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Issue	Food Safety Concerns of Volcanic Ash fall on Water and Agricultural and Fishery Commodities from the Areas Affected by the Taal Volcano Eruption
Background	<p>On a Sunday afternoon of January 12, 2020, Taal Volcano started spewing plumes of smoke and ashes. From Alert Level 2, the warning issued by the Philippine Institute of Volcanology and Seismology (PHIVOLCS) escalated to Alert Level 4 in a matter of 5 hours [1]. As of January 13, 2020, the pyroclastic materials expelled by the volcano reached as far north as Central Luzon [2].</p> <p>The emission of massive volcanic ash affected not only the fisheries found in Taal Lake but also crops and livestock in the nearby towns. As of last report, the volcanic eruption affected 2,772 hectares of agricultural production area, 1,967 animals and cost a production loss of 15,033 metric tons in the fisheries sector. Among the damaged commodities are rice, corn, coffee, cacao, banana and other crops. The cost of agricultural damage also shot up to Php 577.59 million from an earlier figure of Php74.55 million [3].</p> <p>In recent news, the Department of Health (DOH) cautioned the public to refrain from consuming fish products coming from Taal Lake and nearby Batangas provinces as a safety precaution until the competent authority assures that water in the area is safe [4].</p> <p>The Department of Agriculture (DA) directed the Bureau of Fisheries and Aquatic Resources (BFAR) to assess the water quality in Taal Lake [5]. Based on the results of analysis, the DA-BFAR then issued an advisory stating that the levels of heavy metals such as Cadmium, Lead and Mercury in the water are below the set limits established by European Commission Regulation. Thus, the consumption of fish from Taal Lake is safe [6].</p>
Food Hazard Identification and Characterization	<p>According to US Geological Survey, “<i>volcanic ash is hard, does not dissolve in water, extremely abrasive and mildly corrosive which conducts electricity when wet</i>” [7]. However, freshly erupted ash may contain a range of potentially toxic soluble elements such as Fluorine, which may be released either rapidly or more slowly upon contact with water or body fluids [8].</p> <p>Chemical Composition of Volcanic Ash</p> <p>Chemical composition of ash varies among volcanoes, eruptions and even during the same eruption but not all volcanic emissions are adsorbed by ash [9]. The main components that demonstrate the surface enrichment on ash are Sulphur, Hydrogen chloride and fluoride [10]. However, based on most publications of past volcanic eruptions, fluoride was identified as the main component of volcanic ash fall that will pose a short-term risks related to food and feed safety [9].</p>



Fluoride is a principal toxic element adsorbed on ash coming from Hydrogen fluoride. It is naturally found in soil, water, and foods. Fluoride present in volcanic ash is water soluble and is readily leached out by water [10]. Acute exposure to high concentrations of fluoride may result in abdominal pain, excessive saliva, nausea and vomiting. Seizures and muscle spasms may also occur, and death due to respiratory paralysis is a possibility [11].

Fluoride in Agriculture and Fishery Commodities

Humans can be exposed to volcanic fluoride through consumption of contaminated agriculture and fishery commodities listed below:

1. Vegetation

Fluoride may enter plants through the roots, but the major pathway seems to be foliar absorption [9]. The excess accumulation of fluorides in vegetation leads to visible leaf injury, damage to fruits and reduced yield. Toxic fluoride effects include necrosis and chlorosis that eventually lead to plant death [12].

2. Livestock

Ash ingestion may cause fluorosis to animals due to possible excessive intake of feed fluoride content; however, carry-over fluoride in edible tissues or milk will be very low. Kidney may contain more fluoride than other soft tissues due to the excretion of the compound in urine. Fluoride does not readily pass the blood-milk barrier [9].

3. Fisheries

In aquatic animals, specifically fish, primary cause of death in bodies of water are suspended sediments, Hydrogen sulfide toxicity and concentrations of fluoride [13]. Fish bone tissues are assumed to store fluoride where level is influenced by extreme levels in water [9].

Food Safety Mitigation

Due to the potential risk of significant levels of fluoride in agri-fishery commodities, the following are recommended:

1. Select quality fruits and vegetables. Thorough washing and peeling is recommended. If sandy materials are found in the flesh part of the fruit, removing such foreign materials is recommended;
2. Observe caution in consuming kidneys from food-producing animals, or do not consume this internal body parts; and
3. Clean the fish thoroughly and remove the internal organs. Cook fish properly and observe caution in consuming fish bones.



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