

NOROVIRUS FOODBORNE OUTBREAKS ASSOCIATED WITH THE CONSUMPTION OF OYSTERS FROM THE ÉTANG DE THAU, FRANCE, DECEMBER 2002

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In January 2003, the Institut de Veille Sanitaire received notification of clusters of gastroenteritis (GE) thought to be associated with consumption of oysters harvested from Etang de Thau in the south of France. At the same time Italy reported an outbreak (200+ cases) associated with oysters from the Etang de Thau. An investigation was carried out to determine the source and vehicle of the outbreaks.

Descriptive analysis of reported clusters in France, microbiological analysis of stool and oyster samples, genotyping of noroviruses and an environmental investigation of the Etang de Thau were carried out. A retrospective cohort study was also undertaken among those attending a number of family meals in Paris.

Thirteen family clusters in four districts of France (69 cases) could be attributed to the consumption of Thau oysters based on descriptive evidence. Oysters distributed at an office in Paris and consumed at fourteen family meals between 19 and 24 December led to a further outbreak. In this outbreak the attack rate was 21/36 (58%) for Thau oyster consumers and 0/22 for non-consumers ($p=0.00002$). Noroviruses (genogroups I and II) were found in stool samples from four clusters and oysters from three clusters (including Paris). Environmental investigations revealed heavy rainfall, an overflow of a water purification station and faecal contamination of the Etang de Thau in December.

Oysters from the Etang de Thau were responsible for a number of clusters of norovirus GE in winter 2002 in France and also in Italy. High *Escherichia Coli* levels in Thau water and shellfish led to an official request, mid-December, for oyster purification before distribution. This was not possible, due to lack of purification facilities. This investigation has contributed to a change in the way that shellfish harvesting areas are classified in France.

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Introduction

Viruses have emerged as an important cause of food and waterborne diseases in recent years with numerous outbreaks associated with noroviruses. These viruses belong to the genus *Norovirus*, family *Caliciviridae* (previously Norwalk-like) and cause acute gastroenteritis in humans. Transmission is primarily via the faecal-oral route. We describe a foodborne outbreak linked to the consumption of oysters.

In January 2003, the Institut de Veille Sanitaire (InVS) became aware of a number of foodborne outbreaks thought to be due to the consumption of oysters from the Etang de Thau (literally, the Thau pond) in December 2002. Several districts had notified such outbreaks. The Etang de Thau is located in the south of France and has seven shellfish farming sites. At the same time, the Rapid Alert system for food and feed (1) reported over 200 cases of acute gastroenteritis in Italy that were linked to the consumption of oysters from the same area of France. In order to confirm the role of oysters from the Etang de Thau in these outbreaks and the source of their contamination, an epidemiological investigation of one of these outbreaks was carried out. This had taken place among staff of an administrative office in Paris and their relatives. The investigation was supplemented by analysis of data on all notified foodborne outbreaks attributed to the consumption of oysters in other French districts from December 2002 to January 2003.

Methods

Epidemiological investigation of the foodborne outbreak at the Paris administrative office.

The oysters had been distributed to the staff on 19 December 2002, and taken home for personal consumption. A retrospective cohort study was carried out among all those present at the meals at which these oysters had been served.

Cases were defined by the presence of at least one symptom within the 72 hours following the meal at which the oysters had been served:

- Definite case: diarrhoea and/or vomiting
- Probable case: fever or abdominal pains and/or nausea.

A standardised questionnaire was completed for each participant in the study, either by face-to-face interview, telephone interview or by self-administered questionnaire. Demographic and clinical data were collected, as well as data on the other food items eaten during the meals at which the oysters were served.

The association between oyster consumption and illness was estimated by calculation of the relative risk (RR) and its 95% confidence interval (CI95%) using Epi Info Version 6.

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Other reported foodborne outbreaks

The notification of foodborne outbreaks is mandatory in France. A foodborne outbreak is defined as the occurrence of at least two clustered cases with similar symptoms and from the same suspected food source. All reported foodborne outbreaks are investigated by local health authorities in order to identify the food items and risk factors responsible. The characteristics of outbreaks (date of onset and type of symptoms, date of consumption and origin of the suspected food items) that had been reported to the InVS between 15 December 2002 and 15 January 2003 were described in order to evaluate the potential role of oysters from the Etang de Thau in those outbreaks.

Laboratory investigations

Bacteriological (*Salmonella spp*, *Shigella spp*, *Campylobacter spp* and *Yersinia spp*) and virological analyses (astrovirus, adenovirus 40-41 and rotavirus by immunoenzymatic assay and caliciviruses belonging to *Norovirus* and *Sapovirus* genuses by reverse transcription-polymerase chain reaction, (RT-PCR)) were carried out on patients' stool samples. The oysters left over from the meals, were tested for noroviruses by genetic amplification using RT-PCR.

Environmental investigations

Pollution indicators at the oyster production sites (Etang de Thau) and meteorological events were examined. The sites where the consumed oysters originated were identified.

Results

Epidemiological investigation of the foodborne outbreak in the Paris office

A total of 58 people from 14 families had been present at meals at which oysters from the Etang de Thau (Marseillan site) were served between 19 and 24 December 2002. The questionnaire was completed for all 58 people (29 female and 29 male). The median age was 44.5 years (range: 3- 88 years).

Twenty one people (36%) from 11 families had been ill (19 definite and 2 probable cases). The incubation period ranged from 3.5 to 58 hours (median= 34 hours) (FIGURES 1 and 2). The most common clinical symptoms in the 21 cases were abdominal pain (76%) and diarrhoea (76%), followed by nausea (62%), vomiting (43%), and fever (9.5%). The mean duration of illness was 1.5 days (range: 1-3 days).

Thirty six of the 58 participants had eaten raw oysters. Gastroenteritis was reported by 21 of these oyster consumers (attack rate 58%), and none of the non-consumers (attack rate 0%) ($p=2.10^{-5}$). The relative risk was incalculable, and there was no statistically significant increase in risk with an increase in the number of oysters eaten. Apart from the oysters, no other common food item was identified.

Other notified foodborne outbreaks

Thirteen foodborne outbreaks were attributed to the consumption of oysters, resulting in 69 cases between 14 and 25 December 2002. These outbreaks were reported to health authorities in four districts: Hérault, Ile de France, Aude and Côte d'Or. The incriminated oysters came from three production sites adjacent to the Etang de Thau: Bouzigues, Marseillan and Mèze. The main clinical signs were diarrhoea (78%) and vomiting (64%). The incubation period ($n=33$) was between 1.5 and 68 hours (median = 34 hours).

Laboratory investigations

Culture of stool samples from three patients from the same outbreak were negative for *Salmonella spp*, *Shigella spp*, *Campylobacter spp* and *Yersinia spp*.

Virological analysis was performed on 12 stool samples from patients from five different outbreaks. Seven stool samples (58%) were

FIGURE 1

Cases of gastroenteritis to onset of disease. Administrative office, Paris, December 2002.

• Meals when oysters were served were taken at different times in each household, therefore, this curve should be looked at by the date of meal.

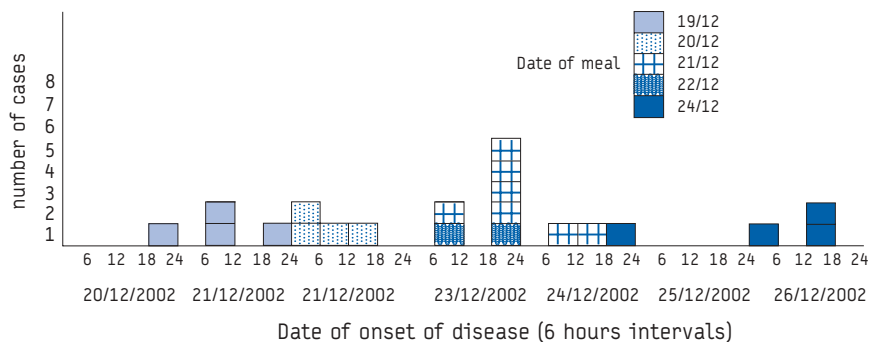
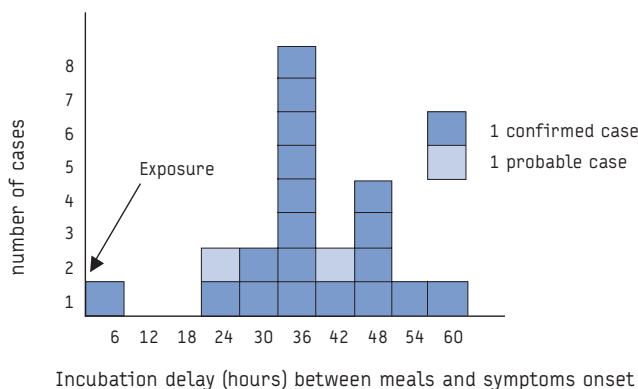


FIGURE 2

Cases of gastroenteritis according to incubation period. Administrative office, Paris, December 2002.



TABLE

Characteristics of noroviruses identified in foodborne outbreaks attributed to the consumption of oysters, France, December 2002

Foodborne outbreak*	Origin of oysters (Thau pond site)	Analysis of	
		Stool samples	Oysters
1	Marseillan	Not done	G II strain-like H104-94-J
2	Bouzigues	Not done	G I Chiba, Malta-like
3	Bouzigues	2 patients with G II - genotype Lordsdale 1 patient with two strains G II New variant GGIIb G I Chiba, Malta-like	G II strain-like H104-94-J
4	Bouzigues	1 patient G II genotype Lordsdale	Not done
5	Bouzigues	1 patient G II genotype Lordsdale	Not done
6	Etang de Thau	1 patient G II New variant GGIIb	Not done

*For 8 outbreaks no stool or oysters analyses were carried out

positive for norovirus. Three different strains were characterised in six patients: two strains belonging to genogroup II (Lordsdale genotype and new variant GGIIb), and one to genogroup I (Chiba genotype, Malta-like strain). The Lordsdale genotype was identified in stool samples of patients from three different foodborne outbreaks (TABLE).

Two different genogroups of noroviruses were detected in samples of oysters eaten in three of the outbreaks. The genogroup II strain (close to the H104-94-J strain) was found in oysters from the Marseillan site that were involved in the Paris outbreak, and in the oysters from Bouzigues involved in the Aude district outbreak. The Malta-like strain, characterised in one stool sample, was also identified in oysters from Bouzigues (TABLE 1). For eight of the outbreaks, it was not possible to perform analyses on stool samples or oysters.

Environmental investigations

Following unusually heavy rainfall and floods on the 10 and 11 December 2002, waste water treatment plants and pumping stations were reported to have overflowed onto the catchment area of the Etang de Thau. Analyses performed on three sites (Marseillan, Bouzigues and Mèze), between 16 and 19 December 2002 showed strong contamination with *Escherichia coli* (between 2900 and 30 400 *E. coli* /100ml). Investigations carried out in the Etang de Thau area showed bacteriological contamination of shellfish.

Discussion

Results of the epidemiological, microbiological and environmental investigations carried out suggest that 14 norovirus foodborne outbreaks linked to the consumption of oysters from different areas of the Etang de Thau occurred in France between 14 and 25 December 2002.

Foodborne outbreaks are considerably underreported in France and the true number of outbreaks that can be linked to the consumption of oysters from the Etang de Thau is probably higher than the number identified. Moreover, the simultaneous occurrence of cases of acute gastroenteritis in Italy, linked to oysters from the same area, suggests that there could have been foodborne outbreaks in countries importing oysters from this part of France.

In Italy, 200 people had acute gastroenteritis after consuming oysters originating from the Meze site on 24 and 25 December 2002. A retrospective cohort study (n=124), carried out by the Istituto Superiore di Sanità in Rome, found an association between the occurrence of gastroenteritis and the consumption of oysters from the Etang de Thau (RR=55.3 (95% CI 2.9- 1058.7)). Two noroviruses (genogroup I and II) were identified in six out of 41 stool samples analysed. The Sindlesham-like strain (Genogroup I) was characterised in two stool samples. Moreover, they identified the same Malta-like sequence as the one detected in the French oysters (TABLE 1). Microbiological analyses carried out on oysters in Italy did not identify noroviruses.

Three different strains of noroviruses (one identical to the strain identified in oysters in France and one identical to the strain identified in stool samples in Italy) were identified in stool samples from patients in France. These results, together with the identification of two other strains, one in oysters in France and one in stool samples from Italy, suggested that the oysters were multicontaminated by several different genogroups. This does not detract from the potential implicated role of the oysters, as there is a wide range of circulating norovirus strains.

Negative results following bacteriological analyses of patients' stool samples were available for only one foodborne outbreak. However, the incubation period and the type of symptoms of all the cases suggests a viral aetiology; a bacterial aetiology is unlikely.

The unusual rainfall and the flooding of waste water treatment plants were probably the source of contamination of the pond. The

oysters incriminated in the outbreaks came from three adjacent sites of the Etang de Thau. The identification of the same norovirus strain in oysters from two sites of the Etang de Thau reinforces the hypothesis that there was a common source of contamination.

A foodborne or waterborne source has been identified in a number of outbreaks of norovirus gastroenteritis (2). The epidemic potential of noroviruses is due to their principal reservoir being humans, faecal-oral transmission associated with a low infecting dose and their significant persistence in the environment (3). In France, the consumption of oysters and other raw shellfish has already been implicated in several foodborne outbreaks of norovirus (4, 5).

Following identification of bacterial contamination of the Thau pond and shellfish from the Thau pond, shell-fish farmers were asked, by decree, to place their shellfish in purification basins. This measure was only partially implemented due to a lack of purification facilities. There was no ban or withdrawal of the sale and consumption of batches of shellfish. Subsequently, there has been a change in the regulations for the classification of shellfish harvesting areas in France.

Faced with the risk of overflowing water purification plants and human faecal contamination of the Thau pond, the improvement and the reinforcement of prevention measures at every level, from production to consumption should be a priority (6). However, in the absence of specific indicators of viral contamination, consumers should be informed of the risk of contracting certain diseases if they consume raw or lightly cooked oysters. Finally, the Rapid Alert system for food and feed has shown its usefulness in the detection, in different member states, of foodborne outbreaks with a common source.

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