombroid poisoning is strictly the result of fish product mishandling, it should be preventable. However, it is often encountered with recreational catches or in countries where international food hygiene standards are insufficiently applied. It is interesting to note that such an outbreak had already occurred several years previously in the French Armed Forces with fish bought in Dakar [13]. For economic and diplomatic reasons, the traditional fishing sector has been chosen to supply the French Armed Forces in Senegal. Nonetheless, where national regulations and controls are deficient, food professionals must intensify sanitary risk management to protect the consumers. As a temporary disposition following the recent outbreak, the veterinary expert advised against scombroid fish consumption. In the future, although it is not specified in the Senegalese regulations, French Armed Forces should ensure improved sanitary security dispositions from their suppliers. The veterinary expert and logisticians in charge of food supplies need to have access to traceback documentation for each product. In particular the certified origin of the product (fishing date and location) and storage conditions (delay and temperature); moreover, handling conditions in respect of hygiene rules should be registered.

In conclusion, this scombroid fish-poisoning outbreak is, to the best of our knowledge, the largest ever reported. Histamine contamination in tuna was substantial and symptoms were extremely intense in some patients. Scombroid fish poisoning must be borne in mind by physicians and, at best, prevented by food professional and official controllers.

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DECLARATION OF INTEREST

None.

REFERENCES