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Qualitative Examination of the Borax and Formalin Content in Food Ingredients and Snack Food

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Abstract

The misuse of formalin and borax remains prevalent, particularly in the processing and preservation of fish. Hence, the primary objective of this research was to ascertain the presence of formalin and borax in food specimens originating from the Depok and East Jakarta locality. The specimens utilized for this investigation encompassed white tofu, yellow tofu, wet noodles, salted snakeskin gourami, salted rainbow sardines, salted fish *bulu ayam*, salted *rebon* freshwater shrimp, salted squid, Indonesian style rice crackers (*kerupuk gendar*), frozen meatballs, and meatballs procured from vendors along the roadside. Qualitative assessments were conducted on the specimens utilizing the formalin test kit for formalin detection, while borax presence was determined through both turmeric extract and turmeric paper. The outcomes derived from this study revealed that samples of wet noodles, Indonesian style rice crackers, and salted rebon freshwater shrimp exhibited positive indications for borax, as evidenced by a discernible alteration in color to red-brownish. In terms of formalin content analysis, the findings demonstrated that yellow tofu, white tofu, wet noodles, and salted rebon freshwater shrimp samples tested positive for formalin using the formalin test kit reagent. It is recommended that regulatory authorities implement regular inspections to monitor the improper use of food additives, particularly preservatives that are prevalent within the community. Furthermore, the general populace is advised to exercise caution when selecting food items to ensure their safety.

Keywords: Borax, Formalin, Food, Test, Turmeric, Curcumin

Introduction

Food is a crucial element that sustains human existence. Individuals engaging in daily tasks require energy derived from food (Elfira Jumrah, Sri Sumiati, Putri Ramadani Hasra, Ainun Musfira, 2023). The maintenance of food safety is a necessary endeavour to prevent the presence of chemicals in food that may disrupt, endanger, or compromise health (Nopiyanti et al., 2018). Food stands as a fundamental constituent with a significant impact on human life, as it is indispensable for human survival. Presently, freely available food sometimes contains harmful substances or preservatives in excessive amounts, leading to potential illnesses (Nani & Wibowo, 2019). One of the food safety problems in Indonesia is the low level of knowledge, skills and responsibility of food or beverage producers regarding food quality and safety, especially in small industries or home industries (Supardan, 2020).

The incorporation of additional components or additives in food production processes has become intricately intertwined. These substances serve various purposes, such as colouring, sweetening, preserving, flavouring, enhancing aroma, and fulfilling other objectives. The inclusion of these elements in food and beverages is aimed at enhancing the appeal of the products to consumers, thereby enabling traders to achieve desired profits (Irawan & Ani, 2016). Based on data from the Indonesian Food and Drug Supervisory Agency (BPOM RI), incidents of food-related poisoning occupied the highest percentage throughout 2012, reaching 66.7%. The presence of food additives like formaldehyde and borax in food products contributes to the occurrence of food poisoning (Kholifah & Utomo, 2018).

The findings of a survey conducted by BPOM RI in 2013, which analysed a total of 24,906 food samples, revealed that 3,442 (13.82%) samples failed to meet the established food safety and quality criteria, including 221 Borax samples and 115 Formalin samples. In 2011, BPOM conducted sampling and clinical assessments of school snacks gathered from 866 elementary schools/madrasahs across 30 cities in Indonesia. Out of the 4,808 snack samples examined, 1,705 (35.46%) did not comply with the food safety and/or quality standards. Testing for banned borax and formalin additives was carried out on 3,206 snack food product samples, encompassing wet noodles, meatballs, snacks, revealing that 94 samples (2.93%) contained borax, while 43 samples (1.34% of samples) contained formalin (Haq et al., 2023).

Literature Review

The Presence of Borax and Formaldehyde in Food Products

The use of borax and formalin in food products is a concerning issue. Formalin, a solution containing 37% formaldehyde along with water and methanol, is primarily utilized as a disinfectant and preservative. Despite its intended purposes, some manufacturers incorporate formalin into food items like noodles, fish, and meatballs (Yuliana et al., 2023). Formalin is not classified as a food additive; however, it is frequently utilized inappropriately. The selection of formalin is attributed to its economic cost and its ability to render food items resilient, intact, functional, and efficient in terms of preservation (Lathifah et al., 2019). This practice poses a health risk as formalin can react with the body's mucous lining in the digestive and respiratory tracts. Among various preservatives, formaldehyde stands out due to its affordability and ease of integration into food products (Mudawaroch et al., 2024).

Additionally, borax, chemically represented as $Na_2B_4O_7 \cdot 10H_2O$ (Ullah et al., 2023), finds application in diverse sectors such as glass production, cleaning equipment, and pest control. Borax is used for anti-fungi, wood preservatives, and antiseptic ingredients (Lathifah et al., 2019; Zurimi, 2021). In the medical realm, borax serves as an antiseptic and a component in ointments and eyewashes. Studies reveal its presence in foods like meatballs, noodles, and crackers to enhance texture and taste. The addition of borax aims to improve density, elasticity, crispness, and flavor, particularly in starchy foods commonly available in markets (Zurimi, 2021).

The Health Implications of Utilizing Formalin and Borax in Food Products

Formalin is extensively used across industries like furniture making, construction, and as a preservative for corpses. On the other hand, borax serves roles as a soldering agent, wood preservative, and antiseptic. Despite their varied applications, both substances are often misused for food preservation. Consumption of foods containing borax or formaldehyde over extended periods can lead to severe health issues, including cancer, brain dysfunction, and kidney and liver problems (Irawan & Ani, 2016). Formalin presence within the human body has the potential to induce the development of respiratory tract cancer as well as elevate the susceptibility to leukemia. It is pertinent to note that formalin is categorized within the initial group of known carcinogens affecting the human body. The established threshold of tolerance for formalin in the human body stands at 0.2 milligrams per kilogram of body weight (Lathifah et al., 2019). The rapid reactivity of formalin within the digestive system and respiratory system of humans has been well-documented. The toxic effects of formalin include symptoms like vomiting, lethargy, sudden abdominal distress, and impaired blood circulation (Sammulia et al., 2020).

The detrimental effects of borax on the digestive system, kidneys, and potential cancer risks necessitate strict avoidance of this compound in food products (Indah et al., 2023). Government regulations, particularly by the Ministry of Health, prohibit the use of borax due to its significant negative impacts on human health (Onabia et al., 2023). Prolonged ingestion, even in small amounts, can result in accumulation in vital organs like the brain, liver, and kidneys. Excessive consumption may lead to a range of symptoms from fever, depression, to fatal outcomes like coma and death (Zulfikar et al., 2022). Short-term exposure to borax may lead to symptoms such as dizziness, vomiting, and diarrhea. Prolonged consumption of borax-contaminated foods can result in the accumulation of carcinogenic compounds in vital human organs like the liver, brain, kidneys, and testes. Ingesting high doses of borax can also manifest symptoms like stomach cramps, kidney impairment, and potentially fatal consequences if the toxicity level reaches 10-20 grams (Ermawati et al., 2021). Regulation stipulated by the Ministry of Health in Indonesia under the reference number 722/MenKes/per/IX/88 categorically prohibits the use of Borax as an additive in food products (Widiati & Wahyuningsih, 2023).

Research Method

The investigation was executed in January 2024. The chosen sites were various establishments vending meatballs, dumplings, tofu, salted fish, rice crackers, salted squid, and wet noodles within the traditional markets situated in Depok, South Jakarta, and East Jakarta.

Borax Test Examination of Borax Utilizing Turmeric Extract, Turmeric Paper, and Reagent Test Kit

In the process of testing borax via a reagent test kit, the initial step involves grinding and dissolving the sample in 10 mL of distilled water to acquire sample filtrate for white tofu, yellow tofu, wet noodles, salted snakeskin gourami, salted rainbow sardines, salted fish *bulu ayam*, salted squid, Indonesian style rice crackers (*kerupuk gendar*), frozen meatballs and meatballs sourced from roadside food vendors. Following this, reagent is dripped onto the extract from each sample to detect the presence of borax within the sample. Testing for Borax Using Turmeric Extract 250 grams of turmeric are dissolved in 250 mL of distilled water and then filtered. Subsequently, the five samples are dripped with turmeric extract, and the resultant changes are observed. A brownish-red color change indicates the presence of borax in the sample, while a yellow color (turmeric color) indicates a negative result. This process is repeated for all samples (Elfira Jumrah, Sri Sumiati, Putri Ramadani Hasra, Ainun Musfira, 2023).

Formalin Test Utilizing Reagent Test Kit

When conducting formalin testing with a reagent test kit, the initial stage involves grinding and dissolving the sample in 10 mL of distilled water to obtain sample filtrate for white tofu, yellow tofu, wet noodles, salted snakeskin gourami, salted rainbow sardines, salted fish *bulu ayam*, salted squid, Indonesian style rice crackers (*kerupuk gendar*), frozen meatballs and meatballs sourced from roadside food vendors. The following step includes dripping reagent onto the extract from each sample to examine the presence of formaldehyde within the sample (Elfira Jumrah, Sri Sumiati, Putri Ramadani Hasra, Ainun Musfira, 2023). The reagent contained in the test kit reacts with formalin to form a purplish red complex compound (Sammulia et al., 2020).

Result/Findings

No.	Sampel	Formalin Test Results with Test Kit	Borax Test Results with Turmeric Extract	Borax Test Results with Turmeric Paper
1	Meatball (from street vendors)	negative	negative	negative
2	Meatball (frozen product)	negative	negative	negative
3	Wet noodles	positive	positive	positive
4	White tofu	positive	negative	negative

5	Yellow tofu	positive	negative	negative
6	Salted rainbow sardines (*ikan asin japuh*)	negative	negative	negative
7	Salted snakeskin gourami (*ikan asin sepat*)	negative	negative	negative
8	Salted fish *bulu ayam* (*Coilia mystus*)	negative	negative	negative
9	Salted rebon freshwater shrimp (*Acetes sp*)	positive	positive	positive
10	Salted squid	negative	negative	negative
11	Indonesian style rice cracker (*kerupuk gendar*)	negative	positive	positive

The outcomes of the formaldehyde content assessment through the utilization of a test kit reagent revealed the presence of formaldehyde in various food specimens. These encompassed white tofu, yellow tofu, and salted *rebon* freshwater shrimp (see Figure 3). Conversely, the examination for borax content utilizing turmeric aqueous extract and turmeric paper displayed the existence of borax in several food samples, such as wet noodles, salted *rebon* freshwater shrimp, and Indonesian style rice crackers (see Figure 2). Correspondingly, the identical findings were demonstrated in the borax content evaluation employing turmeric paper. Numerous food samples exhibited a positive result for borax, specifically wet noodles, salted *rebon* freshwater shrimp, and Indonesian style rice crackers. This was evidenced by the alteration in color of the turmeric extract solution to a reddish-brown hue (see Figure 1).

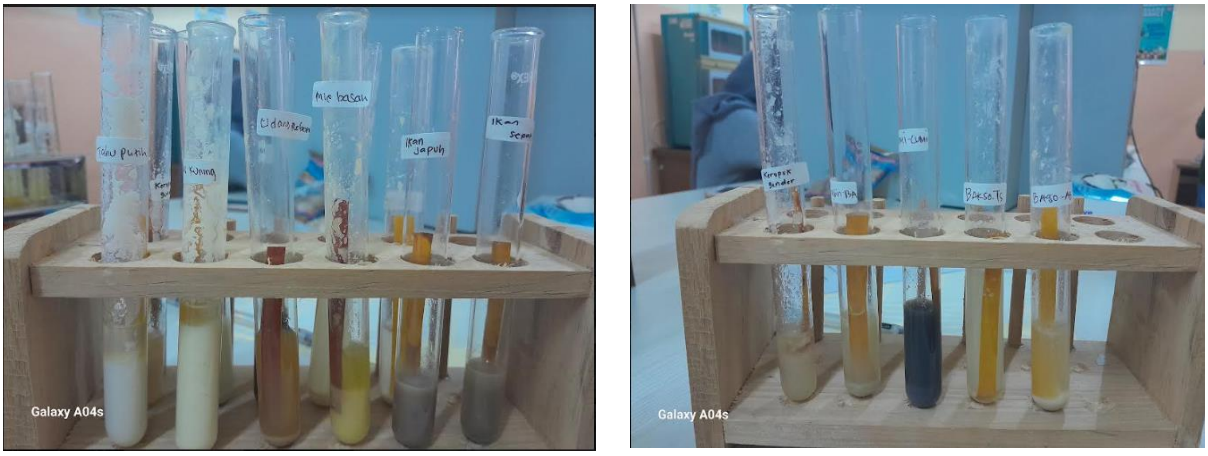

Figure 1 Borax Test Utilizing Turmeric Paper. *The image depicted on the left showed various samples including white tofu, yellow tofu, salted rebon freshwater shrimp, wet noodles, salted rainbow sardines, and salted snakeskin gourami (in sequential order, from the left to the right). On the right side of the image, there were samples of Indonesian style rice cracker, salted fish bulu ayam, dried squid, frozen meatballs, and meatballs sourced from roadside food vendors (in sequential order, from the left to the right). The figures presented a noticeable alteration in the color of the turmeric paper in the salted rebon freshwater shrimp sample and the wet noodle sample.*

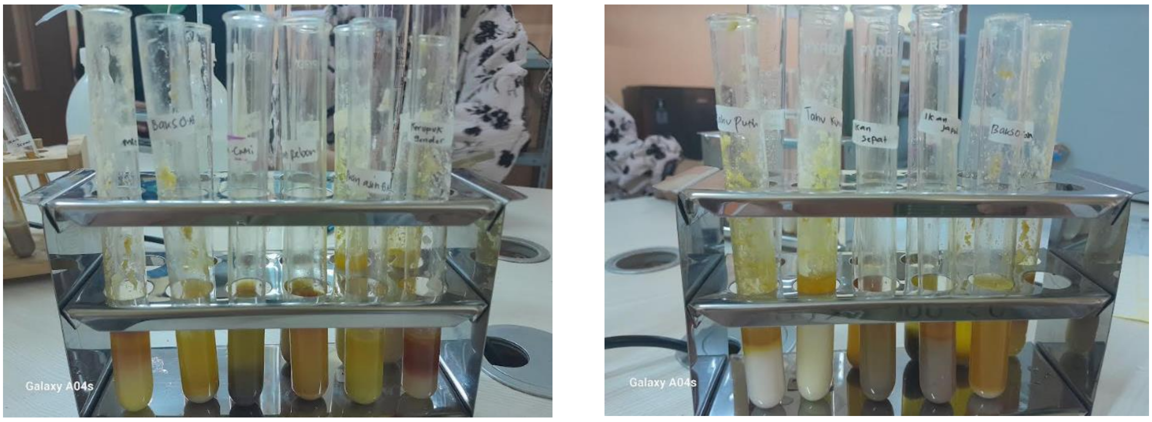

Figure 2 Borax Test Utilizing Turmeric Extract. *The image depicted on the left showed various samples including wet noodles white tofu, meatballs sourced from roadside food vendor, dried squid, salted rebon freshwater shrimp, salted fish bulu ayam, and Indonesian style rice cracker (in sequential order, from the left to the right). On the right side of the image, there were samples of white tofu, yellow tofu, salted snakeskin gourami, salted rainbow sardines, and frozen meatballs (in sequential order, from the left to the right). The figures presented a noticeable alteration in the color of the turmeric extract in the salted rebon freshwater shrimp sample and the wet noodle sample.*

Figure 3 Formalin Test Using Reagent Test Kit. *The image depicted on the left showed various samples including Indonesian style rice cracker, salted rebon freshwater shrimp, meatballs dan dried squid (in sequential order, from the left to the right). On the right side of the image, there were samples of yellow tofu, wet noodles, salted snakeskin gourami, salted rainbow sardines, and white tofu (in sequential order, from the left to the right). The figures presented a noticeable alteration in the color of the white tofu, yellow tofu, and salted rebon freshwater shrimp into purple color.*

Discussion

Numerous food samples exhibited a positive result for borax, specifically wet noodles, salted *rebon* freshwater shrimp, and Indonesian style rice crackers after tested using turmeric extract and turmeric paper. Borax present in food can be identified utilizing natural components in a straightforward manner, specifically a turmeric solution. Turmeric serves as a viable natural indicator for detecting the presence or absence of borax due to the active ingredient it contains, namely curcumin. The compound has the capability to break down the bonds of borax, converting it to boric acid, which then forms a rosocyanine color complex (brownish red) in an acidic setting, resulting in a red-orange to red hue in food items containing borax (Mubarokah et al., 2023). In simple terms, the compound curcumin found in turmeric has the capability to disrupt the chemical bonds present in borax, thereby generating boric acid and producing a curcumin boron cyano complex, which is classified as a complex rosin compound. Although the process of this chemical reaction can be easily observed, there remains a lack of research exploring the optimal turmeric concentration required to effectively identify the presence of borax in food products. Consequently, the utilization of turmeric as a natural indicator for the detection of Borax presents a situation of uncertainty (Lestari et al., 2022; Tarigan, Sri Wahyuni; Sitanggang, 2021). Turmeric paper was also used as indicator of borax content in in the ten kinds of crackers in the previous study. The turmeric papers have changed color to reddish brown or brownish yellow. The results were also confirmed by the laboratory test on the associated crackers confirmed that the crackers were positive, i.e. those crackers indeed contain borax, therefore the turmeric paper was very suitable to be used as the first indicator of the borax content in food (Ermawati et al., 2021).

The results of the assessment of formaldehyde content using a reagent test kit indicated the detection of formaldehyde in different food samples, including white tofu, yellow tofu, and salted *rebon* freshwater shrimp. Based on the results of the formalin test, food that is detected positive for formalin is marked by a color change to purple. The reagent contained in the test kit reacts with formalin to form a purplish red complex compound. Previous studies have shown that the preponderance of analyzed samples of processed fishery products, specifically salted fish, tested negative for the presence of formaldehyde. Based on the findings of the preceding study on the examination of formalin levels in tofu at the Research and Standardization Center Padang industry, it was revealed that the formalin content amounted to 17,100 ppm. Another investigation focused on the analysis of preservative content, specifically formalin, in tofu traded at Anduonohu traditional market in Kendari City, indicating a formalin concentration of 82.5 ppm. Additionally, a separate study on the evaluation of formalin levels in white tofu at Bersehati Market in Manado City reported that out of 14 tofu samples tested, 13 samples tested positive for the presence of formalin (Sammulia et al., 2020). Conversely, in another study it was found that the outcomes of the analysis conducted on white tofu retailed in conventional markets in earlier studies indicated the absence of formalin content following examination with a formalin testing kit (Wuisan et al., 2020). Salted fish undergoes a preservation method involving salting, which serves as a natural means of extending its shelf life. The salting procedure functions as a form of natural preservation, thereby enhancing the product's durability. (Farida et al., 2023).

Conclusion

From the results of the research and the results of the discussion that have been described, the conclusion in this study is that there were several food samples that were tested using turmeric extract (*Curcuma longa linn*) and turmeric paper, as indicators for detecting borax. Samples of wet noodles, Indonesian style rice crackers and salted *rebon* freshwater shrimp were detected positive for borax while other food samples were negative for borax content. From the results of testing food samples for formalin content, the results showed that samples of yellow tofu, white tofu, wet noodles and Salted *rebon* freshwater shrimp obtained positive results from the test results using the formalin test kit reagent. In the future it is hoped that examinations will be conducted on food components and snacks through specific techniques to guarantee the absence of borax and formaldehyde in food available for purchase, thus safeguarding the health and well-being of consumers.

Declaration of conflicting interest

The authors declare that there is no conflict of interest in this work.

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