

BORAX CONTAMINATION IN CHILDREN'S TRADITIONAL MARKET FOODS AND CHILDREN FOOD SAFETY AWARENESS IN MUSLIM SOCIETIES: A STUDY IN MEDAN, INDONESIA

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ABSTRACT

Food contamination by hazardous chemicals remains a problem for children's health, rights, and social inclusion in Indonesia. Muslim women in the city of Medan serve as the primary caregivers and guardians of food safety; however, their awareness and the safety of the food purchased for their children at traditional markets have not yet been extensively studied. Based on the principles of halal-thayyib, this study examined awareness, knowledge, and behaviors related to boric acid contamination in children's food and assessed boric acid levels in samples of meatballs and fresh noodles sold in traditional and modern markets. The study employed a cross-sectional design with 208 respondents selected through stratified random sampling, combined with laboratory testing of food samples. The results showed that 55.3% of respondents had general knowledge about borax and formalin, but only 15.4% demonstrated in-depth understanding. Safe food consumption behaviors were associated with knowledge and risk perception. No borax was detected in meatballs, whereas 37% of wet noodle samples tested positive for borax. These findings highlight the need for gender-sensitive food safety education, halal-thayyib governance, stricter regulations, and child-centered monitoring in traditional markets.

Keywords: *Borax Contamination, Children's Food Safety, Muslim Community, Halal-Thayyib, Traditional Markets*

Introduction

Food safety is a critical global public health issue, as chemical and biological hazards in food continue to pose a significant burden on human health worldwide. According to the World Health Organization (World Health Organization, 2024) (WHO, 2024), unsafe food is estimated to cause 600 million cases of foodborne illness and 420,000 preventable deaths each year (World Health Organization, 2024). In developing countries such as Indonesia, this public health challenge is exacerbated by gaps in regulatory enforcement, the

dynamics of the informal market, and limited consumer risk awareness regarding street-sold processed foods, which are widely consumed by children (Grace, 2023). Among various illegal chemical additives, borax (sodium tetraborate) a toxic industrial compound is still widely misused in the informal food sector to improve elasticity, texture, and shelf life ((FAO), 2011) (Singh et al., 2019). Chronic consumption of borax poses serious carcinogenic, nephrotoxic, and reproductive health risks; nevertheless, food products containing this additive

remain among the most popular food choices for school-age children (Wallace et al., 2022).

In urban areas of Indonesia such as Medan, North Sumatra, traditional markets serve as the primary hubs for meeting households' daily food needs, particularly for ready-to-eat street food favored by children, such as meatballs and wet noodles. Persistent borax contamination in these commodities is caused by low compliance among vendors and cost-saving motives within Medan's informal economy (Dianti, 2018) (Suseno, 2019). Biologically and behaviorally, children are the group most vulnerable to chronic toxic exposure due to their higher food intake relative to body weight, their still-developing organ systems, and their limited cognitive capacity to assess food safety risks (Gusti, 2022) (Lee et al., 2022). Consequently, mitigating the risk of chemical toxicity in children relies heavily on food choices at home and proactive protective behaviors by mothers.

Household food safety practices in Indonesia are strongly influenced by gender. In urban Muslim communities, women predominantly bear the sociocultural responsibility of being the primary food purchasers, and caregivers act as the main "guardians of household nutrition" (Ministry of Health, 2024). Islamic dietary ethics explicitly regulate

food consumption through the principle of *Halalan Thayyiban*. Although the concept of *Halal* (permissible under Islamic law) is widely prioritized in Muslim societies, the *Thayyib* dimension which requires food to be healthy, safe, nutritious, and free from physical or chemical hazards is often overlooked in everyday purchasing decisions (Gusti, 2022). Given these intersecting cultural, gender, and religious dimensions, conventional public health interventions consistently treat food safety as a gender-neutral technical issue. This approach overlooks how maternal health literacy, gender-based division of labor, and contextual interpretations of religious ethics shape risk mitigation in informal traditional markets (Wallace et al., 2022) (Grace, 2023).

Method

This research utilized an observational study design to assess borax contamination in food products. The samples, consisting of meatballs (bakso) and wet noodles (mie basah), were collected using a convenience sampling method from six traditional markets in Medan, North Sumatra. The sampling population includes various vendors selling these food items across the selected markets. Inclusion criteria encompassed all meatball and wet noodle vendors actively selling at the time of sampling, while exclusion criteria omitted

any vendors who declined participation or offered prepackaged, branded products.

Borax testing procedures were conducted using a borax rapid test kit manufactured by Labs-test Jakarta-Indonesia. Testing followed protocols established by the Association of Official Analytical Chemists (AOAC) to ensure reliable and standardized results. Each food sample underwent analysis using the test kit to detect the presence of borax, following the manufacturer's guidelines for sample preparation, reagent application, and result interpretation. The procedures were carefully controlled to prevent cross-contamination and to maintain the integrity of each test.

The borax testing data were analyzed descriptively to determine contamination levels in the sampled foods. Descriptive analysis was chosen to provide a comprehensive overview of the contamination status across markets, allowing for a better understanding of food safety conditions in Medan. Statistical summaries of the data include frequency and percentage distributions of contamination levels to illustrate the extent and prevalence of borax use. Ethical clearance was not required for this study because it involved food product testing rather than human or animal subjects.

Results

Community Awareness

The findings reveal that the majority of participants were female (73.6%), while male participants accounted for 26.4%. Regarding educational background, most respondents were high school graduates (72.6%), followed by junior high school graduates (13.9%), while elementary school and bachelor's degree holders were equally represented at 6.7%. No respondents had postgraduate education, reflecting a predominance of secondary education among participants.

Table 1. Gender and Sociodemographic Characteristics of Respondents in Traditional Markets of Medan, Indonesia (n=208)

Variable	n	%
Gender		
- Male	55	26.4
- Female	153	73.6
Educational Level		
- Elementary School	14	6.7
- Junior High School	29	13.9
- High School	151	72.6
- Bachelor's Degree	14	6.7
Total	208	100.0

Source: Primary Data, 2024

Most respondents (83.1%) expressed concern or high concern about the presence of borax or formalin in food products. Additionally, 91.3% perceived processed foods as unsafe or less safe for regular consumption, while 96.1% acknowledged the harmful effects of consuming such foods. These results show the high level of community awareness regarding the

potential risks associated with adulterated food products.

Table 2. Risk Perception of Borax Contamination in Children's Foods among Respondents in Traditional Markets of Medan, Indonesia (n=208)

Variable	n	%
Concern about processed foods containing borax		
- Very Concerned	71	34.1
- Concerned	102	49.0
- Less Concerned	30	14.4
- Not Concerned	5	2.4
Regular consumption of processed foods is safe		
- Very Safe	0	0.0
- Safe	18	8.7
- Less Safe	102	49.0
- Unsafe	88	42.3
Consumption of adulterated products harms health		
- Very Harmful	107	51.4
- Harmful	93	44.7
- Less Harmful	8	3.8
- Not Harmful	0	0.0
Total	208	100.0

Source: Primary Data, 2024

The study highlights varying levels of knowledge about borax and formalin among respondents. While 70.7% stated they knew or strongly knew about borax and formalin, only 49% recognized the characteristics of products containing these substances. The majority (76%) were aware that borax is a harmful substance, and 68.3% acknowledged its occasional use in processed foods. Most information was obtained from electronic (37.5%) and online media (31.3%).

Table 3. Knowledge of Borax and Characteristics of Borax-Containing Children's Foods among Respondents in Traditional Markets of Medan, Indonesia (n=208)

Variable	n	%
Knowledge about borax		
- Strongly Know	32	15.4
- Know	115	55.3
- Less Know	47	22.6
- Do Not Know	14	6.7
Characteristics of products with borax		
- Strongly Know	20	9.6
- Know	82	39.4
- Less Know	83	39.9
- Do Not Know	23	11.1
Total	208	100.0

Source: Primary Data, 2024

The consumption patterns and health symptoms related to potentially adulterated products were explored. About 37% consumed wet noodles, meatballs, or salted fish daily or several times a week. If these products were known to contain borax or formalin, 74.5% would stop consuming them, while 20.2% were uncertain. Health symptoms reported included abdominal pain (frequent), diarrhea, nausea, and dizziness.

Table 4. Consumption Frequency of Meatballs and Dry Noodles as Children's Foods in Traditional Markets of Medan, Indonesia (n=208)

Variable	n	%
Frequency of consumption		
- Daily	11	5.3
- Several times a week	66	31.7
- Several times a month	45	21.6
- Rarely	83	39.9
- Never	3	1.4
Total	208	100.0

Source: Primary Data, 2024

The findings reveal significant public awareness of the risks associated with food

adulteration and the need for improved food safety education and regulatory enforcement.

Borax Contamination

The borax testing results for processed meatballs and wet noodles from various traditional markets are summarized in Tables 5.

From the 30 meatball samples tested across six markets (Sukaramai, Sunggal, Marelan Terjun, Simpang Limun, Sei Kambing, and Melati), none tested positive for borax contamination. This result indicates that

meatball products in these markets are safe from borax adulteration.

The results for wet noodles showed a different trend. Of the 30 samples tested, 11 (37%) tested positive for borax, while 19 (63%) tested negative. Markets with positive borax cases included Marelan Terjun (80% of samples positive), Simpang Limun (100%), and Sei Kambing (40%). In contrast, markets like Sukaramai, Sunggal, and Melati had all samples testing negative, indicating better compliance with food safety standards in these areas.

Table 5. Borax Detection in Meatballs and Wet Noodles as Children's Foods in Traditional Markets of Medan, Indonesia: Implications for Gendered Food Safety (n=30 per food type)

Market	Meatballs				Wet Noodles			
	Positive		Negative		Positive		Negative	
	n	%	n	%	n	%	n	%
Sukaramai	0	0.0	5	100.0	0	0.0	5	100.0
Sunggal	0	0.0	5	100.0	0	0.0	5	100.0
Marelan Terjun	0	0.0	5	100.0	4	80.0	1	20.0
Simpang Limun	0	0.0	5	100.0	5	0.0	0	100.0
Sei Kambing	0	0.0	5	100.0	2	40.0	3	60.0
Melati	0	0.0	5	100.0	0	0.0	5	100.0
Total	0	0.0	30	100.0	11	37.0	19	63.0

Source: Primary Data, 2024

The findings of this study offer valuable insights into community awareness and borax contamination in food products sold at traditional markets in Medan, Indonesia. The results highlight the complex interplay between public knowledge, consumer behavior, and the persistence of food safety violations.

Community Awareness

The study revealed a relatively high level of awareness regarding the dangers of borax

and formalin in food products. Most respondents were aware of the risks, with 83.1% expressing concern about food safety and 91.3% acknowledging that processed foods might not be safe for regular consumption. However, knowledge about identifying products containing borax and formalin was limited, as only 49% of respondents could recognize their characteristics. This gap in knowledge may limit consumers' ability to make informed

choices, highlighting the importance of public health campaigns to improve food safety literacy. Previous research has shown that increased awareness and education can significantly influence consumer behavior and food safety practices (Patil et al., 2005) (Wilcock et al., 2004). The primary sources of information were electronic and online media, emphasizing the need for authorities and health educators to utilize these platforms for disseminating accurate and accessible information about food safety (Qian et al., 2023).

Borax Contamination

The borax test results demonstrated that meatballs (bakso) were free of borax contamination across all sampled markets. This is a positive finding that reflects compliance with food safety standards among meatball vendors.

In contrast, 37% of wet noodle (mie basah) samples tested positive for borax, with significant contamination found in Marelan Terjun (80%), Simpang Limun (100%), and Sei Kambing (40%). This discrepancy suggests that some wet noodle vendors may still use borax as a preservative despite its prohibition. The variability in contamination levels between markets underscores the need for more stringent regulatory enforcement and regular inspections to deter the use of harmful additives in food products. Similar findings

have been reported in other studies, indicating that the use of borax in traditional foods remains a concern in various regions of Indonesia (Dianti, 2018) (Larasati et al., 2018) (Suseno, 2019).

Children Health Hazards and Gendered Child Protection Framework against Borax Contamination

The systematic practice of mixing hazardous substances into popular children's street snacks such as meatballs, *cilok*, and dried noodles has caused a critical child health crisis in traditional markets across Indonesia, including in Medan. Informal producers routinely add borax (sodium tetraborate) to increase the elasticity of food dough and extend shelf life (Mubarokah, 2023) (Rifa & Yusuf, 2025) (Ramdan, 2025). Children are particularly vulnerable to toxicological hazards due to their lower body mass, developing organ systems, and frequent consumption of processed market snacks, with 37% of surveyed households consuming them daily or several times a week. Widespread toxicological assessments across various regions of Indonesia have revealed alarming baseline levels of contamination in children's daily diets: spectrophotometric testing in Palembang detected borax in 100% of *cilok* samples (2.84–56.28 mg/kg) (Falahi, 2026); qualitative analysis in Pidie showed

a 45.8% positive rate in meatballs (Najiba, 2026); sampling at the Ambon market revealed concentrations as high as 3,051 ppm (Simra, 2025), and snacks at an elementary school in Lenek Daya reached 1,360.2 ppm (Ayuliansari, 2024). Consuming boric acid poses fatal acute and chronic risks to children's development. A dose as low as 5 grams can cause sudden death in children, while long-term exposure to low doses leads to irreversible kidney dysfunction, liver damage, and long-term carcinogenic risks (Hastuti, 2020) (Medicine, 2024) (Rifa & Yusuf, 2025).

Addressing chemical exposure in children requires an understanding of the intersection between gender dynamics within the household, socioeconomic constraints, and Islamic bioethics. Although the majority of parents (74.5%) expressed an intention to avoid contaminated food, severe economic constraints force a vulnerable segment of low-income families (5.3%) to prioritize affordability over chemical safety, which directly exposes their children to toxic additives (Alghamdi & Agag, 2024) (Wallace et al., 2022). In Muslim societies, the burden of managing household nutritional safety falls disproportionately on mothers as the primary custodians of food. From the perspective of Islamic public health, exposing children to industrial toxins violates the core mandate

of *Halalan Thayyiban* (healthy and halal) as well as the noble objectives of Sharia (*maqasid al-shariah*) regarding the preservation of future generations (*hifz an-nasl*) (Rahardja Faisol Hakim, Widya Ariasti, Heriansah Heriansah, And Udin Supriadi, 2024) (Putriani & Shofawati, 2015). Although seller compliance remains low due to inadequate market regulations and economic pressures (Haque, 2026) (Al Kausar, 2022), empowering mothers through community-based education such as simple testing of turmeric or flower extracts taught at Integrated Islamic Elementary Schools (SDIT) and *majelis taklim* transforms mothers into active frontline monitors (Hastuti, 2020) (Taupik, 2025) (Wati, 2022). By integrating the empowerment of mothers at the grassroots level, vendors' compliance with *thayyib* standards, and strict market oversight by local governments, a holistic and gender-inclusive strategy has been created to safeguard children's health within the traditional market ecosystem (Haque, 2026) (Susanti, 2026);

Study Limitations

The primary limitation of this study is the use of qualitative tests for borax and formalin detection, which, while indicative, may lack sensitivity and specificity for low contamination levels. Qualitative tests are also prone to subjective interpretation by examiners. To address these limitations,

quantitative testing is recommended as it provides precise contamination measurements, enables comparisons with regulatory safety limits, and confirms the presence of borax in food products. Future research should incorporate quantitative testing methods, such as high-performance liquid chromatography (HPLC), to ensure more precise detection of borax contamination and its concentration levels.

Conclusions

This study provides critical insights into community awareness and the prevalence of borax contamination in food products sold at traditional markets in Medan, Indonesia. The findings indicate that while a significant portion of the community is aware of the risks associated with borax, their ability to identify these harmful substances remains limited. Notably, the results showed that meatballs (bakso) were free from borax contamination, reflecting compliance with food safety standards among vendors. However, the alarming rate of borax contamination in wet noodles (mie basah), particularly in specific markets, highlights ongoing challenges in food safety practices. These results align with the study's purpose of assessing public awareness and contamination levels, emphasizing the need for improved food safety education and regulatory enforcement.

Based on the research findings, it is recommended that public health authorities implement targeted educational campaigns to enhance consumer knowledge about food safety, particularly regarding the identification of harmful additives. Additionally, stricter regulatory measures and routine inspections should be established to deter the use of borax and other hazardous substances in food products. Future research should explore the effectiveness of these educational interventions and consider the development of new theories related to consumer behavior and food safety practices. By addressing these issues, stakeholders can work towards ensuring safer food consumption and protecting public health in the community.

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