The First Fatal Case of Yam Bean and Rotenone Toxicity in Thailand

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The first fatal case of Yam bean and Rotenone toxicity in Thailand was studied at Forensic Medicine, Chiang Mai, Thailand. A Chinese Taiwan man, 59 years old, was found dead after Yam bean ingestion. Yam bean toxicity and death have been found very rarely in the world and has not been reported in Thailand. The Yam bean plant is grown widely in Northern Thailand. But many people know that mature pods, seeds and filage of the Yam bean, except the tuberous root, are very toxic. The victim ate a lot of Yam bean seeds and died within 2 hours with respiratory failure. The authors detected Rotenone substance in Yam bean seeds, gastric content and 72 ng/ml blood by HPLC. Also generalized microscopic hemorrhage in the brain, lungs, liver and adrenal glands which were of characteristic pathology were detected. The authors concluded that the cause of death was asphyxia from Yam bean or Rotenone toxicity.

Keywords: *Yam bean, Rotenone, HPLC, Asphyxia, Hemorrhage*

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Yam bean (Pachyrhizus erosus Urb) is grown widely in the Northern part of Thailand. Yam bean is a papilionacar specy, known as Derris elliptica, Lonchocarpus utilis and L. urucu. It has a crisp texture or crop, round roots, 3 leaves in each group, violet or dark blue flower and 5-15 cms. A hairy pod contains yellow or brown seeds (Fig. 1). The common names of the plant are tubatoxin, tuba root, derris root or cuba root. Mature pods and seeds are very toxic and contain a lot of toxic substances such as pachyrrhizine, pachyrrhizone,12-(A)-hydropachyrrhizone, dolineone, dehydropachyrrhizone, erosone, neodehydroraute-none, erosenone, erosenin, 12-(A)-hydroxylinenone, pachysaponin A&B[1] Rotenone ($C_{23}H_{22}O_6$). Toxicities cause nausea, vomiting, abdominal pain, gastritis, headache, hemolysis, rash, respiratory failure, cardiac arrest and death. Rotenone is the most important toxic substance in Yam bean or Derris roots. Rotenone is colourless, crystalline solid, has low solubility in water but high solubility in acetone, ethyl acetate and chloroform. It is formulated as pesticides and for fish killing, both natural and commercial products. However, these toxic effects have not been reported in exposed humans or ingestion. The fatal case of Rotenone or Yam bean toxicity is very rare in humans. Rotenone must be used carefully because it will kill a lot of fish within 24-36 hours and contaminate the water source for a long time. Some fish are resistant to Rotenone and require a higher dose to kill them, for example bullheads, goldfish and bowfin. Rotenone, specifically blocks NADH ubiquinone reductase in the electron transport system in mitochondria. The result shows cellular anoxia and cell death later in

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Fig. 1 Shows Yam Bean seeds and a hairy pod

mammals, fish, amphibians, insects and plants. But fish and insects are very highly susceptible to the toxicity because Rotenone is fat soluble and has rapid absorption to the blood system and tissues. However, it is not well absorbed by the gastrointestinal tract of humans.

Rotenone is classified as a moderately hazardous class II by WHO and LD_{50} 132 mg/Kg[2,3]. It is moderately toxic to humans within an oral lethal dose, 300-500 mg/kg body weight[4] or about 200 grams in adults[7]. However, Rotenone irritates the gastrointestinal tract, bronchus, conjunctiva and skin. It causes vomiting, cough, dyspnea, conjunctivitis, dermatitis, convulsion and respiratory failure[3]. Human fatalities are very rare. Rotenone is rapidly broken down in soil and water. Its half life in soil and water is between 1 and 3 days[5]. Rotenone is metabolized by the mammalian liver and eliminated mostly in the feces. There is no evidence for carcinogenic, genotoxic or teratogenic action. There is no specific antidote, so supportive and symptomatic treatment are required. No evidence of chronic toxicity has been seen in humans.

Case Report

A Chinese Taiwan man was brought to the local and provincial hospital in Chiang Rai, Thailand. The chief complaint was unconsciousness 1-2 hours after 100 Yam bean seeds or 100 grams ingestion. In the emergency room, his status was absent heart beat, fixed pupils, unconsciousness and respiratory and cardiac arrest. He died after emergency treatment. An autopsy was performed at the Forensic Department, Faculty of Medicine, Chiang Mai, Thailand.

The autopsy finding: The most significant postmortem findings were:

1. There are central cyanosis on the lips and gums.
2. There are a lot of "Yam bean seeds" in the stomach (Fig. 2).
3. There is moderated brain edema, focal hemorrhage and anoxic neuronal changes with hypotrophy.
4. There is cardiac hypertrophy, 498 grams and focal subepicardial hemorrhage, 20% occlusion of left anterior descending coronary artery due to atherosclerosis and left ventricular wall was 1.6 cms in thickness.
5. There is bilateral pulmonary edema and focal hemorrhage.
6. There is focal adrenal cortical hemorrhage and mild degree of fatty liver.
7. Histological alterations of multiorgans were;

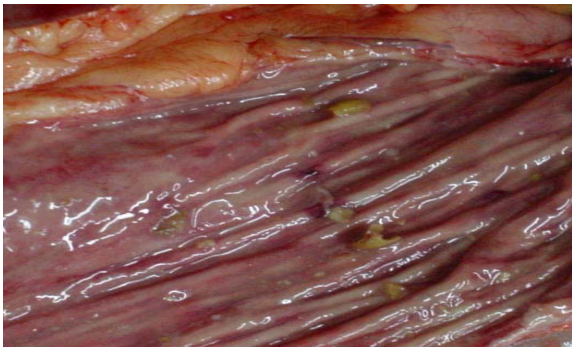

Fig. 2 There are a lot of Yam Bean seeds in the stomach

- subarachnoid hemorrhage and anoxic neuronal change.
- interstitial focal myocardial hemorrhage.
- focal pulmonary hemorrhage and emphysema.
- renal medullary congestion but tissue autolysis.
- focal adrenal cortical hemorrhage.

Material and Method

High Performance Liquid Chromatography (HPLC) with UV detector[4,6] was set up to demonstrate Rotenone in the gastric content, blood, urine and Yam bean seeds. The result of blood Rotenone in this case was 72 ng/ml. The result showed Rotenone in the gastric content and Yam bean seeds but the level of Rotenone can't be demostrated in quantitative values. Owing to limitation of special technique and method. The authors did not find anticholinesterase insecticides, alcohol, strychnine, benzodiazepine drugs, cyanide and cardiac enzyme (Troponin T) in the biological fluids. Hemolysis was found before death. Thin layer chromatography was performed to confirm Rotenone positively in the biological fluids and Yam bean seeds. The cause of death was congestive heart failure which was consistent with coronary heart disease and respiratory failure due to Rotenone toxicity from Yam bean seeds ingestion. The manner of death was accidental.

Conclusion

Yam bean seeds ingestion and toxicity to humans has occurred very rarely and no fatal case has occurred in Thailand and only one fatal case has been reported in the world. The report case was concluded with a brief history of Yam with bean seeds ingestion, and presented Yam bean seeds in the stomach, cellular asphyxia and Rotenone detected in the stomach and Yam bean seeds were found near the victim with about 100 seeds ingestion. It weighed about 100 grams which

is less than the oral lethal dose of 200 grams reported by Lehmann in 1949. However, Lehmann didn't demonstrate the Rotenone blood level in a human case. The authors detected the level of Rotenone in blood to be 72 ng/ml. A lot of toxic substances were excluded by HPLC and other techniques. However, there was coronary artery heart disease in the present case which may be an additive or precipitated effect with Rotenone toxicity, and caused rapid death. De wilde (1986) reported a lethal over dose estimated from 300-500 mg/kg. In one fatal case, the post mortem concentration of Rotenone in the stomach and blood was 1,260 and 2.4 ppm[4]. The fatality of Yam bean ingestion is very rare, especially in Thailand because Thai people know that Yam bean seeds are mostly toxic to humans and insects. There was a report of fatty changes in the liver and kidney[8] and congestive heart failure in a suicidal case of ingestion of the roots of Derris[9] which is similar to this case. People have used it as an insecticide and fish killing for a long time. In the present case, the man had just arrived in Chiang Rai, Thailand, and did not know about Yam bean toxicity. He ate so many bean seeds that he died almost instantly.

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การตายที่เกิดจากพิษในมันแกวละแวกเป็นรายแรกในประเทศไทย

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ผู้เสียชีวิตรายนี้เป็นรายแรกที่กินเมล็ดและฝักของมันแกวละแวก (Yam Bean) ซึ่งมีสารพิษชื่อว่า โรติโนน (Rotinone) เป็นสารพิษที่สำคัญที่สุดที่เป็นสาเหตุของการเสียชีวิตในผู้ที่กินรายนี้ ซึ่งนับเป็นรายแรกที่มีการตรวจพิสูจน์อย่างแน่ชัด ที่ภาควิชานิติเวชศาสตร์ มหาวิทยาลัยเชียงใหม่ ผู้ที่เสียชีวิตเป็นชายชาวจีนไต้หวัน อายุ 59 ปี เสียชีวิตหลังจากกินฝักและเมล็ดของมันแกวละแวกภายในเวลา 2 ชั่วโมง เนื่องจากภาวะหัวใจและการหายใจล้มเหลว โดยปกติการเสียชีวิตจากการกินมันแกวละแวกหรือพิษที่เกิดจากการกินโรติโนนนั้น เป็นเรื่องที่เกิดขึ้นได้ยากมากในประเทศไทยและต่างประเทศทั่วโลก ทั้งนี้เพราะประชาชนทราบดีว่าส่วนใดของต้นมันแกวละแวกกินได้หรือกินไม่ได้ เพราะเป็นพิษอย่างรุนแรง สำหรับศพรายนี้ได้รับการวินิจฉัยจากประวัติที่ชัดเจนว่ากินเมล็ดและฝักของมันแกวละแวก เพราะว่ามีเศษของมันแกวละแวกตกอยู่ในบ้านพักข้างตัวผู้ที่เสียชีวิต ทั้งชนิดที่ต้มแล้วและชนิดที่ยังดิบ ๆ อยู่ ตรวจพบเมล็ดมันแกวละแวกและสารโรติโนนในกระเพาะอาหาร ซึ่งจากเศษอาหารที่ตกค้างอยู่สันนิษฐานว่าเสียชีวิตหลังจากกินอาหารมื้อสุดท้ายไม่เกิน 2 ชั่วโมง และตรวจพบโรติโนนในเลือดสูงมากคือ 72 นาโนกรัมต่อมิลลิลิตร ซึ่งเป็นสาเหตุทำให้หัวใจและการหายใจล้มเหลว อย่างไรก็ตามรายนี้มีภาวะเส้นเลือดหัวใจตีบ และกล้ามเนื้อหัวใจตายมาก่อนซึ่งอาจเป็นสาเหตุร่วมกับความเป็นพิษที่เกิดจากโรติโนนเป็นเหตุให้เสียชีวิต