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IDENTIFICATION OF THE SAFETY OF ANIMAL-DERIVED FOOD PRODUCTS (CHICKEN *CILOK* MEATBALLS) AGAINST BORAX CHEMICAL HAZARDS IN PANJER VILLAGE, SOUTH DENPASAR

Identifikasi Keamanan Produk Pangan Asal Hewan (*Pentol cilok* Ayam) dari Bahaya Kimia Boraks di Kelurahan Panjer, Denpasar Selatan

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Abstract

Borax is a chemical substance prohibited for use as a food additive due to its toxic properties and potential adverse effects on human health. Nevertheless, it is still illegally used in processed food products, including meatballs and *pentol cilok*, to improve texture, elasticity, and shelf life. This study aimed to identify the presence of borax in *pentol cilok* sold in Panjer Village, South Denpasar, as part of efforts to ensure the safety of food products of animal origin. A descriptive study with a qualitative approach was conducted. Samples were collected using a total sampling method involving 32 *pentol cilok* vendors. Borax detection was performed using the LabTest Borax Test Kit based on the colorimetric principle of curcumin-impregnated test paper. A positive result was indicated by a color change from yellow to red or dark red. The results showed that all 32 samples tested negative for borax, as indicated by the absence of a color change on the test paper. These findings indicate that the *pentol cilok* sold in Panjer Village, South Denpasar, were free from detectable borax contamination and therefore met food safety requirements regarding chemical hazards associated with borax. However, continuous monitoring and guidance for producers and vendors of processed foods of animal origin remain necessary to prevent the misuse of prohibited food additives and ensure food safety for consumers.

Keywords: borax, food safety, foods of animal origin, *pentol cilok*, qualitative analysis

Abstrak

Boraks merupakan bahan kimia yang dilarang digunakan sebagai bahan tambahan pangan karena bersifat toksik dan dapat membahayakan kesehatan. Meskipun demikian, boraks masih sering disalahgunakan pada produk pangan olahan, termasuk bakso dan pentol cilok, untuk

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meningkatkan kekenyalan, elastisitas, dan daya simpan produk. Penelitian ini bertujuan untuk mengidentifikasi keberadaan boraks pada pentol cilok yang dijual di Kelurahan Panjer, Denpasar Selatan sebagai upaya menjamin keamanan pangan asal hewan. Penelitian menggunakan metode deskriptif dengan pendekatan kualitatif. Pengambilan sampel dilakukan secara total sampling terhadap 32 pedagang pentol cilok. Deteksi boraks dilakukan menggunakan LabTest Boraks *Test Kit* berdasarkan prinsip perubahan warna kertas uji yang mengandung kurkumin. Hasil positif ditunjukkan oleh perubahan warna dari kuning menjadi merah atau merah tua. Hasil penelitian menunjukkan bahwa seluruh sampel (32 sampel) memberikan hasil negatif terhadap kandungan boraks, yang ditandai dengan tidak adanya perubahan warna pada kertas uji. Hasil tersebut menunjukkan bahwa pentol cilok yang dijual di Kelurahan Panjer, Denpasar Selatan tidak mengandung boraks sehingga memenuhi aspek keamanan pangan dari bahaya kimia boraks. Meskipun demikian, pengawasan dan pembinaan terhadap produsen serta pedagang pangan olahan asal hewan perlu terus dilakukan untuk mencegah penyalahgunaan bahan tambahan pangan yang dilarang serta menjaga keamanan pangan bagi masyarakat.

Kata kunci: boraks, keamanan pangan, pangan asal hewan, pentol cilok, uji kualitatif

INTRODUCTION

Pentol cilok is a processed food product of animal origin that is widely consumed because of its affordable price, savory taste, chewy texture, and easy availability as a street food. *Pentol* is generally made from animal meat at a proportion of less than 45%, mixed with starch and seasonings, whereas cilok is made from tapioca flour and shaped to resemble meatballs (Darmawan *et al.*, 2024; Sa'adah *et al.*, 2021; Solihat *et al.*, 2016). Based on Law of the Republic of Indonesia Number 18 of 2012 concerning Food, these products are classified as processed food products that must meet food safety requirements. Increasing urban community activities have also driven the development of ready-to-eat food trade, including *pentol cilok*. Panjer Village, South Denpasar District, had a population of 24,241 in the first semester of 2024 (Panjer, 2024), so the high demand for practical and affordable food may potentially increase the distribution of these products.

The increasing consumption of processed foods needs to be accompanied by the implementation of food safety measures to prevent biological, chemical, and physical hazards that may endanger human health. Government Regulation of the Republic of Indonesia Number 86 of 2019 concerning Food Safety defines food safety as a condition and effort to prevent food from contamination that may endanger health. One approach to food safety in Indonesia is the Safe, Healthy, Whole, and Halal (ASUH) concept, which emphasizes that food must be free from harmful contaminants and meet applicable quality requirements and regulations (Anggaeni *et al.*, 2022). One of the chemical hazards that requires attention is borax, a boron-derived compound used for various non-food purposes, such as as an antifungal agent and wood preservative (Septiani & Roswien, 2018). The misuse of borax in food may still occur because it can increase chewiness, improve texture, and extend product shelf life (Sari *et al.*, 2023). The use of borax as a food additive is prohibited under Regulation of the Minister of Health of the Republic of Indonesia Number 033 of 2012 concerning Food Additives because it is toxic to humans. Consumption of food containing borax can cause gastrointestinal disorders, irritation of the eyes and respiratory tract, nervous system disorders, and even death following exposure to large amounts (Erlita & Maria, 2019; Hartati, 2017). The presence of borax in processed food products needs to be monitored as part of the implementation of the Safe principle in the ASUH concept.

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To date, scientific information regarding the safety of chicken *pentol cilok* sold in Panjer Village, South Denpasar, particularly regarding borax contamination, remains limited. Qualitative testing using the LabTest Borax Test can serve as a rapid screening method to identify the presence of borax through a color change on the test paper (Aryani & Widyantara, 2018; Hartati, 2017). Therefore, this study aimed to identify the safety of chicken *pentol cilok* sold in Panjer Village, South Denpasar, with respect to the chemical hazard of borax using a qualitative test method in accordance with SNI 01-2894-1992. The results of this study are expected to provide information regarding the safety of products in circulation and support food safety monitoring and increased awareness among producers and consumers in implementing the ASUH principles.

RESEARCH METHODS

Ethical Clearance for Experimental Animals

Ethical clearance for experimental animals was not required because this study did not involve or intervene in live animals or experimental animals. The study used processed animal-derived food products (*pentol cilok*) sold in Panjer Village, South Denpasar, without conducting any intervention on animals.

Research Object

The object of this study was *pentol cilok* sold in Panjer Village, South Denpasar, involving 32 vendors. The subjects of this study were chicken *pentol cilok* vendors in Panjer Village, South Denpasar.

Research Design

This study used a descriptive design with a qualitative approach. The descriptive research design was used to describe the food safety conditions of chicken *pentol cilok* products sold in Panjer Village, South Denpasar, based on the presence of chemical contamination by borax. The qualitative approach was used to identify the presence of borax in the samples through test results, which were then systematically described without manipulating the research objects.

Research Variables

The independent variable in this study was the *pentol cilok* vendor. The dependent variable was the food safety of *pentol cilok* free from borax hazards. The control variable was Panjer Village, South Denpasar.

Data Collection Method

There were 32 *pentol cilok* vendors in Panjer Village, South Denpasar. Following a survey, samples were collected using a total sampling method because the population size was less than 100 (Sari *et al.*, 2020). Chicken *pentol cilok* samples were collected from the selected vendors, coded, and stored in closed containers. A total of 25 g of each sample was cut into small pieces, homogenized using a mortar, and then mixed with 30 mL of distilled water and homogenized. A volume of 1–3 mL of the sample suspension was transferred into a test tube, followed by the addition of 5 drops of LabTest borax reagent, and then homogenized. Subsequently, two drops of the sample solution were applied to borax test paper. All samples were qualitatively tested using the LabTest borax test kit, as shown in Figure 1.

The positive control was prepared by mixing 3–5 mL of standard borax solution with 5–10 mL of distilled water, followed by homogenization, and two drops were applied to the test paper. The test results were interpreted based on the color change on the test paper. The test paper served as the positive control. Samples were considered positive for borax when a color change

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from yellow to red to dark red occurred or when red spots were formed, whereas the absence of a color change indicated a negative result. The positive control is shown in Figure 2.

Data Analysis

The data analysis method used in this study was qualitative analysis. In food research, qualitative analysis can be used to identify the presence of a particular compound or substance in a sample, such as detecting borax. Qualitative testing was performed using a borax test kit, in which the observations were based on the color changes occurring on the test kit paper. The results of the qualitative analysis were then described to draw conclusions regarding the food safety of the tested products.

RESULTS AND DISCUSSION

Results

This study was a qualitative descriptive study involving 32 samples of chicken *pentol cilok* obtained from 32 vendors in Panjer Village, South Denpasar. Based on the test results, all samples showed 100% negative results for borax. A negative result was indicated by the absence of a color change on the test paper from yellow to red or dark red. The overall test results are presented in Table 1.

Discussion

The results showed that none of the chicken *pentol cilok* samples examined were detected to contain borax. This finding indicates that, based on the results of the qualitative testing, the chicken *pentol cilok* distributed in Panjer Village, South Denpasar, met food safety requirements with regard to the chemical hazard of borax. Nevertheless, negative results in all samples cannot be interpreted as indicating that all *pentol cilok* products in other areas are free from the possible use of borax; therefore, regular monitoring and testing remain necessary.

Borax is a chemical compound derived from the heavy metal boron (B) and is commonly used as an antifungal agent, wood preservative, and antiseptic ingredient in cosmetics (Septiani & Roswien, 2018). Borax is often misused by food producers in the manufacture of processed food products to improve taste, color, and texture (Sari *et al.*, 2023; Tubagus & Citraningtyas, 2013). The use of borax in the production of food products is prohibited under Regulation of the Minister of Health of the Republic of Indonesia Number 033 of 2012 concerning Food Additives (BTP), because it can pose a hazard to humans due to its toxicity to all cells. When the body is exposed to large amounts of borax, poisoning may occur, with clinical signs including coughing, eye irritation, vomiting, difficulty breathing, cellular toxicity, and accumulation that may result in death (Awalduin *et al.*, 2024). The borax content in *pentol cilok* is referred to as a residue. A residue is the remaining amount of a particular substance, such as pesticides or veterinary drugs, that remains on or within a material after its use or treatment process has occurred (Choirunnisa *et al.*, 2019). According to the *Kamus Besar Bahasa Indonesia* (KBBI), residue means sediment or waste. It can be interpreted that residue is an intentional occurrence in the process of producing processed food products of animal origin, such as *pentol cilok*. Characteristics of *pentol cilok* containing borax include a chewier texture and pale white color (Ulfa, 2015). It should be emphasized that the use of borax as a food additive is highly hazardous to humans.

Borax ($Na_2B_4O_7 \cdot 10H_2O$) dissolved in water dissociates into boric acid ($B(OH)_3$) and borate ions ($B(OH)_4^-$). Borate ions act as crosslinking agents by forming dynamic borate ester bonds and interchain hydrogen bonds with hydroxyl (-OH) groups of starch molecules, thereby increasing crosslink density and producing a more compact, strong, and elastic starch network (Lu *et al.*, 2024). In the production of meatballs or *pentol*, the starch in tapioca flour undergoes

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gelatinization during heating and interacts with myofibrillar meat proteins to form a stable gel network. The addition of borax strengthens the crosslinking of starch molecules, thereby increasing the strength of the starch-protein gel network, which results in a chewier, denser, more elastic, less easily broken meatball texture and better water-binding capacity. These characteristics are one of the reasons borax is misused in the production of meatballs or *pentol*, although its use as a food additive is prohibited because it is toxic and potentially harmful to health.

The results of this study are consistent with the study by Awalduin *et al*. (2024) in South Purwokerto District, which reported that the *cilok* sold did not contain borax, as demonstrated by qualitative testing using the LabTest test kit. However, these results differ from those of Ulfa (2015), who detected borax in 3 of 10 meatball samples based on flame reaction and turmeric tests. Basically, natural ingredients such as seaweed can be used to increase the chewiness of chicken *pentol cilok*. Fauziah *et al.* (2016) reported that *cilok* containing seaweed as a texturizing agent had better chewiness and contained tocopherol as an antioxidant that functions to neutralize free radicals.

The working principle of the borax test kit is based on a color change of the test paper to red or dark red. The test paper contains a turmeric-based indicator compound that can detect the presence of borax through a visually observable color change (Aryani & Widyantara, 2018). The compound in question is curcumin, which can bind to boric acid/borax to form a red-colored rosocyanine complex and can therefore be used as a test for detecting borax in food (Hartati, 2017). Curcumin is stable under acidic conditions and rapidly decomposes under conditions above neutral pH, appearing yellow at pH 1 to pH 7 and red at pH above 7.5 (Leba *et al.*, 2022; Stankovic, 2004). Borax is a weak base with a pH of 9.15–9.20, causing a color change on the test paper due to the chemical properties of curcumin, which is yellow or yellow-orange under acidic conditions and red under alkaline conditions (Khoiroh *et al.*, 2024). The same finding was also reported by Sari *et al.* (2023) and Awalduin *et al.* (2024), who stated that the color change occurs because curcumin binds with boric acid, subsequently forming a reddish-brown rosocyanine complex or a complex compound known as *Boron Cyanon*, which is a red-colored substance. The reaction that occurs involves curcumin breaking down the borax bonds into boric acid, commonly referred to as a boroncyano curcumin complex compound (Permatasari *et al.*, 2023).

Although 100% of the samples in this study tested negative for borax, this does not mean that all processed *pentol cilok* products are free from the hazard of borax. Monitoring of processed food vendors of animal origin, particularly *pentol cilok* vendors, by relevant authorities or agencies is necessary. Vendors of processed food products of animal origin sold to the public should also obtain distribution permits to ensure product quality and safety.

CONCLUSIONS AND SUGGESTIONS

Conclusion

The conclusion of this study, based on the results, is that chicken *pentol cilok* sold in Panjer Village, South Denpasar, is safe from chemical hazards (borax), as demonstrated by the negative test results obtained through qualitative borax testing based on SNI 01-2894-1992.

Suggestions

Based on the results of this study, future research is recommended to conduct food safety testing not only on chicken *pentol cilok* products but also on the additional ingredients used, such as sauces, chili sauce, and soy sauce, in order to obtain a more comprehensive assessment of the food safety of products consumed by the public. In addition, efforts to disseminate

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information and provide education to producers and vendors of food products of animal origin regarding the implementation of the ASUH principles (Safe, Healthy, Whole, and Halal) in food production and distribution processes are necessary. The possession of permits and food safety certifications for marketed products should also be improved as a form of quality assurance and consumer protection. Furthermore, regular monitoring by the relevant authorities of *pentol cilok* vendors needs to be strengthened to ensure compliance with food safety regulations and guarantee the safety of products distributed to the public.

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Table

Table 1. Results of the qualitative borax test using the LabTest test kit

Sample	Test paper color	Test result
Positive control	Red	Positive
1	Yellow	Negative
2	Yellow	Negative
3	Yellow	Negative
4	Yellow	Negative
5	Yellow	Negative
6	Yellow	Negative
7	Yellow	Negative
8	Yellow	Negative
9	Yellow	Negative
10	Yellow	Negative
11	Yellow	Negative
12	Yellow	Negative
13	Yellow	Negative
14	Yellow	Negative
15	Yellow	Negative
16	Yellow	Negative
17	Yellow	Negative
18	Yellow	Negative
19	Yellow	Negative
20	Yellow	Negative
21	Yellow	Negative
22	Yellow	Negative
23	Yellow	Negative
24	Yellow	Negative
25	Yellow	Negative
26	Yellow	Negative
27	Yellow	Negative
28	Yellow	Negative
29	Yellow	Negative
30	Yellow	Negative
31	Yellow	Negative
32	Yellow	Negative

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Figures

Figure 1. LabTest Borax Test Kit

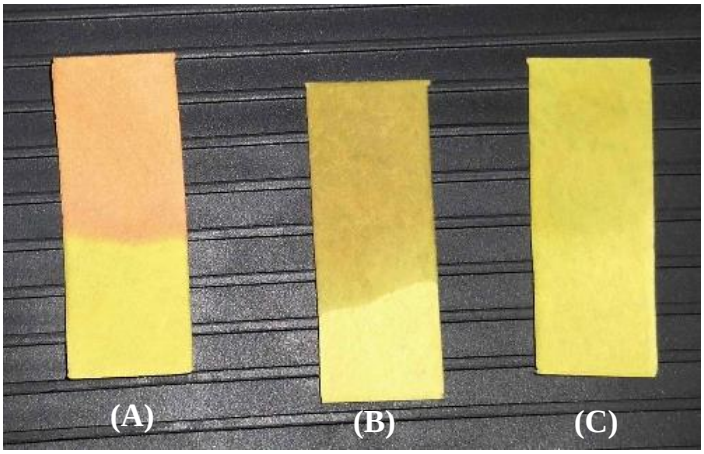

Figure 2. Results of the borax test using the LabTest test kit. (A) Positive control showing a red color change (positive for borax); (B) and (C) negative samples showing no color change (negative for borax).