



A Family Clustered Nitrite Intoxication Investigation in Gaoxin District, Suzhou, China, 2013

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Abstract

Background: In April, 2013, a Suzhou Hospital reported a nitrite intoxication patient in coma as well as 2 family members with the similar symptom 5 days ahead. We investigated the event to identify the cause, source and possible pollution ways of the contamination.

Methods: We defined case as any person living in YSHY community who has cyanosis and with at least one of the following symptoms: dizziness, headache, fatigue, tachycardia, drowsiness, nausea, vomiting, abdominal pain or diarrhea during April 15 to April 25, 2013. We searched for case by interviewing community residents and reviewing clinics' medical records; information was then retrospectively collected on the patient's food history, cooking procedures and food sources.

Results: We identified 3 nitrite intoxication cases, 1 male and 2 female from a family. The interval time between dinner and onset was < 1 hour. Retrospective survey showed 'sugar stir and mix asparagus' on April 17 and 'scrambled asparagus' on April 21 were suspected foods. Both suspected dishes had 'sugar' added, sourced from a clean-up of a neighboring rental house. Nitrite was detected in a vomitus sample, the 'sugar' and two leftover food samples.

Conclusion: This family clustered nitrite intoxication was induced by using unidentified nitrite as sugar to cook dishes. We recommend sodium nitrite should be dyed with bright colors to avoid mistaking it for plain salt or sugar, health departments strengthen food hygiene propaganda to improve people's recognition of food safety, and to alert them the dangerous of eating unidentified or unknown source food.

Keywords: nitrite intoxication; family clustered; unidentified food; sugar

Introduction

On April 22, 2013, Suzhou University affiliated NO. 2 hospital reported to Suzhou Center for Disease Control and Prevention (SZCDC) a probable nitrite poisoning coma patient, and 2 family members of the patient had the similar toxic symptom 5 days ahead. We conducted an investigation to identify the cause of nitrite intoxication, the source of potential toxin, and possible pollu-

tion ways, and to recommend control measure to prevent likewise events in the future.

Materials and Methods

A case was defined as any person lived in YSHY community who had cyanoderma (lip, tongue tip, fingertip, conjunctiva, face or the whole body) and

with at least one of the following symptoms such as dizziness, headache, fatigue, tachycardia, drowsiness, nausea, vomit, abdominal pain or diarrhea from April 15 to April 25, 2013. Active case finding was conducted by interviewing residents in YSHY community and reviewing clinics' medical records.

We used a structured questionnaire which included questions on food and water exposure and other environmental factors, to collect information about patient's dinners before intoxication, specific cooking procedure of suspected food, and the source of feed and condiment.

We conducted in-depth interview with patients and their family members to learn the detailed dining information and activity during April 17 and April 21, especially focusing on dining information 12 hours before patients' clinical feature onset.

1 venous blood sample and 1 vomit sample were collected from the patient on April 21, we also collected 10g salt, 20g chicken powder, 15g 'sugar', 20g monosodium glutamate, 100g rare asparagus, 50g bacon, 150g remnant 'scrambled asparagus' and 100g remnant 'fried lettuce' of dinner on April 21 (Food on April 17 dinner was discarded and not collected). These samples were tested to ascertain the nitrite content or density by using Griess-saltzman method according to the Chinese national standard examination methods (GB/T-5009.33-2010).

Results

We finally identified 3 cases in YSHY community during April 15 and April 25, 2013. 3 cases included 1 male and 2 female, and they were from one family. Their clinical features included die blausucht (3/3), dizziness (3/3), tachycardia (3/3), nausea (3/3), vomit (1/3), unconsciousness (1/3) and coma (1/3).

Case A, case C (*mother of case A*) and Liu Sannan (LSN, *father of case A*) live in an apartment which is located at Building 107th in YSHY community, case B (daughter of case A) and Xie Lili (XLL, *mother of case B*) live in another apartment which is located at Building 116th in the same community. Case A and Xie used to be couple and divorced about 10 years ago, so their daughter case B lives with Xie but sometimes go to her father's apartment for dinner.

Case A named Liu Hongjiu (LHJ) is male, and 43 years old. He had dinner at 18:00 on April 17, about 50 minutes later; he appeared symptoms of lip cyanosis, dizziness, cardiopalmus, nausea and went to Suzhou NO. 7 People's Hospital for treatment, then he was transferred to Emergency Department of Suzhou University affiliated NO. 2 Hospital and was intravenous injected with 'methylene blue' (MB) for treatment, he was cured and discharged from hospital at 14:00 on April 18 (Fig. 1).

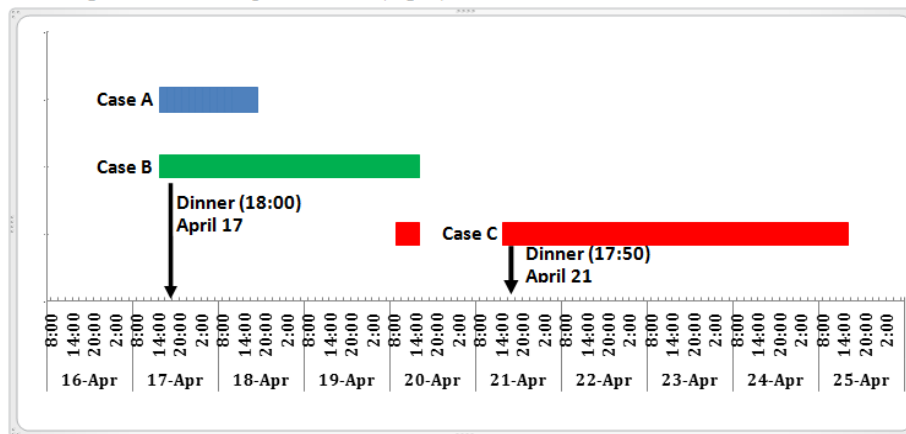


Fig. 1: Dinner time, case onset and treatment schematic diagram for a family clustered nitrite intoxication in Gaoxin district of Suzhou, Jiangsu, China, 2013

Case B named Liu Lingling (LLL) is the daughter of Case A, and is 21 years old. On April 17, she ate dinner with case A at 18:00, and went back to her mother's apartment. At about 19:00, she felt dizzy, nauseating, and with an accelerating heart beat, she phoned her father and went to Suzhou NO. 7 People's Hospital for treatment, then she was also transferred to Emergency Department of Suzhou University affiliated NO. 2 Hospital and received MB treatment by intravenous injection. She hospitalized 3 day in the hospital and discharged at 12:00 on April 20 (Fig. 1).

Case C named Chen Jifang (CJF) is the mother of case A, 68 years old. On April 20, she went to the hospital to meet her granddaughter case B, and was asked to see a doctor due to her lip cyanosis. After given Vitamin C intravenous drip treatment, she felt better and went back home. On April 21, she ate dinner at about 17:50, and about 40 minutes later she felt dizzy, nauseating, and then became unconsciousness, she was sent to Suzhou NO. 7 People's Hospital for treatment and went into coma, and then she was transferred to Suzhou University affiliated NO. 2 Hospital, she hospitalized in Intensive Care Unit (ICU) for 4 days and discharged at 13:00 on April 25, 2013 (Fig. 1).

As described in Fig. 2, we can figure out the specific dining information and physical activity of the 3 cases and their family member LSN clearly and easily during April 17 and April 21. According to characteristic of nitrite intoxication, a (or some) specific food at dinner on April 17 and April 21 were possibly polluted by nitrite.

On April 17, the dinner included 4 dishes (garlic stew pork, sugar stir and mix asparagus, scrambled asparagus and bacon bamboo shoot), LSN, CJF ate the other 3 dishes except for 'sugar stir and mix asparagus', while LLL and LHJ ate all 4 dishes and became sick in an hour, so 'sugar stir and mix asparagus' was the probable contaminated food. On April 21, LHJ, LSN and CJF had dinner together; there were only 2 dishes in that evening, the scrambled asparagus and the fried lettuce. All 3 of them ate the 2 dishes, but LHJ and LSN mainly ate the 'fried lettuce', while CJF ate mainly the 'scrambled asparagus' and mixed rice with soup of the scrambled asparagus, and then she became a victim later. So the 'scrambled asparagus' was the probable contaminated food.

In-depth interview revealed that LSN had helped neighbor cleaning rental house on April 15 and picked up a plastic bag of unmarked 'sugar' in bulk in the rental house and took back home as condiment. CJF used some 'sugar' to cook the dish of 'sugar stir and mix asparagus' on April 17 and the dish of 'scrambled asparagus' on April 21, but not for other dishes. LHJ told interviewer that he also added a few 'sugar' when he cooked lettuce on April 19 and fish on April 20.

In Table 1, we can see that 'sugar' is high density nitrite (714286 mg/kg), the nitrite content in remnant scrambled asparagus of April 21 dinner is 9071mg/kg, and 173 mg/kg in patient's vomit. The nitrite content in remnant fried lettuce of April 21 dinner is low, only 14 mg/kg. So mistakenly use nitrite as 'sugar' to cook food induces this family clustered nitrite intoxication event.

Table 1: Nitrite density in samples collected in a family clustered nitrite intoxication in Gaoxin district of Suzhou, Jiangsu, China, 2013

Sample ID	Sample Name	D(mg/kg)	Sample ID	Sample Name	D(mg/kg)
SZ0422F02	'sugar'	714286	SZ0422F06	Fried lettuce (remnant)	14
SZ0422F07	Scrambled asparagus (remnant)	9071	SZ0422F08	bacon	6.7
SZ0422F04	chicken powder	474	SZ0422F01	salt	2.2
SZ0422F10	Rare asparagus	187	SZ0422F05	monosodium glutamate	1.9
SZ0421B02	vomit	173	SZ0421B01	Venous blood	0.30

Note: D for density (mg/kg)

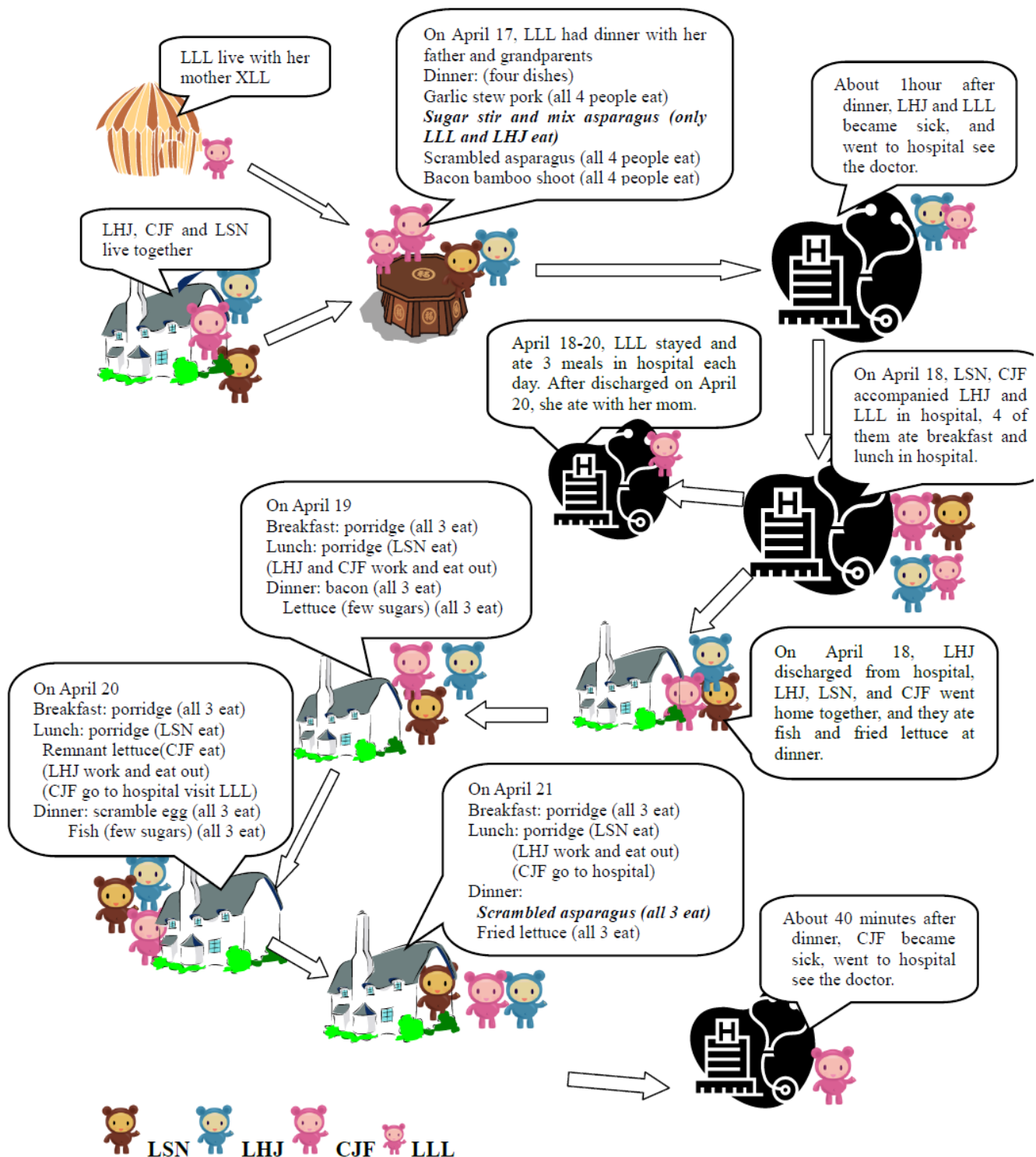


Fig. 2: Flowchart of specific dining and activities during April 17 and April 21 in a family clustered nitrite intoxication in Gaoxin district of Suzhou, Jiangsu, China, 2013

Discussion

Nitrite is the general term of a category of inorganic compound, mainly indicates the sodium nitrite. Sodium nitrite with the chemical formula NaNO_2 is a white to slight yellowish crystalline powder that is very soluble in water and is hygroscopic, and is widely used in industry and building construction (1, 2). But sodium nitrite is probably best known as a food additive to prevent botulism. In the early 1900s, sodium nitrite has been found to inhibit growth of disease-causing microorganisms; give taste and color to the meat; and inhibit lipid oxidation that leads to rancidity. So sodium nitrite is widely used as food additive in bacon, sausage and canned animal food due to its ability that led to production of meat with improved food safety, extended storage life and improving desirable color/taste (3),

While sodium nitrite will prevent the growth of bacteria, it can be toxic in high amounts for humans. Sodium nitrite's LD_{50} for human is 71 mg/kg, meaning a 65 kg person would likely have to consume at least 4.615g to result in death (4). Acute nitrite intoxication is commonly caused by intake as salt mistakenly or eating large amount of vegetables or meats which contain high content of nitrite (5, 6). Research demonstrates that acute nitrite intoxication occurs when a person intakes 200mg-500mg, the incubation period is 20 minutes to 3 hours, commonly within 1 hour. Victims will have clinical feature of dizziness, fatigue, tight-chest, nausea, vomit, cyanosis in lip, fingernail and skin, tachycardia, unconsciousness, coma, and even death if the intoxication is serious (7-10), that's because nitrite can cause methemoglobinemia, which will make red blood cell (RBC) losing the oxygen carrying ability and reduces the amount of oxygen that is released from hemoglobin.

In this investigation, we documented a family clustered nitrite intoxication caused by using nitrite as sugar to cook meals. The 'sugar' was proved as high density nitrite by lab test, and the nitrite content in suspected food 'scrambled asparagus' and patient's vomit were both quite high. In-depth interview illuminated that nitrite was used as sugar to cook the suspected food ('sugar

stir and mix asparagus' on April 17 and 'scrambled asparagus' on April 21).

It is unlikely that the city water supply is the cause of intoxication. City water is provided in the whole YSHY community, there is no case from other residents, so we assume that the city water is not associated with the outbreak. And it is unlikely that other food is the cause of nitrite intoxication, for cases have no other common food exposure before the intoxication onset.

As we have mentioned above, LHJ added a few 'sugar' when he cooked lettuce on April 19, and CJF ate the remnant lettuce (especially rice mixed with remnant lettuce soup) as lunch meal on April 20, this could explain why CJF was asked to see a doctor when she went to the hospital meeting her granddaughter LLL after her lunch. Unfortunately, she did not pay intensive attention to her illness, and the doctor also did not give her suggestion to take prevention measures or help her to find the nitrite source in the family, which lead to her serious intoxication on April 21. It is really a regret that some doctors in China only focus on work of singular patient treatment, but have no interest or insight to consider related patients together to explore the original source of some disease or the cause of some misfortune events.

It was clear that on April 17, LHJ and LLL ate the nitrite contaminated food 'sugar stir and mix asparagus' and became sick, while LSN and CJF were not attacked because both of them did not eat the contaminated food. On April 21, LHJ, LSN and CJF had dinner together, CJF ate mainly the nitrite contaminated 'scrambled asparagus' and mixed rice with the soup of the scrambled asparagus, and then became a victim. But LHJ and LSN were not attacked even though they ate some contaminated food, this possibly could be explained by the following reasons. First, LHJ mainly ate the 'fried lettuce' on April 21 which was not contaminated by nitrite, and he received 'methylene blue' treatment -the antidote of nitrite- 4 days ahead which might left some residues in his body, and could make his asymptomatic. Second, LSN mainly ate the 'fried lettuce' but a few nitrite contaminated food on April 21, so he could only intake very little nitrite during that meal, we also

learned by in-depth interview that LSN was 71 years old with medium Alzheimer's disease (AD), so it was understandable that LSN would less likely to tell the family member seven he had some mild intoxication symptoms.

In table 1, the nitrite content in chicken powder sample was 474 mg/kg which was quite high and exceeded the national standard of condiment. Environmental investigation showed that they shared one spoon to fetch the 'sugar' and 'chicken powder' in the kitchen, so some nitrite might fall into and pollute the chicken powder when the spoon was used alternately. The nitrite content in rare asparagus sample was 187 mg/kg, because the rare asparagus was pretreated with the sugar by CJF on April 21.

The limitation of this investigation is that we can't acquire the original source of the nitrite picked by LSN on April 15, because the rental house is sold and the pre-house renter contacting information is lost by the household, which makes it unreachable. In recent years, nitrite intoxication happens frequently in China although lots of propagandas are launched. This is probably related to its characteristic that sodium nitrite has the similar appearance with salt, sugar and things alike, tastes salty and being widely used as food additive. In China, people can buy sodium nitrite easily from chemical store or company without any special certification or prove; residents have little knowledge on sodium nitrite and are unaware of the potential harm; and the regulation, surveillance and supervision work are also quite weak. So we recommend that sodium nitrite should be dyed with bright colors such as red, blue, yellow to avoid mistaking it for plain salt or sugar. Health departments should carry out health education and health promotion on food hygiene and food safety, especially in rural areas, to improve residents' knowledge and awareness. Food and Drug Administration (FDA) should strengthen the supervision of sodium nitrite in the market, strictly manage and control sodium nitrite use for industry use and food additive, and force nitrite industries adding obvious danger warning label on the package, to reduce the hidden dangerous of nitrite.

Conclusion

This family cluster of nitrite poisoning resulted from the mistaken use of nitrite as sugar to cook dishes.

Ethical considerations

Ethical issues (Including plagiarism, Informed Consent, misconduct, data fabrication and/or falsification, double publication and/or submission, redundancy, etc.) have been completely observed by the authors.

Acknowledgements

The authors declare that they have no competing interests.

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