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DETECTION TOOL FOR BORAX CONTENT IN MEATBALL FOOD

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ABSTRACT

The use of prohibited food additives is still often found and is even increasing, especially among food entrepreneurs. Small industries or households generally produce these additives. One type of food preservation that is currently widely used is borax and formalin. This research aims to determine the tool's characteristics for detecting preservatives (borax) in food and the presence/absence of preservatives (borax) in meatball food. The method used in this research is an experiment using Arduino, TCS320 colour sensor, LCD, and mini projectboard. The results obtained in this research can conclude that borax is still used in meatball-type food. However, whether the seller uses borax on purpose or the flour used contains borax without the seller knowing it has yet to be known. The borax content itself dramatically influences the frequency value. Based on the results of checks using tools that have been made, meatballs in Wonosobo that are sold to the public have been detected to contain 15% borax. This amount shows a high value and is dangerous for the health of those who consume this food. This research is significant for people who consume meatballs.

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1. INTRODUCTION

The use of prohibited food additives is still often found and is even increasing, especially among food entrepreneurs. Small industries or households generally produce these additives. Good food must comply with the Food and Drug Supervisory Agency (BPOM) standards for humans and meet health and hygiene requirements. Food can be freely circulated and sold in Indonesia without going through the BPOM for health. More than 70% of the food circulated and sold is produced by producers that are still far from meeting health requirements and are fit for consumption. The problem we often face from time to time is a problem in the field of safety, namely food poisoning (Rorong & Wilar, 2020; Sari, 2017).

The use of preservatives in the health sector raises various problems that require special attention from regulators, the health industry, and the public (Lestari, 2020; Nababan et al., 2021). Although preservatives have an essential role in maintaining the stability and effectiveness of health products, such as medicines, vaccines, and some biological products, their use is not free from concerns regarding potential health risks. Preservatives such as borax and formalin, often used in health products, can cause user side effects. For example, borax has been linked to endocrine disruption and a potentially increased risk of cancer, while formaldehyde is a known carcinogenic substance that can cause allergic reactions, skin irritation, and respiratory problems (Asmi et al., 2023; Santi, 2017). Certain preservatives must be used carefully, especially in products used regularly and in the long term.

The health industry often relies on preservatives to maintain the quality and safety of health products, including in producing vaccines and medicines that require long-term stability. This dependency created a dilemma when it was discovered that certain preservatives were potentially harmful to health, forcing the industry to look for safe yet effective alternatives. In responding to the problem of using preservatives, research and developing safer alternatives is very important. Several studies have focused on using natural and synthetic materials that are more environmentally friendly and have a better safety profile. However, challenges in effectiveness, stability, and production costs often become obstacles to replacing traditional preservatives.

One type of food preservation that is currently widely used is borax and formalin (Alifia et al., 2023; Nurkhamidah, 2017). Borax is widely used in food preservation industries to make wet noodles, lontong, ketupat, tofu, meatballs, sausages, and soy sauce. Even though this chemical is a toxic material and dangerous for humans, it is strictly prohibited from being used as a raw food material or additive. Borax is a chemical compound derived from the heavy metal boron (B) (Sugiyono et al., 2009; Suseno, 2019). Borax is an antiseptic and germ killer. This material is widely used in cosmetics as an anti-fungal, wood preservative, and antiseptic (Santoso et al., 2012). Borax is usually called sodium tetraborate ($Na_2[B_4O_5(OH)_4]\cdot 8H_2O$). If it dissolves in water, it will become hydroxide and boric acid. Consuming foods containing borax does not have immediate harmful consequences, but borax will accumulate little by little because it is absorbed in the human body cumulatively. The prohibition on the use of borax is also strengthened by the Republic of Indonesia Minister of Health Regulation No. 235/Menkes/VI/1984 concerning food additives, which states that sodium tetraborate, better known as borax, is classified as a food ingredient that is prohibited from being used in food. However, in reality, there are still many forms of abuse of chemical substances (Agung et al., 2019; Alifia et al., 2023).

Borax is widely used in industries such as food preservation in making wet noodles, lontong, ketupat, tofu, meatballs, sausages, and soy sauce. Even though this chemical is a toxic material and dangerous for humans, it is strictly prohibited from being used as a raw food material or additive. Borax is a chemical compound derived from the heavy metal boron (B) (Sugiyono et al., 2009; Suseno, 2019). Borax is an antiseptic and germ killer. This material is widely used in cosmetics as an anti-fungal, wood preservative, and antiseptic (Santoso et al., 2012; Septiani & Roswien, 2018). Borax is usually called sodium tetraborate ($Na_2[B_4O_5(OH)_4]\cdot 8H_2O$). If it dissolves in water, it will become hydroxide and boric acid. Consuming foods containing borax does not have immediate bad consequences, but borax will accumulate little by little because it is absorbed in the human body cumulatively. The prohibition on the use of borax is also strengthened by the Republic of Indonesia Minister of Health Regulation No. 235/Menkes/VI/1984 concerning food additives, which states that sodium tetraborate, better known as borax, is classified as a food ingredient that is prohibited from being used in food. However, in reality, there are still many forms of abuse of chemical substances.

Formalin is often misused, although based on the Regulation of the Minister of Health of the Republic of Indonesia No. 033 of 2012, formalin is prohibited from being used as a food additive (Budianto, 2011; Dewi, 2019). Formalin is widely used as a food preservative by home industries or small and medium industries. This is because the price is relatively more affordable compared to using preservatives included in the ADI group, such as benzoic acid and its salts. Formaldehyde abuse, especially in food, is a serious public health issue. Formalin, chemically known as formaldehyde solution, is traditionally used as a preservative in the medical and cosmetic industries. However, due to its preservative properties, formaldehyde has also been misused in food preservation, although this is prohibited in many countries due to the health risks it poses.

Apart from health risks, misuse of formaldehyde in food also raises issues of trust and food safety (Budianto, 2011; Rahmawati, 2021). Consumers are becoming concerned about the safety of the food they consume, which can have a negative impact on the food industry, especially sectors that depend on consumer trust, such as the fishing and agricultural industries. Several steps have been taken to address this problem, including increased supervision and regulation by health and food safety authorities, public education regarding the dangers of formaldehyde, and the development and promotion of the use of safer alternative preservatives for food . However, effective law enforcement and widespread public awareness remain key challenges in combating the abuse of formaldehyde in food. This concern ultimately prompted us to create a microcontroller-based food preservative (borax) detection tool. So, this research aims to discover the characteristics of the preservative (borax) detection tool in food that is made and the presence/absence of preservatives (borax) in meatball food sold in the community.

2. METHOD

In this research, designing tools is an integral part of the research method. Figure 1 presents the detection tool design suite for preservatives (borax) in food. The working principle of this borax detector uses the TCS3200 color sensor. This sensor functions to change color into the electric current; then, the electric current is converted into a frequency as a square signal. The Arduino Uno circuit can directly read sensor output data via the INT0 pin, a pin with a particular function as a hardware or software interrupt. The results of the color sensor reading will produce the RGB Frequency. The change in the RGB frequency value differentiates food that contains borax from food that is free of borax.

The data analysis technique used is qualitative descriptive. This type of qualitative descriptive research utilizes qualitative data and describes it descriptively. This type of qualitative descriptive research is often used to analyze social events, phenomena, or situations. In this study, we examined the reading results of the preservative (borax) detection tool for each meatball with variations in the mass of borax. Apart from that, we also tested meatballs taken from several sellers in the city of Wonosobo. In this study, we examined the reading results of the preservative (borax) detection tool for each meatball with variations in the mass of borax. Apart from that, we also tested meatballs taken from several sellers in the city of Wonosobo.

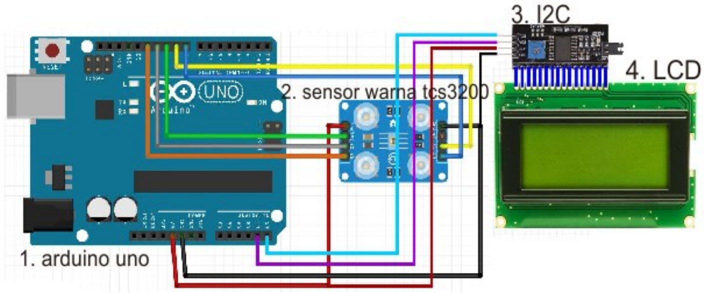

Figure 1. Detection tool design suite for preservative (borax) in food

3. RESULTS AND DISCUSSION

The color detection system with the TCS3200 sensor works when the photodiode receives an input signal, then the current from the photodiode is converted into a square signal (Athifa & Rachmat, 2019). The resulting signal frequency is proportional to the intensity of the LED light on the sensor. The sensor has an 8 × 8 photodiode consisting of 16 red, green, blue, and no color filters each. To activate each filter, this can be done by setting the S2 and S3 selectors to select the photodiode that will be activated according to the color that will be detected. Then, selectors S0 and S1 are used to set the desired output frequency scale.

Using a color sensor in a borax detector is useful for detecting color changes in borax when it is dripped with turmeric (Indah et al., 2023). Turmeric contains curcumin, which can react with borax (Astuti & Nugroho, 2017). From this reaction, a color change occurs. Colors contain waves that color sensors can convert into frequencies. By distinguishing the frequencies produced by color sensor readings, we can distinguish which foods contain borax. The following explains the respective colors Red, Green, and Blue from foods containing borax.

The way to calibrate the tool is to take the object under study, place the object support in its original place, and wait 1 minute until the LCDs show that this food is borax-free. This borax detection tool will turn on automatically when the probe cable is connected to the available power bank. Using a power bank on this tool saves on buying batteries continuously because we only need to recharge them when the battery runs out. The reading results on this Borax Detector Tool will be at their maximum if the light is adequate because light greatly influences the color sensor reading results.

This research started by varying the mass of borax and continued with variations of meatballs taken from various sellers in the Wonosobo city area.

3.1. Variation of Borax Mass

Data collection was taken by varying the mass of borax in the same food. With a control variable in the form of the color change time of food dripped with turmeric. The time used was 60 s, and the variations in borax mass were 0.3, 0.6, and 0.9 g of borax. Based on Table 1, it can be seen that meatball without borax has a value of R (68), G (80), and B (68), and the display on the LCDs shows "this food is free of borax". This is based on original data, which states no borax in meatballs. Meatballs with 0.3 g of borax produce a value of R (81), G (92), and B (78), and the display on the LCD is "This food has 8% borax". After increasing the borax mass to 0.6 g in meatballs, the resulting values are R (99), G (112), and B (92), and the display on the LCD is "This food has 35% borax". Based on this result, the increase of borax mass in the meatball also presents the enhancement of borax value in LCD by detection tool of borax preservative.

Table 1. Detection results of borax preservative in meatballs with variations in borax mass

No	Food	Time (s)	RGB value (Hz)			LCD Display
			R	G	B	
1	Meatball without borax	60	66	81	69	borax free
2	Meatball with 0.3 g of borax	60	81	91	77	8% borax
3	Meatball with 0.6 g of borax	60	81	99	88	16% borax
4	Meatball with 3 g of borax	60	99	112	92	35% borax

3.2. Variation of meatballs in several places

Data was collected by testing meatballs sold in several places in Wonosobo to determine whether they contained borax.

Table 2. Detection results of borax preservative with variations of meatballs in several places

No	Food	Time (s)	RGB value (Hz)			LCD Display
			R	G	B	
1	Meatball in place 1	60	66	79	68	borax free
2	Meatball in place 2	60	64	72	65	borax free
3	Meatball in place 3	60	81	100	87	16% borax

Based on Table 2, testing meatballs from various places selling meatballs in Wonosobo in place one obtained values of R (67), G (68), and B (80), and the display on the LCD screen was "This food is free of borax". In the meatball sample in place 2, the values R (64), B (72), and G (66) were obtained, and the display on the LCD screen was "This food is borax-free". Different results were found for meatballs in place three, which showed results R (79), B (99), and G (87), and the display on the LCD screen was "this food contains 16% borax". The results in this third place are dangerous for health because they contain high borax levels. Many meatballs are circulating and consumed by the public, but they contain much borax, which humans should not consume. From the data obtained above, it can be seen that in the city of Wonosobo, some still use borax to make meatballs. To avoid meatballs that use borax, improving your health by cooking your food or reducing fast food such as meatballs is better.

4. CONCLUSION

The tool for detecting preservatives (borax) in food is a microcontroller-based borax detection tool that looks at the color difference before giving turmeric. Borax will change color when you drop turmeric water because it contains curcumin, which will react when it meets borax. This tool will detect changes in food color by calculating the borax's RGB value, which can produce a color change presentation. High levels of borax greatly influence the RGB frequency value. From the data obtained, it can be seen that in Wonosobo, borax is still used. However, it is still being determined whether the maker deliberately used borax or whether the flour already contained borax without the seller knowing it. The results of checks using tools that have been made, meatballs in Wonosobo that are sold to the public have been detected to contain 15% borax. This amount shows a high value and is dangerous for the health of those who consume this food. This research is significant for people who consume meatballs.

REFERENCES

Agung, M., Hasibuan, T. O., Studi, P., Analis, D., Abdi, S., & Palembang, N. (2019). Analis Keberadaan Boraks Pada Rebusan Daun Singkong Dirumah Makan Padang. *Jurnal ‘Aisyiyah Medika*, *4*, 35–43.

Alifia, N. N., Marlina, E. T., & Utama, D. T. (2023). Analisis Kandungan Boraks dan Formalin pada Produk Olahan Daging yang dijual oleh UMKM di Kota Bandung. *Jurnal Teknologi Hasil Peternakan*, *4*(1), 62.

Asmi, N. F., Nurpratama, W. L., & Alamsah, D. (2023). Uji kandungan boraks, formalin dan rhodamin B pada makanan jajanan mahasiswa. *Jurnal SAGO Gizi Dan Kesehatan*, *4*(2), 152.

Astuti, E. D., & Nugroho, W. S. (2017). Kemampuan Reagen Curcumax Mendeteksi Boraks dalam Bakso yang Direbus Capability of Curcumax reagent to detect borax in boiled meatballs. *Jurnal Sains Veteriner*, *35*(1), 42–48.

Athifa, S. F., & Rachmat, H. H. (2019). Evaluasi Karakteristik Deteksi Warna Rgb Sensor Tcs3200 Berdasarkan Jarak Dan Dimensi Objek. *Jetri : Jurnal Ilmiah Teknik Elektro*, *16*(2), 105–120.

Budianto, A. (2011). Formalin Dalam Kajian Undang-Undang Kesehatan; Undang-Undang Pangan dan Undang-Undang Perlindungan Konsumen. *Jurnal Legislasi Indonesia*, *8*(1), 151–172.

Dewi, S. R. (2019). Identifikasi Formalin Pada Makanan Menggunakan Ekstrak Kulit Buah Naga. *Jurnal Nasional Ilmu Kesehatan*, *2*(1), 10–19.

Indah, Z., Pratama, M. I. L., & Melo, R. H. (2023). Sosialisasi Penggunaan Kunyit Sebagai Bahan Uji Deteksi Borak Di Desa Padang Kuas. *Jambura Arena Pengabdian*, *1*(1), 6–8.

Lestari, T. R. P. (2020). Keamanan Pangan Sebagai Salah Satu Upaya Perlindungan Hak Masyarakat Sebagai Konsumen. *Aspirasi: Jurnal Masalah-Masalah Sosial*, *11*(1), 57–72.

Nababan, R., Sidauruk, J., & Sihotang, L. (2021). Perlindungan Konsumen Terhadap Penggunaan Bahan Pengawet Makanan Menurut Undang-Undang Nomor 8 Tahun 1999 Tentang Perlindungan Konsumen. *Jurnal Hukum: Pengabdian Masyarakat*, *2*(02), 4–6.

Nurkhamidah, S. (2017). Identifikasi Kandungan Boraks Dan Formalin Pada Makanan Dengan Menggunakan Scientific Vs Simple Methods. *Sewagati*, *1*(1), 26.

Rahmawati, E. (2021). Analisis Terkait Tanggung Jawab Pelaku Usaha Terhadap Penggunaan Boraks Dan Formalin Pada Makanan. *Jurnal Meta-Yuridis*, *4*(2), 1–17.

Rorong, J. A., & Wilar, W. F. (2020). Keracunan Makanan Oleh Mikroba. *Techno Science Journal*, *2*(2), 47–60.

Santi, A. U. P. (2017). Analisis Kandungan Zat Pengawet Boraks Pada Jajanan Sekolah Di Sdn Serua Indah 1 Kota Ciputat. *Holistika Jurnal Ilmiah PGSD*, *1*(1).

Santoso, M., Hadikusumo, S. A., & Aziz, & A. (2012). Kombinasi Boraks dan Asam Borat Sebagai Bahan Penghambat Api dan Anti Rayap Pada Kayu Meranti Merah. *Jurnal Ilmu Kehutanan*, *6*(2), 1–2.

Sari, M. H. (2017). Pengetahuan dan sikap keamanan pangan dengan perilaku penjaja makanan jajanan anak sekolah dasar. *Journal of Health Education*, *2*(2), 163–170.

Septiani, T., & Roswien, A. P. (2018). Analisis Kualitatif Kandungan Boraks Pada Bahan Pangan Daging Olahan dan Identifikasi Sumber Boron dengan FTIR – ATR. *Indonesia Journal of Halal*, *1*(1), 48.

Sugiyono, Siti, M., & Rukanah. (2009). Analisis Kandungan Boraks Sebagai Boron Pada Gendar Yang Diproduksi Oleh Industri Rumah Tangga Di Daerah Ambarawa. *Jurnal Ilmu Farmasi Dan Farmasi Klinik Vol. 6 No.1 Juni 2009*, *6*(1), 33–38.

Suseno, D. (2019). Analisis Kualitatif dan Kuantitatif Kandungan Boraks Pada Bakso Menggunakan Kertas Turmerik, FT – IR Spektrometer dan Spektrofotometer Uv -Vis. *Indonesia Journal of Halal*, *2*(1), 1.