Borax is Still Detected in Crackers Sold at Jenangan District Market Using the Rapid Test Method

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ABSTRACT
Borax is a prohibited food additive according to the Regulation of the Minister of Health of the Republic of Indonesia Number 033 of 2012 because of its harmful effects on human health, including disorders of the central nervous system, kidney and liver dysfunction, and even death. Nevertheless, the use of borax is still suspected in certain food processing practices, including the production of crackers. This study aimed to determine the presence of borax in crackers sold at the market. This research used a descriptive design with organoleptic testing and qualitative borax testing using the rapid test method. The research objects were cracker products sold by three vendors in the Jenangan District Market. Total sampling was applied based on the total number of crackers sold by the vendors, resulting in 21 samples. The results of the organoleptic test showed that three samples had slightly dull colors and seven samples had textures that were difficult to crush. The qualitative rapid test results indicated that 14.3% of the cracker samples were positive for borax. Crackers containing borax were generally characterized by a dull appearance and a hard texture that was difficult to crush. In conclusion, borax was still found in a proportion of cracker products sold in the Jenangan District Market, indicating that the use of this prohibited additive persists in some food products and may pose potential health risks to consumers.
Keywords: borax, crackers, organoleptic test, qualitative test

INTRODUCTION
Borax is a chemical compound that functions as an antimicrobial agent by inhibiting the growth and development of microorganisms. It is commonly used in pharmaceutical preparations such as ointments, powders, and eye drops [1]. In addition, borax is utilized in various industrial applications, including soldering materials, cleaning agents, wood preservatives, and disinfectants [2]. However, its misuse is still frequently found in food products such as noodles, meatballs, and crackers, where it is added to improve texture [3].

The prohibition of borax use in food has been regulated by the Indonesian government under the Regulation of the Minister of Health of the Republic of Indonesia Number 033 of 2012 [4]. The presence of borax in food poses significant health risks, including food poisoning characterized by symptoms such as diarrhea and vomiting, impaired kidney function, and even death [5]. Despite these regulations, the use of borax in food processing, particularly in crackers, is still reported. A study conducted in a market in Surakarta found that 80% of 30 cracker samples tested positive for borax [6]. Crackers containing borax are typically characterized by a slightly dull and darker color, as well as a hard texture that is difficult to crush [7].

In Indonesia, crackers are available in various types, such as garlic crackers, *puli* crackers, shrimp crackers, fish crackers, and many others. The consumption of crackers containing borax may lead to food poisoning, with symptoms including abdominal pain, decreased appetite, loss of concentration, dehydration, and liver damage [8]. Cases of borax-related food poisoning have also been reported, including an incident in Yogyakarta in 2018, where 23.82% of food samples did not meet safety standards. Among these, 9% were associated with the use of prohibited food additives, including borax [9]. Therefore, the government strictly prohibits the use of borax in food products.

Food products containing borax violate the provisions stated in the Regulation of the Minister of Health of the Republic of Indonesia Number 033 of 2012 concerning food additives. Access to safe and high-quality food is a fundamental human right [10]. Thus, food consumed by the public must comply with hygiene standards and be free from harmful contaminants [11]. A total of 55 cracker producers in Jenangan District distribute their products to markets in Ponorogo Regency, including the Jenangan District Market. Between 2020 and 2022, inspections conducted on nine cracker producers in Ponorogo Regency revealed that 2.1% of producers were still using borax. Additionally, laboratory testing of five cracker samples collected from markets showed that 40% were positive for borax. These findings indicate that the use of borax is still prevalent in the community, highlighting the need for continuous monitoring and supervision of food additive use in food processing.

Considering the harmful effects of borax on human health, further surveillance is required regarding its use in crackers sold at the Jenangan District Market. This study was conducted in collaboration with the Ponorogo District Health Office to examine borax content in crackers using the rapid test method. The rapid test kit used in this study consists of curcumin test strips and borax reagents. A sample is considered positive for borax if the test strip changes color to orange, red, or brick red [12].

Therefore, this study aims to determine the presence of borax in crackers sold at the Jenangan District Market using the rapid test method.

METHODS
This study was conducted at the Jenangan District Market, Ponorogo Regency, in 2023. It employed a descriptive research design aimed at identifying and determining the presence of borax in crackers sold in the market. The population of this study consisted of all cracker products sold by vendors at the Jenangan District Market. The samples included crackers obtained from three vendors, with a total of 21 samples comprising various types such as garlic crackers, terasi crackers, Bandung crackers, puli crackers, shrimp and fish crackers, and rambak crackers. A total sampling technique was applied, in which all available cracker products from the selected vendors were included as samples.

The variable in this study was the presence of borax in crackers. Data were collected through organoleptic testing and qualitative borax testing. The organoleptic test was conducted to assess the physical characteristics of the crackers, including odor, taste, texture, and color, using an observation checklist as the data collection instrument. Meanwhile, the qualitative borax test was performed using the curcumin paper method with a rapid test kit consisting of curcumin test strips and borax reagents.

The data collection procedure began with sample preparation at the Jenangan District Market. Each cracker sample was ground, and 25 grams of the sample were weighed and placed into an Erlenmeyer flask. Then, 50 mL of warm water was added, and the mixture was homogenized. The solution was filtered using filter paper, and the filtrate was transferred into a test tube. Subsequently, three drops of borax reagent were added and mixed thoroughly. The treated sample solution was then dropped onto a curcumin test strip using a dropper. A color

change of the strip to orange, red, or brick red indicated a positive result for borax. Data analysis was carried out descriptively by presenting the results in the form of frequencies and percentages to describe the presence of borax in the cracker samples.

RESULTS

The organoleptic examination was conducted by 30 non-standardized panelists by observing the odor, taste, texture, and color of the cracker samples. The results of the physical quality assessment are presented in Table 1. Out of 21 samples examined, three samples were categorized as fair, namely samples 6, 12, and 19. These samples exhibited similar physical characteristics, including a slightly stale odor with a faint raw material smell, a savory taste with noticeable seasoning and weak raw material flavor, a hard texture that was difficult to crush, and a dull color that tended to be darker.

The qualitative borax examination was carried out using the curcumin paper method with a rapid test kit. A positive result was indicated by a color change of the curcumin paper to orange, red, or brick red. The rapid test kit consisted of a borax reagent solution and curcumin test strips. The test was performed by observing the color change of the strip after being exposed to the food sample extract. The results of the qualitative borax test are presented in Table 2. The 14.3% of the cracker samples tested positive for borax using the curcumin paper method. This was indicated by a color change of the curcumin paper from yellow to orange, red, or brick red. This color change occurs because curcumin reacts with borax, breaking it down into boric acid and forming a red-colored complex [13].

Table 1. Physical quality assessment of crackers at Jenangan District Market in 2023

Physical quality	Samples	Percentage
Good	18	85.7
Fair	3	14.3
Poor	0	0

Table 2. Results of qualitative borax testing of crackers sold at Jenangan District Market in 2023

Assessment category	Frequency	Percentage
Positive	3	14.3
Negative	18	85.7

DISCUSSION

The results of the organoleptic examination indicated that 14.3% of the cracker samples exhibited characteristics suggestive of borax contamination, including a slightly rancid and musty odor, a predominantly savory taste with a bitter aftertaste, a relatively hard texture that was difficult to crush, and a dull color tending toward a darker appearance [14]. These findings are consistent with the known properties of borax, which can alter the physical and sensory characteristics of food products, particularly by increasing hardness and imparting a slightly bitter taste [15].

Crackers containing borax are characterized by a musty or rancid odor, a slightly bitter or astringent taste dominated by preservative-like notes, a firm texture that is difficult to break, and a dull or less appealing color. The evaluation of cracker quality using the organoleptic method relies on sensory assessment by human panelists, which serves as a primary tool for determining product acceptability. Organoleptic testing encompasses several parameters, including color, odor, taste, texture, and other relevant attributes necessary for comprehensive product evaluation [16]. However, it is important to note that sensory perception varies among panelists, which may influence the results of organoleptic assessments. Differences in sensory sensitivity can be attributed to several factors, including age, health conditions, and other physiological or environmental factors that may interfere with taste and smell perception. Additionally, degenerative changes in body cells and organs may lead to a progressive decline in sensory function, thereby affecting the accuracy and consistency of organoleptic evaluations [17].

In this study, three cracker samples sold at the Jenangan District Market demonstrated characteristics indicative of borax presence, particularly in terms of their hard texture and dull, darker color. The increased hardness of these crackers is associated with the physicochemical properties of borax, which can enhance elasticity and increase viscosity during the dough preparation process, resulting in a firmer texture. Moreover, the difficulty in crushing the crackers may also be influenced by moisture content, as higher water content can affect the structural properties of the product. During frying, however, moisture reduction occurs, leading to increased crispness due to structural changes in the food matrix [18].

The dull and darker color observed in borax-containing crackers can be explained by chemical reactions occurring during processing, particularly the Maillard reaction. This reaction involves reducing sugars and amino acids when exposed to high temperatures, typically ranging from 150°C to 260°C, which are common in cooking processes. The Maillard reaction plays a significant role in the development of color and flavor in processed foods. The intensity of the resulting color depends on factors such as heating time, temperature, the presence of chemical additives, and the composition of raw materials. Higher protein content and certain ingredient substitutions may enhance browning reactions, resulting in a darker and less bright appearance of crackers [19].

The qualitative analysis using the curcumin paper method showed that 14.3% of the cracker samples tested positive for borax. This was indicated by a distinct color change of the curcumin paper from yellow to orange, red, or brick red [20,21]. The color change occurs due to the chemical interaction between curcumin and borax, where curcumin reacts with borax compounds, breaking them down into boric acid and forming a red-colored complex [13]. Cracker samples that tested positive for borax in the qualitative test also exhibited corresponding physical characteristics in the organoleptic assessment, particularly a hard texture and a slightly dull color. When subjected to the curcumin paper test, these samples showed a visible color change on the test strip, confirming the presence of borax. A positive reaction is characterized by the transformation of the curcumin paper color from yellow to orange or brick red [22,23]. This reaction occurs because curcumin, a natural compound found in turmeric, interacts with borax under acidic conditions to form a reddish-brown complex, thereby indicating the presence of borax in the food sample [3].

According to the Regulation of the Minister of Health of the Republic of Indonesia Number 033 of 2012 concerning food additives, boric acid and its compounds are strictly prohibited from being used in food products due to their harmful health effects. The consumption of foods containing borax, including crackers, may lead to adverse health outcomes such as dizziness, vomiting, diarrhea, and abdominal cramps, particularly at high exposure levels. Furthermore, long-term exposure may result in serious health issues, including damage to the central nervous system, kidneys, and liver [5]. Despite these risks, borax is still sometimes used by producers because it enhances certain desirable qualities in crackers, such as increased firmness, improved crispness after frying, and extended shelf life due to its preservative properties [24]. Therefore, it is essential to explore safer alternative substances that can provide similar functional benefits without posing health risks. One potential alternative is seaweed, which contains natural hydrocolloids such as alginate, carrageenan, and agar. These compounds act as natural thickeners and can improve the texture of crackers in a safe manner [25]. Crackers produced using seaweed-based ingredients tend to have a cohesive texture, a slightly yellowish-white color, and a pleasant savory taste, making them a safer and acceptable substitute for borax-containing products [26].

CONCLUSION

Borax testing using organoleptic and qualitative methods revealed that a proportion of cracker samples were positive for borax, characterized by slightly musty odor, a savory taste with a mild additive aftertaste, a hard texture that was difficult to crush, and a dull, darker color. Therefore, the use of safer alternative substances with similar functional properties is recommended to replace borax in food production.

Ethical consideration, competing interest and source of funding

-This study adhered to research ethics by ensuring that the samples were used solely for research purposes, maintaining the confidentiality of vendors' identities, and conducting the study in collaboration with the local health office to ensure proper procedures and accountability.
-There is no conflict of interest related to this research and publication.
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