

**Epidemiology  
& Public Health  
Bulletin**

- 115 A Snail Poisoning  
Outbreak in Fangliao,  
Pingtung County
- 123 Cases of Notifiable and  
Reportable Diseases,  
Taiwan-Fukien Area

## A Snail Poisoning Outbreak in Fangliao, Pingtung County

### 1. Introduction

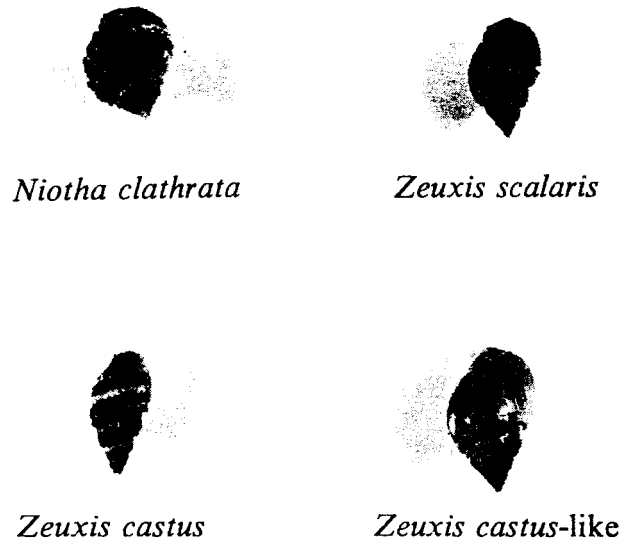
On 12 May 1993, seven residents of Fangliao Township, Pingtung County, were admitted to hospital for dizziness and such neuro-symptoms as perioral numbness and numbness of extremities. One patient was placed under Intensive Care Unit care for respiratory failure. All had eaten a snail, *Nassa livescens* Phil. To better identify and describe the source of poisoning for future prevention, an investigation was made.

*Nassa livescens* Phil., a species of *Nassarriidae*, is a sea-water gastropod mollusk. Four species are commonly found in Taiwan: *Niotha clathrata*, *Zeuxis scalaris*, *Zeuxis castus*, and *Zeuxis castus*-like<sup>(1)</sup>. Hwang et al., during August 1989 and July 1990, studied the four species for a year, and discovered that, with the exception of *Zeuxis castus*, the other three snails carried weak-to-moderate tetrodotoxin ranging from 2 to 1,900 MU (mouse unit) and a new neurotoxin. The toxin appeared in 62% of *Niotha clathrata*, 93% of *Zeuxis scalaris*, 41.4% of *Zeuxis castus*-like, and 0% of *Zeuxis castus*. The amount of toxin and even its existence varied from place to place. The toxicity of *Niotha clathrata* for instance, varies seasonally; it is higher in spring and autumn<sup>(1-3)</sup>.

Tetrodotoxin is a heat-stable, nonprotein neurotoxin<sup>(4)</sup>, and had been thought to exist only in toadfishes. The toxin has now been identified in squillas, newts, South American frogs, octopuses, snails and crabs<sup>(1-6)</sup>. Symptoms of tetrodotoxin poisoning are mild headache, nausea, vomiting, numbness or stinging (mouth, tongue and extremities), dizziness, weakness, a floating feeling, loss of coordination, drooling, swallowing difficulty, plus respiratory failure, hypotension and slow heartbeat in severe cases. The incubation period can be about three hours, but more usually is within 10 to 45 minutes. Manifestation of symptoms and the incubation period vary with the amount of toxins ingested<sup>(6,10,11)</sup>. Prognosis is good if the patient survives for 18 to 24 hours<sup>(6)</sup>. Tetrodotoxin poisoning has been reported in Japan, Taiwan and Thailand, primarily from toxins of fugu or fishes of unknown species<sup>(1,7-9)</sup>. Incidents of tetrodotoxin poisoning

from snails, however, have never been reported.

**Figure 1. Four Species of *Nassa livescens* Phil.  
Commonly Found in Taiwan**



## 2. Background Information

Fangliao Township of Pingtung County has 15 villages (see Figure 2), with a total population of 31,376 persons. The hospitals often used are the Fangliao Private Hospital and the Young's Private General Hospital. The cases in the present investigation came from the three coastal villages of Paosheng, Anlo and Fangliao. Residents are mostly farmers and fishermen; some also collect snails. Pike eels are placed in bamboo cages of 10 cm in diameter and 3 cm in depth as bait. The cages are placed off-shore to catch snails, sometimes *Nassa livescens* Phil. as well. The snails collected are consumed, given to friends and relatives and sometimes sold.

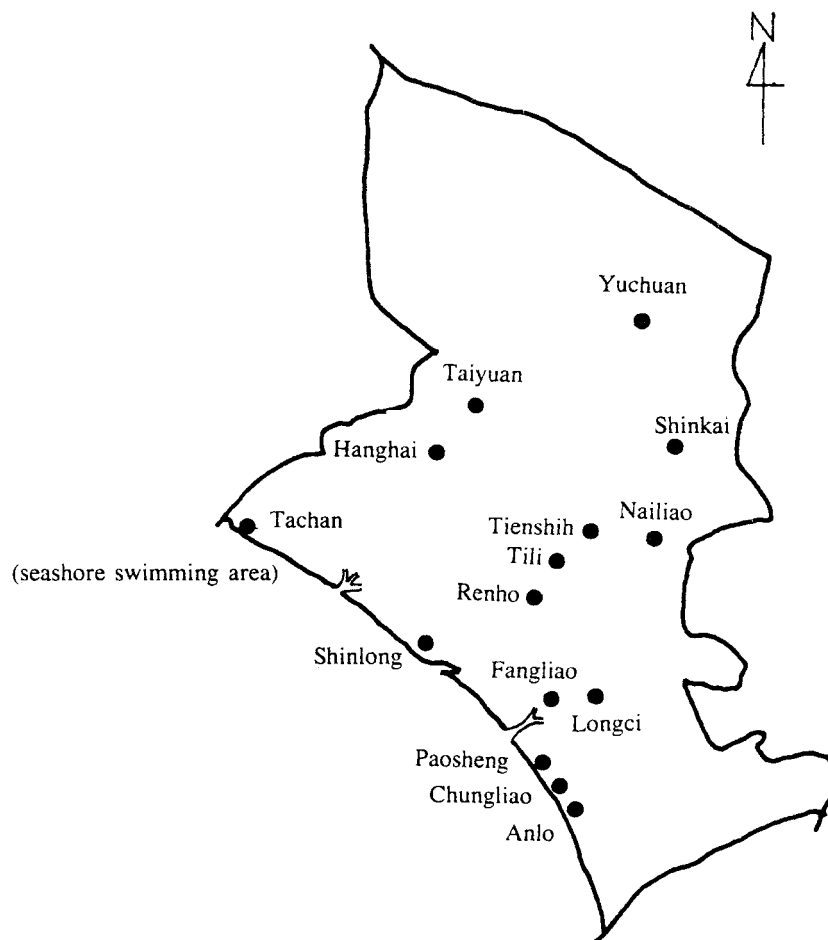
## 3. Materials and Methods

Survey Method and Target Population:

A structured questionnaire was used to interview by telephone or in person cases

identified by the hospitals, the health station or individuals who met the case definition. Information requested concerned personal background, family size, number of family members who had eaten the snails, number of patients in the family, the time the snails were taken, the time of onset, quantity of snails consumed, and description of symptoms. To determine the incidence of poisoning, 30 households each were randomly selected from Paosheng (244 households), Chungliao (350 households) and Anlo (506 households) villages for interview.

**Figure 2. Map of Fangliao Township, Pingtung County**



**Case Definition:**

Any resident of Fangliao Township who became ill between 23 April and 12 May 1993 with one of these two symptoms:

- 1) perioral numbness; or
- 2) numbness of extremities plus one of the following:
  - (1) dizziness
  - (2) nausea
  - (3) vomiting
  - (4) staggering
  - (5) vertigo

Data Processing: tested with  $\chi^2$  test.

**Laboratory Testings:**

At the Marine and Oceanic University, Professor D. F. Hwang tested the snail by bioassay and High Performance Liquid Chromatography (HPLC) for toxic component

**4. Findings**

Through the Fangliao Hospital, Young's Private General Hospital, the Health Station and by home visits, 17 cases were identified. They ranged in age from 12 to 71 years, with a male-female ratio of 7:10; 8 of the them live in Paosheng, 2 live in Fangliao and 7, from Anlo. The incubation period ranged from 1 to 12 hours, with 5 cases becoming ill within 3 hours. Symptoms included perioral numbness (88.2%), dizziness (82.4%), staggering (70.6%), nausea (70.6%), vertigo (52.9%), numbness of the lower limbs (47.1%), and vomiting (41.2%) (see Table 1). Of the 12 who were measured for blood pressure, 8 had a blood pressure of higher than 150/90. The snails had been boiled and from 50 to 200 pieces were eaten at one time. Analysis of the 17 cases and their family members showed that eating snails was significantly related to the incidence ( $p < 0.00$ ) at an odd ratio of 85 (see Table 2). The attack rate was found to be between 0% and 100%.

From the community 8,290 questionnaires (91.11%) were returned from the community, without significant difference in return rate among the three villages. Of the 334 samples selected from the three villages, 13 had eaten the snails between 23 April and 12 May, only 1 of them had developed mild symptoms. Through adjustment by population, the snail consumption rate was found to be 4.2%, the attack rate to be 7.7%, and the prevalence rate, 0.3%. At these rates, of the total 5,338 population of the three villages, estimates were that 224 persons had eaten the snails and 17 had been poisoned. By analysis of the randomly selected residents, eating snails was significantly related to the illness ( $p < 0.001$ ) at an odd ratio of 77 (see Table 3)

**Table 1. Distribution of Symptoms**

Symptoms	No.	%
	N=17	100.0
Perioral numbness	15	88.2
Dizziness	14	82.3
Numbness of upper limbs	13	76.5
Staggering	12	70.6
Nausea	12	70.6
Vertigo	9	52.9
Numbness of lower limbs	8	47.1
Vomiting	7	41.2

**Table 2. Snail Consumption and Posioning  
(17 Cases and Family Members)**

Became Ill		Not Ill		p value	OR
Eaten	Not eaten	Eaten	Not eaten		
17	0	10	25	0.000*	85

\* P&lt;0.001.

**Table 3. Snail Consumption and Posioning  
(Analysis of Community Survey)**

Became Ill		Not Ill		p value	OR
Eaten	Not eaten	Eaten	Not eaten		
1	0	12	321	<0.001	77

The consumption rates of the snails differed significantly in the three villages (see Table 4). No one in Chungliao Village had eaten the snails in the last two months; no one was poisoned.

Laboratory testing showed that the snails contained tetrodotoxin at  $150 \pm 40$  MU.

**Table 4. Consumption of Snails in Three Villages**

	Paosheng N=104	Chungliao N=112	Anlo N=118	p value
Eaten	9	0	4	0.0042
Not eaten	95	112	114	

## 5. Discussion

Hospital records showed that cases ranged in age from 12 to 71 years with varied occupations (students, farmers, laundry shop owner and housewives). No clustering of patients was noticed. All cases had taken the snails before becoming ill; none of the family members who had not taken the snails became ill. Symptoms were perioral numbness, dizziness, numbness of upper and lower limbs, and staggering. Laboratory testing identified tetrodotoxin in the snails. The snails were considered to be the source of poisoning.

For community survey, Paosheng, Chungliao and Anlo villages were selected purposely because most cases came from paosheng and Anlo villages, yet in Chungliao village close to the other two villages no case was found.

Studies of the 17 cases, their families and the community showed that the snails (*Niotha clathrata* and *Zeuxis scalaris* in this case) were the sources of poisoning. Though Chungliao village is next to Anlo and Paosheng villages, no cases were found. Community survey showed that residents of Chungliao are generally not fond of eating the snails, and no one in the past two months had taken any. This fact may indirectly support the finding here that the snails were the source of poisoning.

The said snails contain tetrodotoxin. The amount of toxin is higher in snails found in the coastal areas of Kaohsiung and Pingtung, and in spring and autumn<sup>(1-3)</sup>. Both factors correspond with the time and place of the present incident. Tetrodotoxin at  $150 \pm 40$  MU was identified in the snails tested, using HPLC by Prof Hwang. Symptoms, with the exception of higher blood pressure, are in line with the symptoms of tetrodotoxin poisoning. Deng et al. in their 1991 report on tetrodotoxin poisoning, found 8 of the 30 cases (27%) studied to be hypertensive, and maintained that hypertension,

particularly for hypertensive individuals, should also be considered one of the symptoms<sup>(7)</sup>. The hypertension rate of the present investigation was 67% higher than that of Deng's. However, cases in the present investigation were measured for their initial blood pressure only, further investigation is needed. The incubation period of 1 to 12 hours, and only 5 cases within 3 hours, of the present investigation were longer than the 3 hours of many reports<sup>(6,10,11)</sup>. Probable reasons are: 1) the amount of toxins consumed was not large; 2) most individuals consumed the snails either at dinner or after dinner, and the onset of symptoms started after going to bed; measuring either did not notice the onset nor the time of onset; 3) toxicity of tetrodotoxin in the human body is reduced either by heating or by food additives such as salt<sup>(12)</sup>. Data show that the attack rates ranged from 0 to 100%, depending upon the quantity of snails consumed, the amount of toxin contained in each snail, and the sites from which snails were collected. Each snail contains different amount of toxin<sup>(2,3)</sup>; estimates of the amount of toxin intake, based on the number of snails consumed can be wrong. If, however, the amount of toxin in each snail is estimated at 150 MU, and each patient had taken 50 to 200 snails at one time, the total amount of toxin intaken would be 7,500 to 30,000 MU. With heating and food additives such as salt, the residual amount of toxin should not exceed the lethal amount of 10,000 MU for tetrodotoxin<sup>(13)</sup>. Therefore, with the exception of the 71-year old diabetic patient who had been admitted to the ICU for respiratory failure, no one death was reported.

Though it was epidemiologically established that the snails in question were the source of poisoning and that the snails in fact contained tetrodotoxin<sup>(2,3)</sup>, snail consumption has been popular among the villagers for years, why is it that no snail poisoning has previously been reported? Not unlikely reasons are: 1) local fishermen reported the enlarger catch of snails this year than previously. Allowing more snails available for consumption by more people; sporadic cases in the past would have been overlooked, with one seriously ill patient admitted to an ICU, more attention was given to the poisoning; 2) the amount of toxin contained in the snails collected this year was higher; although taken from the same waters, the amount of toxin in the snails collected from different sites could be different. While no incidents of tetrodotoxin poisoning from snail consumption have been reported in Taiwan, the possibilities of snails being contaminated by some substances in the water or contaminated by some toxins in the process of catching must also be considered.

The average amount of toxin in each snail was  $150 \pm 40$  MU. Cases who had developed mild symptoms by consuming small amount of snails may not have visited hospitals for care. The actual number of cases could well have been more than 17.

## 6. Limitation of Investigation

Though the community survey estimated that the number of persons who had consumed the snails in the past two months was 224 and that 17 of them had developed symptoms, only 30 households were selected for study from each village. Whether the sample size was adequate remains to be evaluated.

## 7. Recommendations

Some villagers of Fangliao Township are fond of snails. The Health Station has been urged to educate the public, particularly residents of Paosheng Village, fishermen and their relatives, to the possibility of poisoning from eating snails and to discourage this practice.

## Acknowledgement

The assistance of the Toxic Substances Center of the Veterans' General Hospital, the Fangliao Health Station and the Bureau of Food Sanitation is highly appreciated.

**Prepared by:** H.F. Wei, P.H. Wu, T.Y. Chao, K.T. Chen, D.F. Hwang, C.B. Hornig

**Reported by:** Fangliao Health Station, Bureau of Food Sanitation of DOH, and National Institute of Preventive Medicine of DOH

**Laboratory testing by:** the Marine and Oceanic University Laboratory, the National Laboratories of Foods and Drugs

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