

Investigation of Foodborne Illness Caused by Chlorpyrifos among Two Families in a Community in South Tongu District of Ghana

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ABSTRACT

Objective: On 2nd March 2018, eight people of two households in Akakpokope in South Tongu district of Volta region were admitted to the South Tongu district hospital after eating banku and okro soup, a local diet on 27th February 2018. We investigated the food poisoning to assess the magnitude of the problem, identify the causative agent and instituted control measures.

Methods: We conducted descriptive investigations, active case search and environmental health survey. We constructed a simple case definition to guide case finding as “any person who ate banku and okro soup on 27th February, 2018 at Akakpokofe and had developed abdominal pains and vomiting”.

Leftover food sample from the home of the affected patients was taken to Food and Drugs Authority to determine cause of the food poisoning. A blood sample from the index case was also sent to the Poison Centre in Accra.

Results: The blood sample of the index case and leftover food contain chlorpyrifos, an organophosphate pesticide used for agricultural purposes. Patients delayed three days before seeking health care contributing to high mortality of 75% among them.

Conclusion: The cause of the food poisoning was due to chlorpyrifos contaminating food eaten by the two households. However, how the food got contaminated was undetermined during the investigation.

Keywords: Food poisoning; Foodborne diseases; Chlorpyrifos; Organophosphates; Pesticides

INTRODUCTION

Access to sufficient amounts of safe and nutritious food is key to sustaining life and promoting good health however, unsafe food containing harmful bacteria, viruses, parasites or chemical substances contribute immensely to morbidity and mortality globally (World Health Organization, 2017). Foodborne diseases most commonly referred to as food poisoning comprises of a broad group of illnesses caused by enteric pathogens, parasites, chemical contaminants and bio toxins (WHO, 2007) (World Health Organization, 2015). There are more than 250 different foodborne illnesses caused by various pathogens or by toxins.

The most common clinical presentation of foodborne disease consists mainly of gastrointestinal symptoms; however, neurological, gynecological, immunological and other symptoms may also be experienced (World Health Organization, 2015). Chemical contamination can lead to acute poisoning or long-term diseases, such as cancer (World Health Organization, 2017). Estimated 600 million people (1 in 10 people) become ill annually after ingesting contaminated food resulting in 420,000 deaths globally (World Health Organization, 2017) (World Health Organization, Foodborne Disease Burden Epidemiology). Most of these foodborne illnesses were due to diarrhea causing disease agents. Although foodborne illnesses cause substantial

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morbidity in developed countries, the main burden is borne by developing countries. This is attributable to the use of unsafe water for cleaning and processing of food, poor food-production processes food-handling and inappropriate use of agricultural chemicals (WHO, 2015). Coupled with these are the absence of adequate food storage infrastructure and inadequate or poorly enforced regulatory standards (WHO, 2015).

In Ghana, the actual burden of food borne illnesses is unknown. However, the Ministry of Food and Agriculture and the World Bank (2007) estimated 1 in every 40 Ghanaian suffer serious food borne illness per year, 420,000 cases were reported with an annual death rate of 65,000 [1]. According to the Food and Drugs Authority (FDA) Report of 2006, 297,104 people reported to health facilities with food and hygiene-related illnesses with associated 90,692 deaths and productivity loss of approximately 594,279 days (19,809 months).

Studies conducted on food borne diseases in Ghana were scanty and concentrated in the capital cities [1]. Although all food hazards are detrimental to the health of consumers and require monitoring and control in the country, studies conducted so far were mainly on the commercial food sector with special focus on street foods [1]. Current studies mostly highlighted microbiological hazards on ready to eat foods and chemical hazards on pesticides from agricultural products including fresh vegetables and fruits [2]. The most predominant bacteria contaminating Ghanaian foods found in these studies were *Enterobacter spp*, *Citrobacter spp*, *Klebsiella spp*, *Shigella spp* and *Escherichia spp*. Food items found with unacceptable levels of contamination with microbial were salads, macaroni, fufu, omo tuo, red pepper and tomato stew. Pesticides are used mostly by farmers in Ghana especially for controlling weeds, pests, and preservation of harvested crops [3]. However, they are inappropriately applied leading to high level of residues of these pesticides in vegetables. Residue analysis detected the presence of chlorpyrifos, DDT, cypermethrin, and dimethoate in shallots, with levels of chlorpyrifos exceeding the codex maximum residue level in most samples [2,4].

Chlorpyrifos is a broad-spectrum, chlorinated Organophosphate insecticide, acaricide and nematicide. Chlorpyrifos is the common name for the chemical 0,0-diethyl 0-(3,5,6-trichloro-2-pyridinyl)-phosphorothioate. It can cause cholinesterase inhibition in humans by causing a whole host of symptoms, including headache, nausea, dizziness, confusion, vomiting, abdominal pain and diarrhea. At very high exposures they can cause an overstimulated nervous system causing respiratory paralysis and death. Prompt diagnosis and treatment including general supportive measures and use of specific pharmacological agents such as atropine and oximes are necessary to avoid adverse outcomes. The chlorpyrifos causes ten of thousand deaths per year worldwide [5]. In recent times several episodes of food poisoning have been reported with Ghanaian media with high mortality and morbidity alleged to be associated with improper use of chemicals and pesticides used for farming.

Nature of the problem

On the 2nd of March, 2018, two households of eight people at Akakpokope, a community about 7 km from Sogakope were

admitted to the Sogakope district hospital following complaints of abdominal pain, vomiting, restlessness and general weakness after they had a meal of banku made from a mixture of grains (corn mill flour) with okro soup on the 27th February, 2018. This was reported to the South Tongu District Health Directorate, the Public Health Authority in the district. Investigations were undertaken with support of Regional Health Directorate, Food and Drug Authority and Environmental Health Unit of the South Tongu district assembly, to assess the magnitude of the problem, identify the causative agent and to institute control and preventive measures.

MATERIALS AND METHODS

We conducted investigation of a foodborne disease among two households in a village called Akakpokope, 7 km from Sogakope after ingestion of a local staple food, banku and okro soup. The affected family members reported to the South Tongu district hospital at Sogakope, the capital of the South Tongu district in the Volta region of Ghana on 2nd March, 2018 with complaints of abdominal pain, vomiting, restlessness and weakness after eating banku and okro soup on 27th February, 2018.

Study area

South Tongu district is located in the southern part of the Volta region of Ghana. It occupies an area of about 643.57 square Km. It shares boundaries with central Tongu, Keta, Akatsi South and North Tongu districts. The district has six sub-districts namely Agorta-Gamenu, Dabala-Adutor, Sogakope, Dorkplorme, Sotewu and Dordokope with a total population of 106,997.

The district has 27 health facilities consisting of two hospitals, four health centers, 18 Community Based Health Planning Services (CHPS), one Planned Parenthood Association of Ghana (PPAG) Clinic and two private facilities.

The disease control system in the district was run by the Disease Control Unit of Ghana Health Service and the Environmental Health Unit of the District Assembly. The Disease Control Unit in the district is responsible for investigation and control of public health emergencies. Additionally, it is responsible for conducting public health surveillance for notifiable diseases and providing health education to alleviate public health emergencies. The main occupation of the people is farming and trading. South Tongu district had two rainy seasons; the major season is from March to June and the minor season, from September to October. The Volta River runs through the district and the construction of the lower volta bridge provides link between the west and east by the Accra-Aflao road.

Study design

We interviewed key informants in the district to obtain information on the foodborne disease and collected preliminary data on those who were affected. We constructed a simple case definition to guide case finding as “anybody who ate banku and okro soup on 27th February, 2018 and had developed abdominal pains and vomiting”.

An epidemiological case sheet was developed for collecting information on demographic characteristics of case-patients, date and time of onset of illness and time of reporting to the district hospital, food items eaten and presenting symptoms. A line listing of all case-patients was also done.

All cases that reported to the hospital on 2nd March, 2018, were traced and their relevant details were obtained. Case search was also conducted for additional cases in the surrounding communities using the case definition and individuals with similar symptoms within the same period. All cases were followed up till the outcome of illness. All community members who milled grains within five days using the same corn mill as case-patients were all interviewed for similar signs and symptoms of illness reported by cases.

Laboratory investigations

Food samples from the homes of the affected victims had been taken to Food and Drugs Authority for investigations and confirmation. A blood sample from the index case was also sent to the Poison Centre in Accra.

Environmental survey

After reviewing the descriptive data and hypothesis generation interviews the food poisoning pointed to contamination of corn flour that was used to prepare banku that was eaten on 27th February, 2018. An environmental survey was conducted to assess the hygiene and sanitation of all the communities including Lakpo, Abusakope, Kahokope and Lakpo junction which used the corn mill machine at Akakpokope to grind their maize.

Data analysis and ethical considerations

The investigation was authorized by the Regional Health Directorate and conducted in collaboration with the district public health officials after obtaining authorization from local government authorities. Verbal consent was obtained from the case-patients. Privacy, confidentiality and rights of patients were ensured during and after the conduct of the study. Oral informed consent was obtained from each case after detailed explanation of the objectives of the investigation of the existence of the foodborne disease and the planned use of the information. The data collected were analyzed anonymously.

RESULTS

Descriptive epidemiology

On 2nd March, 2018 eight people from two households at Akakpokope, were admitted with complaints of mainly of abdominal pains, vomiting and general bodily weakness after eating banku with okro soup on the 27th February, 2018.

The index case was a 44 years old male who owned and operated a corn-mill machine on regular basis in the community for several years without any incident. His corn-mill was the only one in the community and was also patronized by four other nearby communities. He usually used the corn flour residue

from the corn-mill for preparing banku and on several occasions sold some to his community members. On 27th February, 2018, after the close of work, he milled some millet which was given to him by his sister with the corn flour residue and used it in preparing banku. The banku was eaten with okro soup which was also prepared that same day by the two households consisting of eight people. However, the okro soup was shared with a lady who was also a resident from the same community. The lady and her household (consisting of six members) ate the okro soup with banku she prepared herself with her own corn flour. No member of her household was throughout the period of the investigation.

The index case presented with abdominal pain, vomiting and general weakness which started on 28th February, 2018 but reported to the South Tongu district hospital on 2nd March, 2018. All the other seven members of the two households who ate the same banku with okro soup also became ill on same day but reported on 2nd March 2018 to the South Tongu district hospital. There was three days delay before presentation at the district hospital. The main symptoms presented by the cases were mainly gastrointestinal and neurological. All the eight cases presented with vomiting, seven with abdominal pains, three with general weakness and only one of the case-patients had seizures and restlessness. Among the seven cases who presented with vomiting one had blood in her vomitus.

The eight cases were made up of six females and two males. Among them were five children under fifteen years (their ages were 7, 9, 10, 12 and 13 years) and three adults of which two were 44 and one was 45 years old.

We observed a point common source exposure as shown in Figure 1 with peak incidence on 28th February 2018 a day after consumption of contaminated food. Six of the cases died within three days after admission despite supportive treatment and antibiotics. The two cases that survived were the index case and a nine year old female who was his daughter. The survivors developed jaundice with mild to moderate derangement in liver functions which resolved on conservative management.

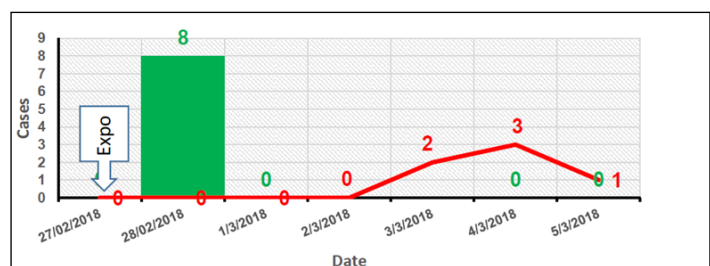


Figure 1: Epicurve of food poisoning cases at Akakpokope, South Tongu district from 27th February to 5th March 2018.

Note: ■ Date of onset, — Number of deaths.

Laboratory results received from Ghana Poison Centre detected 0.027 mg/L of chlorpyrifos in the blood sample of the index case. This was corroborated by the results from the Ghana Standard Authority (GSA) which showed the presence of chlorpyrifos in the banku sample, confirming the initial laboratory analysis conducted by the Food and Drug Authority

(FDA) Quality Control Laboratory. Chlorpyrifos is a very toxic substance found in commonly used pesticides which when ingested can cause death. The test results from Noguchi Memorial Institute of Medical Research was negative for Lassa fever and other haemorrhagic fevers.

Environmental survey

Akakpokope and its surrounding four communities have pipe borne and borehole water which were mostly available for domestic use. Liquid and solid waste was appropriately disposed with all the communities visited looking fairly neat.

The inhabitants of Akakpokofe and surrounding communities were mainly farmers growing crops like maize and okro. The most common pesticides used for agricultural purposes were chlorpyrifos (sunpyrifos) and phostoxin tablets for storage of maize. The index case alleged he undertook only subsistence maize farming and neither use herbicide in farming nor store maize with any chemical.

DISCUSSION

Chlorpyrifos and other organophosphate commonly used for agricultural purposes in Ghana, have contributed immensely in increasing food supply and improvement in public health. However, it has caused tremendous harm to the environment as a results of inappropriate use of pesticides by farmers with consequent contamination of water bodies, fish, vegetables, food and soil [3,6-8]. It is evident from biological monitoring studies that farmers are at higher risk for acute and chronic health effects associated with pesticides due to occupational exposure but the general public who patronized agricultural products and ready to eat foods are similarly at risk [6]. Because residues of chlorpyrifos and other pesticides have been found in variable amounts in vegetables and other food crops sometimes exceeding acceptable levels [2,4]. However, direct contamination of food prepared in the home by chlorpyrifos was unknown in Ghana. We found banku diet eaten by the two household of eight and blood sample from the index case containing chlorpyrifos. How the food became contaminated by chlorpyrifos remained undetermined. The index case alleged he never use organophosphate pesticides in farming and storing grains. Recently, there have been several reports of deaths attributed to pesticide poisoning including 15 farmers in Upper East Region and 17 out of 28 persons from various farming communities in the East Mamprusi District of the Northern Region due to inappropriate use of chemicals and pesticides for farming. Most of these deaths may have resulted from poor storage of pesticides, which seeped into food stocks. Furthermore, some deaths considered "natural" among Ghanaian farmers might be related to inappropriate pesticide use since poisonings are hard to diagnose and routine investigations for poisons are usually not performed for suspected foodborne diseases.

The results showed that the patients delayed 72 hours before reporting to the hospital compared to four hours observed in

other studies [9]. This might have contributed to the high mortality rate of 75% (6/8) observed. Time is of essence in organophosphate poisoning, early reporting, rapid diagnosis and instituting prompt and effective interventions reduce complications and mortality [9,10]. The patients presented to the hospital when their conditions were severe since most of them were weak and restless before admission. It was noted that the organophosphate poisoning from unintentional ingestion was rarity in South Tongu district. However, intentional poisoning from DDT, a known organochloride is occasionally encountered and managed in the district hospital nevertheless, less than three cases were seen per year.

CONCLUSION

Unintentional and accidental ingestion of food contaminated by chlorpyrifos containing pesticides and other organophosphates commonly used in is real. Health education of farmers and community members on appropriate use of pesticides would reduce morbidity and mortality due to accidental ingestion of food contaminated by pesticides. Enforcement of laws and policies on appropriate use of pesticides would also ensure protection of life. Unintentional ingestion of pesticides should be considered in all cases of food poisoning to avoid delay in instituting appropriate intervention.

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