Preliminary Study on the Use of Optical Fiber to Detect Borax Content in Meat

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Abstract. A preliminary study has been conducted to detect the presence of borax in meat using an optical fiber sensor. The study was conducted in 2 stages, the first stage was a test using a UV-Vis spectrometer which was used as reference data to test the presence of borax in meat with variations in the borax mass of 0.1 gr, 0.2 gr and 0.3 gr mixed with each 40 gr of beef, while the next stage is to use an optical fiber sensor that has been made where the results of testing are compared with the results of the first stage. The results obtained in the initial stage are more and more borax content in the meat showing the absorbance value increases at a wavelength of 419 nm with an \( R^2 \) value of 0.93. In the second stage using an optical fiber sensor, the results of transmittance values obtained at 419 nm wavelength decreased linearly with \( R^2 \) values of 0.99, the transmittance value is inversely proportional to the absorbance value. This shows that a fiber optic sensor made has the potential to be used as detection for borax content in meat.

1. Introduction
Borax is a chemical compound that is harmful if consumed, usually found in solid form. Borax in liquid form into sodium hydroxide and boric acid which generally has properties that can develop, give a supple effect, and kill microbes. This causes many of the manufacturers to use it for food substances that have a bad effect on the health of the body. Technology is required to detect the content of borax in the flesh, one of which uses optical fiber sensors [1].

Until now, a wide audience cannot yet know the difference of meat containing borax and not, while its nature accumulates or is buried when consumed continuously. So the borax dose in the body becomes high. In adults, death will occur if the dose has reached 10 – 20 grams or more. At this time to detect the borax contaminated meat is done using the spot test. This method requires a relatively expensive cost due to this method can only be done in the laboratory, while to test samples to the laboratory not all people are free to do so, only the agencies in certain cases such as product registration by manufacturers, student research, the need for government agencies, private, and the investigation of authorities who can conduct sample tests in laboratories and require costly costs[2].
There have been various studies and several methods that have been used to test the presence of borax, the development of fluorophotometric methods for the determination of formaldehyde in environmental waters, based on the reaction of formaldehyde with acetooacetanilide and ammonia. Determination of total formaldehyde in drinking water samples in 1 liter of water was derivatized with 2,4-dinitrophenylhydrazine in acidic medium and then extracted with chloroform. After separation by solvent extraction, the product was confirmed using reverse phase liquid chromatography, colorimetry, fluorimetry, polarography and gas chromatography (GC), infrared detection, injection flow analysis and gas detector tubes. Colorimetric procedures with the curcumin method, gas chromatography-mass spectrometry coupled with a simple and selective derivatization reaction using triethanolamine, Formalin test using extract flower of ribose ruellia, hibiscus rosa-sinensis L and Impatiens L balsamina, while for borax test using ruellia simplex, plumeria rubra, portulaca grandiflora and curcuma longa and borax detection with resistance sensors.

Fiber optics as one of the sensors have been widely used researchers in the world, where the working principle of fiber optic sensors is to turn the electrical signal into a light wave with mirror function inside the cable. Electrons obtained from electrical energy are converted into photons of light particles so that the photon is what carries the digital information at a very high speed and can be bent. Advantages of the use of fiber optic, materials used cheap and widely available in the community, easy to use, and high success rate. Several research has successfully conducted research related to the utilization of fiber optic to perform the detection process at Optic and photonic research center Sebelas Maret University, among them are the detection of cholesterol content in the blood, the detection of glucose content in the blood, fiber optic heart rate detection, Sugar concentration detection, persistent organic pollutants detection, Glucose Solution Concentration detection and pressure detection.

This article is examined by the use of fiber optics to detect the presence of borax in meat.

2. Experimental
This research to know the content of borax in the flesh is done with 2 stages, namely Test UV spectrometer and ocean optic test. Sample making is done by taking extracts from the beef that is already mixed with borax. The sample variations used were beef weighing 40 grams and borax 0.1 grams, 0.2 grams, and 0.3 grams. The first material testing used UV Vis spectrometers to determine the absorption value of each sample. The next stage is to create a series to test the borax content using a fiber optic-based sensor with a series of optical fiber testing with the following tool placement:

**Figure 1.** The basic scheme of measuring boracic content in meat uses fiber optic sensors. Description: 1. Optical chopper, 2. Polarizer, 3. Beam splitter, 4. Lens, 5. Flat Mirror, 6. Photodetector, 7. Computer
Fiber optic testing is used to prove the linkage of transmittance value in samples that are variate with the same wavelength. The tool used is a series of Ocean Optic Spectrometer tools and to place samples used petri bowls that have been pasted fiber optic in it.

3. Result and Discussion
Borax are soft crystals containing the boron element, easily soluble in water, and are chemical compounds that are harmful if they are consumed. The first Test uses the UV-Vis A that is carried out alternately for each sample so that the wavelength data is obtained by absorbancy. From the data obtained, the absorbance will experience the highest peak at the UV wavelength. At peak wavelengths taken at 419 nm. In Table 1. The absorbance value at a wavelength of 419 nm indicates an increase for each addition of the Boracic content in the flesh.

| Sample   | Absorbansi |
|----------|------------|
| Without boraks | 3.180      |
| 1         | 3.604      |
| 2         | 3.789      |
| 3         | 3.927      |

![Graph of borax content variation with Absorbansi value at 419 nm wavelengths using a Vis UV spectrometer](image)

In Figure 2 shows the linkage between variations in the Boracic content in the flesh with the absorption value obtained by the result of the linear curve with a value of R2 of 0.93 at a wavelength of 419 nm, this indicates that with increasing boracic content in the flesh, the value of absorbance is greater in accordance with the research that has been done by Rusli in 2009.

In experiments with Ocean Optic, it uses a deuterium light because the formed chart will have peaks at a wavelength of about 400 nm according to the borax detection wavelength in the literature and in accordance with the experiments of UV-Vis spectrometry. The area of the sensor begins with the optical fiber sanding in one section. This passage will be on the sample,
with a length of 4 cm. The result is the relationship between transmittance and wavelengths from 419 nm from a sample without borax, meat samples with borax 0.1 gr, 0.2 gr and 0.3 gr as in Table 2.

Table 2. Result data transmittance value at 419 nm wavelength

| Sample   | Transmittance |
|----------|---------------|
| Without borax | 58924.25   |
| 1        | 58799.23     |
| 2        | 58570.34     |
| 3        | 58481.42     |

Figure 3. Graph of borax content variation with transmittance value at 419 nm wavelength using fiber optic sensor

Figure 3. shows the result which increases the boracic content in the flesh and Transmittansiya is reduced by a good trend in which the value of the linearity is 0.99, meaning that the absorption value is greater because the value of transmittance is inversely proportional to the absorbancy value. By comparing the results between Figure 2 and Figure 3 have a suitable trend where the more borax content in the flesh then the absorption value is greater or transmittance value is smaller. The value of transmittance is inversely proportional to absorption or removals. From these results, it can be concluded that the optical fiber sensors are the potential to be used in detecting the borax content in the flesh.

4. Conclusion
Research conducted has succeeded in creating a fiber optic that can detect the content of borax in the flesh, which has been variate borax content and produced its transmittance value is reduced by the linearity of 0.97. This results in the first method by testing the material using the Vis UV Spectrometer. The content of borax in the flesh is increasingly greater and the value of the absorbasni is also greater with a linearity value of 0.93. The absorbance value is the inverse of transmittance. It can be said that in this study it could potentially be a detection sensor of borax in the flesh. This fiber optic sensor can be used to determine the presence of borax content in meat.
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