

UNVEILING HIDDEN HAZARDS: HEAVY METAL CONTAMINATION IN CANNED FOODS AND ITS IMPACT ON PUBLIC HEALTH

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Abstract

Background: Food safety is an urgent public health issue, especially with the rising incidence of heavy metals as contaminants in the processed food items. Canned foods, popular for their convenience and durability, can contain a poisonous metals like lead, cadmium, and chromium that carry great health risks if consumed long-term. Extended exposure to these pollutants has been associated with the numerous negative impacts, such as organ impairment, developmental problems, and vulnerability to long-term diseases. Even with the regulatory measures in place, consumers are largely ignorant of these risks and do not possess the information needed to make healthy food choices. The research will evaluate the Grade 10 students awareness of the heavy metal contamination in canned foods and its health effects. Through the dissemination of results in educational materials and seminars, the study hopes to empower students and their families to practice safer food intake and contribute to wider public health consciousness.

Methods: The research method used in this study is a mixed-method approach with an experimental research design.

Result: The findings of the study indicated that the occurrence of lead (Pb), cadmium (Cd), and chromium (Cr) in the luncheon meat and canned sardines are confirmation of the possible health hazards involved in their consumption. By using the Atomic Absorption Spectrophotometry (AAS), different levels of the heavy metals were found to be present, pointing towards the imposition of the tougher food safety standards and public awareness. The spread of information using brochures and seminars effectively raised awareness among students and their families, generating better food safety habits and a move towards fresh food instead of canned food.

Conclusion: The research points out the occurrence of heavy metals in food items sold in cans, pointing out the risks to health and the necessity of stricter regulations in food safety. Greater awareness has resulted from campaigns and educational activities, and changes in consumer habits have been made for the better, encouraging students and their families to opt for safer and healthier foods.

Keywords: Hazard, Metal Contamination, Canned Food, Public Health.

Introduction

The study examines the dual effect of the food technology, or the process of canning food, on contemporary society. Though canned food has greatly added convenience, value, and preparedness for the disaster situations, it may also contain a threats to human health through a heavy metal contamination. The research has linked lead, cadmium, and chromium as some of the top toxic dangers of processed foods that have devastating consequences on health. Exposure to lead has been associated with cognitive impairment, cardiovascular disease, and reproductive problems (National Toxicology Program, 2012). Cadmium, a known human carcinogen, impacts kidneys, liver, and musculoskeletal system and induces anemia, nerve damage, and developmental delay in infants (Agency for Toxic Substances and Disease Registry [ATSDR], 2017). Chromium (VI), a known carcinogen, has been reported to cause damage to cardiovascular, gastrointestinal, and reproductive systems (ATSDR, 2017).

The study supports the Sustainable Development Goals (2015) of the United Nations, specifically the global health goal of decreasing deaths and illnesses due to dangerous chemicals in the air, water, and land by the year 2030. With the rising use of canned and processed foods globally, the issue of toxic heavy metals becomes a concern that needs urgent attention (Hezbollah, Sultana, Chakraborty, & Patwary, 2016; Tchounwou, Yedjou, Patlolla, & Sutton, 2012).

The study, driven by a personal experiences in a school setting, has observed the repeated use of the same brand of canned meat for ten years. Fearing for the health and safety of the students, this study intends to raise public consciousness and campaign for stronger food safety regulations. It stresses the imperative necessity for a toxicological education among Filipinos to alleviate the risks posed by heavy metal contamination of canned food products.

Methods

Research Design

The study employed an experimental research design in conducting this toxicological investigation, since the study seeks to determine the concentrations of the heavy metals in canned food

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products such as sardines and luncheon meat. The study also draws techniques from both the qualitative and quantitative methods. The mixed method of research was employed by the researcher in this study using Atomic Absorption Spectrophotometry (AAS) to quantitatively analyse the samples for the presence of lead (Pb), cadmium (Cd), and chromium (Cr).

Respondents of the Study

The study purchased the canned products: two (2) canned sardines labelled as Brand A (local product) and Brand B (imported product) and two (2) canned luncheon meat labelled as Brand X (local product) and Brand Y (imported product), all are locally distributed and available within the Philippines. For comparative analysis, one canned item for each category is a Filipino-made product and the other one is manufactured outside the country. Thirty (30) participants from Grade 10 section 1 to 7 was interviewed. Another one hundred (100) family members composed of parents, guardians or siblings were asked on what they learned about heavy metals.

Instruments of the Study

The interview guide used in the study was composed of seven (7) open ended survey questionnaires (see Appendix B). It was also validated by some experts in food chemistry.

Result

Four canned products consisting of two (2) sardines and two (2) luncheon meat were chosen and purchased from Divisoria market. These canned foods were selected because of their high saleability. The batches of canned food samples collected and tested have the same date of expiration to ensure the quality and accuracy of the results. The laboratory results were not assessed due to the significant differences in the detection limits of the AAS and the standard limits of WHO.

Part I. Concentration levels of lead, cadmium, and chromium in canned sardines and canned luncheon meat the food analysis yield

What concentration levels of lead, cadmium, and chromium in canned sardines and canned luncheon meat does the food analysis yield?

The concentration levels of lead, cadmium, and chromium on the samples of two (2) canned sardines and two (2) luncheon meat were not detected. The detection limits of the Analytical Services Laboratory in the University of the Philippines, Diliman are far higher than the recommended standard safety limits of World Health Organization (WHO); hence, the results were not detected on all the samples.

The heavy metal contents of the investigated metals in canned foods (mushroom, corn, pea, mixed vegetable, tomato, red mullet, stuffed grape leaves, pickle, bean, delicatessen) from Turkish markets were proven in traces and expressed in microgram per gram ($\mu\text{g/g}$) which conformed with the food standards (Tuzen and Soylak, 2007). Meanwhile, the content of Cd and Pb were examined in 25 canned fish products in Poland. Each sample has trace metals expressed in $\mu\text{g/g}$ and did not also exceed international safety levels. Fish and canned fish consumption can be promoted since fish is not very eagerly consumed in Poland (Winiarska, Kwiecien, and Krusinski, 2015).

Part II. The amounts of lead, cadmium, and chromium compared with the standard values set by the World Health Organization (WHO)

How may the amounts of lead, cadmium, and chromium be compared with the standard values set by the World Health Organization (WHO)?

The laboratory analysis indicated that lead, cadmium, and chromium were not found within the detection limits of the employed equipment. Consequently, their concentrations were not compared with WHO-recommended permissible limits. Nonetheless, even small traces of non-essential and toxic heavy metals can be harmful, and have long-term implications for health. The metals may bioaccumulate in the body and remain there for a lifetime.

Interviews with students who often eat canned foods at school and home identified a lack of information about heavy metal contamination. Although some students were aware of lead and mercury as dangerous substances, they were not aware of their origin and dangers. Generally, the respondents showed minimal knowledge of the health consequences of heavy metal exposure. Most had reported cases of health problems caused by eating canned food, which in most cases was caused by not inspecting cans for spoilage, expiration dates, rust, damages, or dents. Most comments highlighted the importance of incorporating learning on food safety and consumption as health-conscious into science and allied subjects.

Human exposure via oral pathway is one of the major routes of heavy metals (Khan, Malik, and Muhammad, 2013; Alia, Sadar, Said, Salma, Sadia, Sadaf, Toqeer, and Miklas, 2015). The concentrations of heavy metals even in traces are still hazardous as they have the tendency to undergo the process of bioaccumulation and toxicity is endangering, as these metals may stay in the body for a lifetime. Moreover, there is no safe level of concentration of lead for young children and fetuses. The World Health Organization (2017) also

affirmed that children are susceptible up to the extent of 4-5 times much lead (Pb) compared with the adults and the biological half life may be significantly longer in children than adults.

Part III. Students' awareness with respect to the effects of heavy metals in canned products

What is the students' awareness with respect to the effects of heavy metals in canned products?

The researcher interviewed Grade 10 students to determine their awareness and understanding of the food toxicity in canned products. The study showed that most of the students regularly consume canned foods because they are more convenient, cheap, and easy to prepare. Numerous students depend on them because they have busy lives, no time to cook, or are not financially stable. Some teachers felt the same way.

But most of the respondents were not aware of the existence and risks of heavy metals (e.g., lead, cadmium, chromium, and mercury) in canned foods. Most of them confessed that they had no idea about these contaminants beforehand, and some mentioned that such information was not taught in their education. Their knowledge of food safety came mostly from personal experience or word of mouth. Some students indicated they had experienced illnesses, including diarrhea, stomach pains, and urinary tract infections, after consuming dented, out-of-date, or rusty canned foods.

Following a seminar on the food toxicity, most students reported a shift in their attitudes. They accepted the health hazards of the regular consumption of canned foods and appreciated the need to limit their intake. Some even passed on the new knowledge to their families, resulting in the joint decisions to cut down on canned food intake.

It can also be affirmed that they only depend on hearsays which are of course insufficient and without scientific explanations. Some of them who experienced problems with canned products like diarrhea or low bowel movement (LBM) and abdominal pain will only be able to identify the tin can as the culprit after thorough observations that it was rusting, dented, near expirations or had expired already. The realization of the negligence takes place after a serious incident has happened. According to WHO (2017), diarrheal diseases are the most usual illnesses resulting from the ingestion of contaminated food, affecting 550 million people to fall ill and almost 230,000 deaths every year.

Part IV. Integration of lessons on healthful food consumption in Grade 10 Chemistry

How may lessons on healthful food consumption be integrated in Grade 10 Chemistry?

The Grade 10 Chemistry syllabus includes the biomolecules like carbohydrates, proteins, and lipids as the main chemical of constituents food. It also discusses chemical reactions, which can provide an explanation for how the food decays or becomes contaminated by way of chemical bond changes. Such subjects are best suited to the inclusion of lessons on toxicology, safe consumption of food, and health awareness.

Interactive teaching methods like role-playing, drama, viewing films, reflective writing, and journaling activities can be an effective way of improving students' knowledge about food toxicology and safety. Further, action plan development, research projects, and school-based initiatives can also advance health awareness and promote safe food habits in the community.

Most organic compounds are degradable by natural processes while no heavy metals are degradable so these are cumulative and stay in the body for a longer time (Wilson, 2017). Since heavy metal is non- biodegradable, persistent, and has no known biological function in the body, it generally accumulates in the cells or tissues, becomes toxic and later on damages the organs. Nutrient minerals or essential metals such as zinc, selenium, manganese, iron, copper, calcium, potassium, and others when in excess can be in a form that is highly toxic to the body.

Research Simulacrum

Part V. Intervention program in disseminating the results of the study

The seminar was conceived and was born on the need to disseminate information on heavy metal toxicity in canned foods, to educate the public of its adverse health effects, to transform the knowledge acquired in developing their abilities to formulate informed decisions in making food choices, and to use this research as a basis for the reinforcement of food safety program.

The aim was to create an awareness of the canned product heavy metal poisoning and the negative impact of heavy metal intoxication on their health, instilling informed decisions on food safety.

To effectively share the findings, a brochure entitled "The Adverse Health Effects of Heavy Metal in Canned Products" was created. It was addressed major points such as the nature of heavy metals, their occurrence in the food, health hazards, and safety tips. The brochure was created with graphics and concise text to ensure maximum involvement and comprehensiveness.

Aside from the brochure, a seminar on food toxicology was conducted after obtaining necessary

approvals from the Division of City Schools of Manila and the school administration. The seminar informed the 300 Grade 10 students about the hazards of heavy metals, citing World Health Organization (WHO) safety standards as well as figures on food poisoning. Data was arranged in an orderly fashion, and participants were given brochures upon check-in.

An assessment form was used to obtain the feedback, which indicated that students learned something of value and were committed to practicing safer food eating habits. The program has highlighted the significance of the education and awareness in reducing health risks related to food contamination.

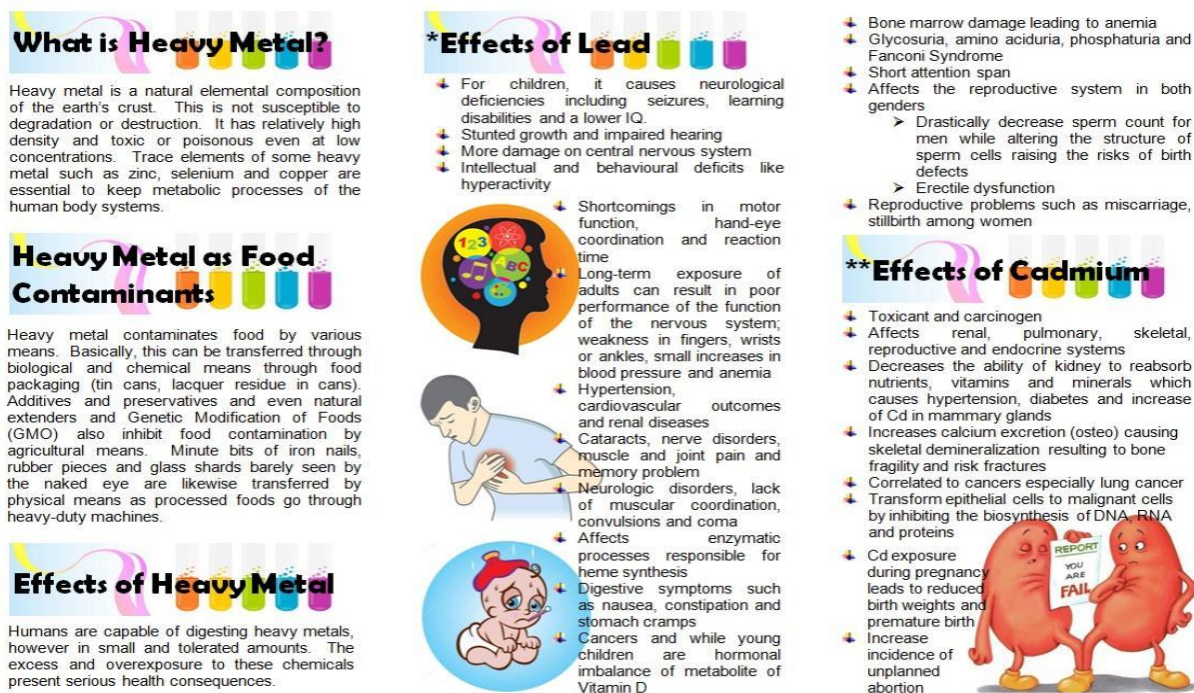


Figure 1: The Brochure distributed to the Students, Teachers, and Stakeholders

Conclusion

The study focused on the significance of health consciousness, especially with respect to heavy metals as foodborne contaminants. By conducting the seminar and the distribution of brochures, the students and their parents were provided with beneficial information on the dangers of heavy metal toxicity among canned foods.

The following was consultation with their parents, students assisted in the raising awareness within their homes of the toxic food contaminants and likely exposure hazards. Subsequently, most families decided to reduce their intake of the canned items and focus on fresh foods.

The healthy advice given in the brochure also affected their food safety measures. Households started to be more cautious when reading a food labels, examining the canned food for dents and rust, and verifying the overall food quality before buying. This heightened awareness created a community intervention in households to use safer and healthier means of eating, eventually leading to better well-being.

Recommendation

Based on the findings of the study, the following are hereby recommended:

1. Food industries should continuously improve their products and product quality by following standard operating procedure (SOP) mandated and directed by Philippine government offices and other private agencies.
2. It is highly recommended to perform heavy metal analyses for other batches of canned products like corned beef and tuna.
3. Heavy metal test like arsenic, aluminum, mercury, tin, and zinc for canned products should be conducted.
4. Microbial analysis is also highly recommended since there is an issue on the growth of yeast, molds, fungi, and botulinum in canned products.
5. There is a need to design approaches and strategies in disseminating wide range of information and in promoting awareness on food toxicity, food safety, and the health impacts of heavy metals.
6. Create innovative instructional materials, enrichment activities, infomercials, and brochures on chemical toxicology.
7. Consistently provide programs and campaigns to help the people realize the impacts of heavy metals and the importance of ensuring food safety and to awaken the sense of responsibility and duty to maintain safe and nutritious food products.

Conflicts of Interest

The author declares that there is no conflict of interest in this manuscript. Results have been deduced objectively; nothing influenced this result by any individual, monetary, or institutional interests. In effect, utmost endeavors were in order to conduct a bias-free operation of gathering and analyzing the data into interpretation and producing a study based on merit, away from research inconsistencies.

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