SRIWIJAYA JOURNAL OF MEDICINE

Quantitative Analysis of Borax in Cilok from Selected School-area Vendors in Seberang Ulu II, Palembang Using UV–Vis Spectrophotometry

Muhammad Fachri Falahi[1], Yanti Rosita[2]*, Putri Erlyn[3], Yuni Fitrianti[2]

[1]Medical Study Program, Faculty of Medicine, Universitas Muhammadiyah Palembang, Indonesia
[2]Department of Biochemistry, Faculty of Medicine, Universitas Muhammadiyah Palembang, Indonesia
[3]Department of Pharmacology, Faculty of Medicine, Universitas Muhammadiyah Palembang, Indonesia
E-mail : yantirosita42@gmail.com

Abstract

Cilok is one of the most popular traditional street foods in Indonesia because of its chewy consistency, low price, and unique flavor. Despite its popularity, concerns regarding food safety remain, especially related to the misuse of hazardous additives such as borax. Based on the Regulation of the Indonesian Ministry of Health issued in 2012, the use of borax in food products is prohibited due to its harmful effects on human health. However, several studies have reported the continued presence of borax in traditional foods and snacks sold in the community. Therefore, this study was conducted to evaluate the physical characteristics of cilok suspected of containing borax and to measure borax concentrations quantitatively. Samples were obtained from selected vendors in the Seberang Ulu II district through purposive sampling with enrichment criteria. Borax analysis was performed using a curcumin-based UV–Vis spectrophotometric method. All collected samples showed diverse physical characteristics and were confirmed positive for borax contamination, with concentrations ranging from 2.84 to 56.28 mg/kg. These results demonstrate that borax is still being used in cilok sold by certain vendors in Seberang Ulu II, Palembang City. This condition suggests that food safety supervision by authorities, including the National Agency of Drug and Food Control and local Health Offices, has not yet achieved optimal effectiveness. Greater efforts are needed to strengthen policy implementation, improve routine monitoring, and increase educational campaigns for the public, particularly parents and school communities, in order to enhance the safety of street food products and safeguard public health.

Keywords: Borax, Cilok, UV-Vis Spectrophotometry, Curcumin Method

1. Introduction

Indonesia, with its rich culinary diversity, offers a wide variety of affordable food options for people from all walks of life, one of which is *cilok*. Cilok is a popular traditional snack in Indonesia, particularly among children and adolescents. The term *cilok* is an acronym for *"*aci dicolok*"*, referring to a snack made primarily from tapioca flour and commonly served with peanut sauce or broth. This food has its own appeal due to its chewy texture, relatively low price, and savory taste.[1] Despite its widespread consumption, concerns regarding food safety have emerged, especially due to the potential use of harmful food additives such as formaldehyde, salicylic acid, and borax.[2]

According to the Regulation of the Indonesian Ministry of Health issued in 2012 concerning food additives, the use of hazardous substances such as formaldehyde and borax in food products is strictly prohibited due to their potential health risks. Nevertheless, the misuse of borax is still found in various food products, including traditional snacks like cilok, owing to its ability to enhance textural elasticity, extend shelf life, and improve product appearance. Previous studies reported that cilok sold in several schools in Palembang City was still found to contain borax, with a positive rate reaching 40%.[3]

Therefore, quantitative analysis is necessary to determine the exact borax content in cilok circulating in Palembang.

Quantitative methods using UV-Vis spectrophotometry have been widely applied in previous studies due to their ability to accurately detect and measure borax levels. While previous studies have primarily focused on qualitative detection of borax, this study provides quantitative measurement using the UV–Vis spectrophotometric curcumin method, combined with physical characteristic profiling of cilok samples from school-area vendors.

Accordingly, this study aims to quantitatively determine the borax content in cilok using UV-Vis spectrophotometry in order to provide a clearer assessment of the food safety of this product.[4,5]

2. Method

This research employed a quantitative descriptive approach, and the samples were selected through purposive sampling techniques with enrichment criteria targeting cilok suspected of containing borax. Inclusion criteria included cilok sold around school areas in Seberang Ulu II, Palembang City, without food safety certification and showing firm texture, bright color, and resistance to disintegration. Fried or spoiled cilok were excluded. A total of ten samples were obtained. This sampling approach was not intended to represent the overall cilok population.

Borax analysis was performed using the curcumin-based UV–Vis spectrophotometric method. Quantitative identification was based on the formation of a red-colored complex after reaction with curcumin reagent under acidic conditions, indicating the presence of borax. Quantitative determination was conducted by measuring absorbance and calculating concentrations using a calibration curve.

Standard borax solutions (5, 10, 15, 20, 30 µg/mL) were prepared from a stock solution (500 µg/mL). Each solution was treated with NaOH, heated to dryness, reacted with curcumin, followed by the addition of a sulfuric acid–acetic acid mixture. After dilution with ethanol, absorbance was measured at 380–500 nm to determine the maximum wavelength. A calibration curve was constructed using absorbance values at the selected wavelength.

Cilok samples (25 g) were homogenized with 100 mL of distilled water and centrifuged. One milliliter of the supernatant was treated with 10% NaOH, heated to dryness, and further heated at 100 ± 5°C for 5 minutes. After cooling, the curcumin solution and acid mixture were added sequentially. The solution was filtered, diluted to 50 mL with ethanol, and measured at the maximum wavelength using a UV–Vis spectrophotometer.[6] Preparation of positive control was conducted by producing cilok with the addition of borax at a concentration of 25 grams per 300 grams of ingredients. Meanwhile, the negative control was prepared using the same ingredients as regular cilok without the addition of borax.[6]

The limit of detection (LOD) and limit of quantification (LOQ) were estimated from the calibration curve, yielding values of 5.72 µg/mL and 17.32 µg/mL, respectively. Data were analyzed descriptively and presented as mean, range, and standard deviation. This study has received ethical approval from the Bioethics Committee of the Faculty of Medicine, Universitas Muhammadiyah Palembang (No. 097/EC/KBHKI/FK-UMP/X/2025).

3. Result

This study was conducted at the Biomedical Laboratory, Faculty of Medicine, Universitas Muhammadiyah Palembang, involving a total of ten samples. Quantitative analysis of borax content was performed using UV–Vis spectrophotometry with a Dlab-brand instrument. Macroscopic observations were first carried out to assess the physical characteristics of each cilok sample, including color, aroma, and texture. Subsequently, quantitative testing was conducted by measuring the absorbance values of the prepared sample analytes. The observed physical characteristics of the cilok samples are presented in Table 1.

Based on Table 1, the evaluation results indicate that all cilok samples exhibited variations in physical characteristics, including differences in color, aroma, and consistency. Visually, the samples showed whitish-gray, dark gray, and yellowish-white colors, with predominant savory or flour-like aromas. In terms of texture, variations were observed, ranging from soft, chewy, and very chewy to chewy with a tendency toward hardness. This pattern was further supported by comparisons with control samples, in which the borax-treated positive control exhibited a chewy to hard texture, while the negative control tended to be soft. Following the physical observation, the analysis was continued with quantitative testing using UV–Vis spectrophotometry, beginning with the determination of the maximum wavelength of a 500 µg/mL standard borax solution within the range of 380–500 nm.

Table 1. Physical Characteristics

Sample code	Physical Indicator		
	Color	**Aroma**	**Texture**
A	White-Grey	Savoury	Very chewy
B	White-Grey	Flour	Chewy
C	White-Yellowish	Savoury	Soft
D	Grey	Flour	Slightly firm
E	White-Yellowish	Savoury	Soft
F	Grey	Savoury	Very chewy
G	White	Savoury	Soft
H	Grey	Flour	Chewy
I	White-Grey	Savoury	Slightly firm
J	White-Grey	Savoury	Soft
Control +	White	Flour	Chewy and firm (tough)
Control –	White	Flour	Soft

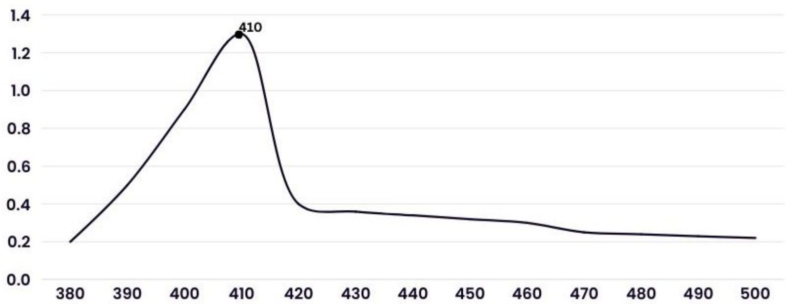

Figure 1. Maximum Wavelength

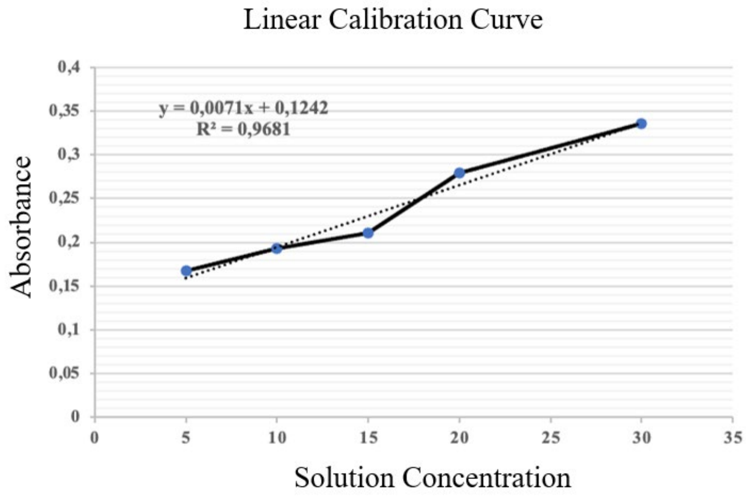

Figure 2. Regression Calibration Curve

The maximum wavelength (λmax) of the standard borax solution was obtained at 410 nm. The difference between this value and that reported by Rohani *et al.* is presumed to be influenced by variations in the specifications and sensitivity of the spectrophotometric instruments used.[7] Subsequently, a calibration curve was constructed using standard borax solutions with concentrations of 5, 10, 15, 20, and 30 µg/mL, measured at a wavelength of 410 nm, yielding absorbance values of 0.167, 0.193, 0.211, 0.279, and 0.336, respectively, as presented in Figure 2.

The calibration curve results indicate that absorbance values increased with increasing borax concentration. The relationship between concentration and absorbance was expressed by the linear regression equation *y = 0,0071x + 0,1242* with a coefficient of determination (R^2) of 0.9681, indicating a strong linear relationship and meeting the acceptance criteria due to its proximity to 1. This regression equation was subsequently used to calculate the borax content in cilok samples, with absorbance as the dependent variable and concentration as the independent variable.[6] The limit of detection (LOD) and limit of quantification (LOQ) were estimated based on the standard deviation of the regression residuals and the slope of the calibration curve. LOD and LOQ were calculated using the equations LOD = 3.3 × (SD/slope) and LOQ = 10 × (SD/slope). The obtained LOD and LOQ values were 5.72 µg/mL and 17.32 µg/mL, respectively, and are presented in Table 2.

Table 2. Calculation Table for Residual

Concentration (µg/mL)	Observed	Predicted y = 0,0071x + 0,1242	Residual (Observed-Predicted)
5	0.167	0.1597	0.0073
10	0.193	0.1952	-0.0022
15	0.211	0.2307	-0.0197
20	0.279	0.2662	0.0128
30	0.336	0.3372	-0.0012

Standard Deviation (SD) of residuals = 0.0123;

LOD = 3,3 x (0,0123/0,0071) = 5.72 µg/mL; LOQ = 10 x (0,0123/0,0071) = 17.32 µg/mL

Table 3. Borax Level, Borax Content Each Sample, and Interpretation of LOD-LOQ

No	Code		Absorbance	Borax level (µg/ml)		Borax Content (mg/kg)	Interpretation of LOD-LOQ
				result	mean		
1	A	A 1	0.323	28	28.09	56.18	≥ LOQ
		A 2	0.326	28.42			
		A 3	0.322	27.85			
2	B	B 1	0.159	4.90	5.04	10.08	< LOD
		B 2	0.161	5.18			
		B 3	0.160	5.04			
3	C	C 1	0.135	1.52	1.42	2.84	< LOD
		C 2	0133	1.23			
		C 3	0.135	1.52			
4	D	D 1	0.152	3.91	3.81	7.62	< LOD
		D 2	0.152	3.91			
		D 3	0.150	3.63			
5	E	E 1	0.184	8.42	8.32	16.64	LOD–LOQ
		E 2	0.184	8.42			
		E 3	0.182	8.14			
6	F	F 1	0.209	11.94	11.66	23.32	LOD–LOQ
		F 2	0.206	11.52			
		F 3	0.206	11.52			
7	G	G 1	0.192	9.54	9.59	19.18	LOD–LOQ
		G 2	0.193	9.69			
		G 3	0.192	9.54			
8	H	H 1	0.186	8.70	8.74	17.48	LOD–LOQ
		H 2	0.186	8.70			
		H 3	0.187	8.84			
9	I	I 1	0.154	4.19	4.09	8.18	< LOD
		I 2	0.153	4.05			
		I 3	0.153	4.05			
10	J	J 1	0.139	2.08	2.17	4.34	< LOD
		J 2	0.139	2.22			
		J 3	0.140	2.22			
11	Control +	K 1	0.514	54.90	54.99	109.98	≥ LOQ
		K 2	0.514	54.90			
		K 3	0.516	55.18			
12	Control –	L 1	0.077	0	0	0	< LOD
		L 2	0.075	0			
		L 3	0.077	0			

10 samples: Mean ± SD = 16,59 ± 14,83 mg/kg; Range 2,84 – 56,28 mg/kg; coefficient of variation (CV) = 89,4%

Borax content in samples (mg/kg) was calculated from the measured concentration in the final extract (µg/mL) by considering the sample weight (25 g) and the final extract volume (50 mL). The conversion was performed using the equation:

$$\text{Borax content (mg/kg)} = \frac{(CxV)}{(1000xW)}$$

Where C is the measured concentration (µg/mL), V is the final volume of the extract (mL), and W is the sample weight (kg). Based on this calculation, the conversion factor used in this study was mg/kg = C × 2.

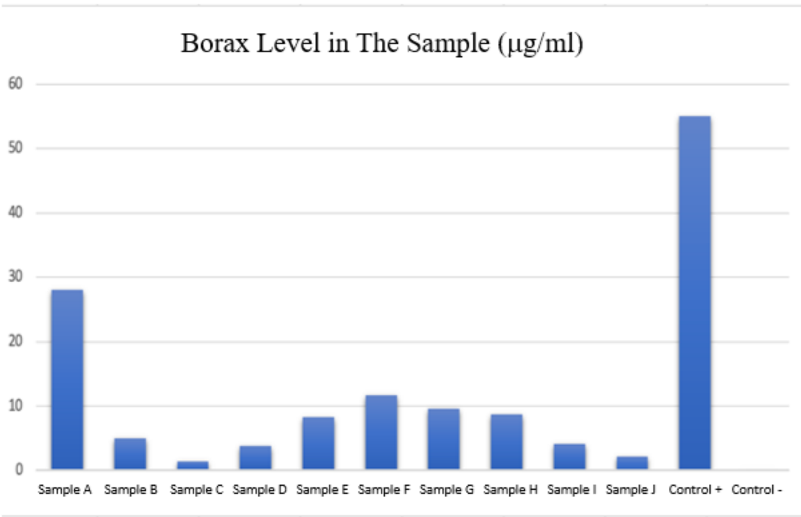

Figure 3. Diagram Average Borax Level

The results of the borax content analysis of the ten cilok samples tested using UV–Vis spectrophotometry with three replicates are presented in Table 3. The data presented in Table 2 show that the standard deviation of the residuals was calculated from the difference between observed and predicted absorbance values. The mean residual was first determined, followed by the calculation of squared deviations, which were summed and divided by (n−1). The square root of this value yielded an SD of 0.0123.

The data presented in Table 3 show that all cilok samples analyzed with three replicates were detected to contain borax at varying concentrations. The highest borax content was found in Sample A at 58,16 mg/kg, while the lowest concentration was observed in Sample C at 2,84 mg/kg. The positive control test yielded a high borax concentration of 109,98 mg/kg, whereas borax was not detected in the negative control. The borax content showed a mean value of 16.59 ± 14.83 mg/kg, with a range of 2.84 to 56.28 mg/kg. The high coefficient of variation (89.4%) indicates substantial variability in borax levels among samples, suggesting differences in processing practices among vendors.

Based on the calculated LOD (5.72 µg/mL) and LOQ (17.32 µg/mL), only two samples showed borax concentrations above the LOQ, indicating reliable quantitative results. Four samples had concentrations between the LOD and LOQ, suggesting the presence of borax but with limited quantitative accuracy. The remaining samples were below the LOD, indicating that borax was not reliably detected in those samples. These findings indicate that although borax was detected in several samples, only a small proportion could be quantified reliably, highlighting limitations in the sensitivity of the analytical method for low-level detection.

The mean borax concentrations of the ten cilok samples and two control samples analyzed using UV–Vis spectrophotometry are presented in Figure 3.

4. Discussion

This study was conducted to analyze the presence and concentration of borax in cilok snacks using the UV–Vis spectrophotometric method. Cilok, an abbreviation of *aci dicolok*, is a traditional West Javanese snack made primarily from tapioca and wheat flour that is boiled and shaped into small balls, resulting in a naturally white color and chewy texture.

Cilok is highly popular due to its affordability, wide availability, and acceptance among various age groups, particularly school-aged children and university students.[8,9] Observations of physical characteristics revealed that the ten cilok samples exhibited considerable variation in color, aroma, and texture. Five samples were whitish-gray, three were dark gray, and two were yellowish-white; in terms of aroma, seven samples exhibited a savory odor, while three had a flour-like aroma. Textural variations were also observed, ranging from soft, chewy, very chewy, to chewy with a tendency toward hardness. The negative control cilok showed natural characteristics, namely a white color, flour aroma, and soft texture consistent with its flour-based ingredients, whereas the positive control cilok exhibited a chewy to hard texture, illustrating physical changes associated with borax addition.

Quantitative analysis using UV–Vis spectrophotometry demonstrated that all tested cilok samples (A–J) were positively detected to contain borax at varying concentrations, with Sample A exhibiting the highest level at 28.09 µg/mL and Sample C the lowest at 1.42 µg/mL. The use of borax at low concentrations did not always result in noticeable physical changes, as evidenced by the similarity between several samples and the negative control prepared without borax. In contrast, the positive control, which contained borax at a concentration of 25 g per 300 g of dough, showed marked differences, including a whitish-gray appearance and a very chewy to hard (tough) texture. Overall, variations in physical characteristics among the ten samples indicated that Samples A and F exhibited very chewy textures consistent with relatively higher borax concentrations, in line with literature reporting borax as a texturizing agent. Meanwhile, Samples D and I demonstrated chewy-to-hard textures despite low borax levels, suggesting the influence of other food additives such as sodium tripolyphosphate (STPP) or carrageenan, as well as processing factors, particularly water proportion in the dough.[10] Variations in cilok color were also observed, with whitish-gray coloration presumed to be associated with the addition of beef broth, which may affect product color, taste, and aroma.

The observed association between texture and borax content in this study was based on subjective assessment. Future studies should incorporate objective texture measurements (e.g., texture analyzer) or standardized sensory evaluation to validate this relationship. This represents a limitation of the study, as the assessment of texture was subjective and may introduce measurement bias.

The results of this study indicate that all samples obtained from different vendors tested positive for borax at varying concentrations ranging from 1.42 to 28.09 µg/mL. Differences in borax levels among samples were influenced by the amount added and the intended purpose of its use. These findings are consistent with the literature stating that spectrophotometric methods are capable of detecting borax even at low concentrations.[11] Thus, the widespread use of borax in cilok can be understood as a combination of its chemical functions as both a preservative and a texture enhancer, facilitated by its availability under alternative names (e.g., *bleng*), low cost, and widespread accessibility.[12] The presence of borax in all samples indicates that illegal use of borax as a food preservative in cilok persists. Even at low concentrations, borax use is prohibited due to its potential health risks, as regulated by the Indonesian Ministry of Health through Regulation No. 033 of 2012.[13] Nevertheless, the purpose of borax use in this study cannot be definitively identified as a preservative, as shelf-life testing at room temperature was not conducted.

Although most samples contained low borax concentrations, its presence in food remains hazardous due to its carcinogenic and toxic properties when accumulated in organs such as the liver, kidneys, brain, and testes. Reported health effects include decreased appetite, hematemesis, gastrointestinal irritation, central nervous system disturbances, and organ damage. A study by Zurimi & Assagaf (2023) reported that excessive borax consumption at doses reaching 2 g/kg body weight can cause poisoning, with symptoms including skin and respiratory tract irritation; digestive disorders such as nausea, persistent vomiting, abdominal pain, and diarrhea; while severe poisoning may lead to skin rashes, decreased consciousness, respiratory depression, and even renal failure.[14] Lethal doses in adults range from 15–25 g/kg body weight, while in children they range from 5–6 g/kg body weight.[15] Furthermore, a study by Juhana & Rohmah (2016) demonstrated that oral borax administration at graded doses for four weeks in Wistar rats resulted in macroscopic and microscopic alterations in renal morphology.[16] Although the toxic effects of borax are well documented, this study did not assess dietary exposure or consumption patterns; therefore, the actual health risk to consumers cannot be determined.

Borax testing, whether qualitative or quantitative, can be employed for detection; however, both approaches differ significantly in terms of technical aspects and sensitivity. Qualitative methods such as flame tests, turmeric paper tests, and borax test kits rely on characteristic color changes or flame reactions.[17,18] These methods are rapid and simple, do not require expensive equipment or highly trained personnel, and are suitable for preliminary screening, but they exhibit low sensitivity.[7] In contrast, quantitative methods offer higher sensitivity, enable detection of borax at low concentrations, and provide accurate numerical values, thereby justifying the necessity of quantitative studies even when qualitative testing has been previously performed.[19,20]

While previous studies in Palembang have identified borax in school snacks[3], the present study extends these findings by quantifying borax levels, revealing substantial variability (2.84 to 56.28 mg/kg). This variation may be influenced by differences in food processing practices, sampling methods, and analytical techniques used in studies.

It is important to note that the sampling approach used in this study was purposive with enrichment criteria targeting suspected borax-containing cilok; therefore, the findings do not represent the overall prevalence of borax contamination in Palembang City. Despite this limitation, these findings indicate that the use of borax was detected in all selected samples, suggesting that illegal use of borax may still occur, or its use may still occur in certain settings. These findings highlight the need for strengthened monitoring systems and stricter regulation of borax distribution, as well as improved public education, particularly for schools and parents, regarding the importance of selecting safe and healthy snacks to protect public health.

5. Conclusion

Physical examination revealed considerable variability in the color, aroma, and texture of all cilok samples analyzed. The observed colors included grayish-white, dark gray, and yellowish-white, while the aromas were characterized as savory or flour-like. In terms of consistency, the samples ranged from soft to chewy, very chewy, and slightly hard-chewy. Quantitative testing confirmed that all samples were positive for borax, with concentrations ranging between 1.42 µg/mL and 28.09 µg/mL.

References

1. Darmawan E, Saputro AE, Firsta NC. *Kandungan Gizi dan Daya Terima Cilok dengan Penambahan Daun Kelor (Moringa oleifera)*. *AGROTECH*. 2024;6(1):24–25.
2. Wahyuningsih S, Nurhidayah N, Melinda T. *Uji Kualitatif Kandungan Boraks Pada Cilok yang di Jual di Lingkungan Karang Jangu Kota Mataram*. Journal Sanitasi dan Lingkungan. 2022;3(1):216-222.
3. Fitri Y. *Identifikasi Kandungan Boraks pada Pangan Jajanan Anak Sekolah di Kota Palembang*. *Repository Politeknik Kesehatan Palembang*. 2018.
4. Sulaiman RN, Augustina I, Ratnasari A, Toemon AI, Nugrahini S. *Analisis Kandungan Boraks (Natrium tetraborat) Pada Kerupuk yang Beredar di Pasar Besar Kota Palangka Raya*. *J Kedokt Univ Palangka Raya*. 2024;12(1).
5. Sepriyani H, Devitria R. *Analisis Boraks Pada Jajanan Anak Yang Dijual Di SDN 18 Dan SDN 20 Kota Pekanbaru*. *Jurnal Analisis Kesehatan Klinikal Sains*. 2018;5(1):8.
6. Bolo AL, Wibawa DAA, Soebiyanto. *Analisis Boraks Dan Formalin Pada Bakso Di Kelurahan Mojongsongo Kota Surakarta*. *Journal Kimia dan Rekayasa*. 2023;4(1):1–8.
7. Rohani S, Rosita Y, Pramayastri V, Hafidzah L. *Borax Analysis With Spectrophotometry On Meat Bakso Of Frozen Food That Sold In Modern Markets And Traditional Markets In Palembang*. *Int J Ecophysiol*. 2023;5(1):19–35.
8. Putra MEY, Kurniawati E. *Uji kualitatif keberadaan boraks pada cilok yang dijual di beberapa lokasi di Kecamatan Bondowoso*. *J Agritechnol Food Process*. 2023;3(2):85–91.
9. Khomsiyah S, Ayun Q, Susanti REE. *Pengembangan Metode Spektrofotometer UV-Vis Untuk Menentukan Kadar Boraks Dengan memanfaatkan Senyawa antosianin dari Ekstrak Buah Naga Sebagai Indikator*. *Jurnal Crystal*. 2019;1(2):23–33.
10. Amalia L, Velita V, Mardiah M, Kusumaningrum J. *Pengaruh Penambahan Berbagai Pengenyal Terhadap Karakteristik Kimia Dan Sensori Bakso MDM (Mechanically Deboned Meat) Ayam*. *Jurnal Ilmiah Pangan Halal*. 2023;5(2):91–101.
11. Suharyani I, Rohadi D, Kunaedi A, Tomi, Arisandi D, Hasim I, et al. *Review: Berbagai Metode Analisis Kualitatif Dan Kuantitatif BORAKS Dalam Sampel Makanan*. *Journal of Pharmacopolium*. 2021;4(3):174–179.
12. Putri MA, Priatni L. *Analisis Kuantitatif Kandungan Boraks pada Ketupat dengan Metode Spektrofotometri UV-Vis*. Cerata Jurnal Ilmu Farmasi. 2024;15(2):101–109.
13. Kementerian Kesehatan RI. *Peraturan Menteri Kesehatan RI Nomor 033 tahun 2012 tentang Bahan Tambah Pangan*. 2012.
14. Zurimi S, Assagaf F. *Deteksi Boraks Menggunakan Kertas Whatman Dengan Ekstrak Kunyit (Curcuma Longga Linn) Pada Tahu Di Pasar Mardika Kota Ambon*. Global Health Science. 2023;8(1):9.
15. Harimurti S, Setiyawan A. *Analisis Kualitatif dan Kuantitatif Kandungan Boraks Pada Bakso Tusuk di Wilayah Kabupaten Gunungkidul Provinsi Daerah Istimewa Yogyakarta*. Farmasains : Jurnal Ilmiah Ilmu Kefarmasian. 2019;6(2):43–50.
16. Juhana HA, Rohmah IN. *Pengaruh Pemberian Boraks Dengan Dosis Bertingkat Terhadap Perubahan Makroskopis Dan Mikroskopis Ginjal*

Tikus Wistar Selama 4 Minggu Dilanjutkan 2 Minggu Tanpa Paparan Boraks. Jurnal Kedokteran Diponegoro. 2016;5(1):65–70.

17. Nurlailia A, Sulistyorini L, Puspikawati SI. *Analisis Kualitatif Kandungan Boraks pada Makanan di Wilayah Kota Banyuwangi*. Media Gizi Kesmas. 2021;10(2):254–260.
18. Muada D, Maarisit W, Hariyadi, Paat VI. *Identifikasi Kandungan Boraks (H3BO3) Pada Bakso yang DiJual di Kota Tomohon*. Jurnal Biofarmasetikal Tropis. 2019 Mar 9;2019(1):16–21.
19. Umar CBP, Latumahina M. *Analisis Kadar Boraks Pada Tahu Putih Yang Di Produksi Dengan Menggunakan Spektrofotometri UV-Vis*. Jurnal Riset Rumpun Ilmu Kedokteran (JURRIKE). 2022;1(1):20–27.
20. Akbar M, Hidayati L, Alfian M. *Analisis Kandungan Boraks Pada Makanan Cilok Menggunakan Spektrofotometri Uv-Vis Sebagai Verifikasi Produk Halal Di Daerah Istimewa Yogyakarta*. Jurnal Penelitian dan Pengabdian Kepada Masyarakat UNSIQ. 2024;11(01):25–31.