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Digital Formaldehyde Meter Performance Test to Detect Formaldehyde Content in Solid and Liquid Materials Using Electronic Nose Technology

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ABSTRACT

Test results from the Food and Drug Supervisory Agency (BPOM) stated that out of 700 samples of food products taken from Java, 56% contained formaldehyde. The danger of formalin abuse can cause disease, both chronic and acute effects. The government, especially BPOM and the wider community, need a formalin detection test method to determine the formaldehyde content precisely, but currently there is no fast detector available at an affordable price. Testing of Solid Samples and Liquid Samples in Design to determine the performance of the tool in direct testing. The Digital Formaldehyde Meter test method uses a solid sample (the sample is cut into 3 cm as much as 5 grams) tested placed in a closed container with a volume of 30 ml and a liquid sample with a volume of 30 ml, then heated for 1 minute and the results will be displayed on the LCD. The test results showed that the average tool error for testing liquid samples was 2.78% while for solid samples it was 2%. Tests on several foods obtained from the market such as meatballs, sausages, and tofu have formalin levels that are safe for consumption, while marine fish are dangerous for consumption. In addition, it has also been confirmed that the "Digital Formaldehyde Meter" tool can be implemented to overcome problems in cases of formalin abuse by knowing the formaldehyde content quickly and accurately.

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1. INTRODUCTION

Formaldehyde is the simplest form of aldehyde. Formaldehyde is flammable, has a sharp odor, is colorless, and polymerizes easily at room temperature. Formaldehyde is soluble in water, acetone, benzene, diethyl ether, chloroform and ethanol (IARC, 1982). At 150ºC, formaldehyde is easily decomposed into methanol and carbon monoxide. Formaldehyde is easily oxidized by oxygen in the atmosphere to form formic acid, which is then converted to carbon dioxide by sunlight (WHO, 2009).

Formalin has several types that are freely sold in the market which does have a free license to be sold in general but already has a certain dosage. Formaldehyde is a normal metabolic product that is important for the biosynthesis of several amino acids in the body. The level of formaldehyde in endogenous tissues which metabolically forms formaldehyde is 3 -12 mg/g tissue. Formalin is usually used for caring for living creatures that have died, but there are some mistakes in using formalin in food.

There are many cases of formalin misuse as a food preservative in Indonesia. Test results from the Food and Drug Supervisory Agency (BPOM) stated that out of 700 samples of food products taken from Java, South Sulawesi and Lampung, 56% contained formaldehyde (BPOM, 2005). The danger from the misuse of formalin as a food preservative requires special attention, because the use of formalin as a food preservative can cause several diseases, including direct acute human health effects such as (irritation, allergies, nausea, vomiting, abdominal pain and dizziness), and side effects. chronic, i.e. the effects on human health are seen to be affected over a long period of time and repeatedly, such as digestive disorders, liver, kidney, pancreas, central nervous system (Handayani, 2006).

Consumption of food and drink containing formalin in the long term or exceeding the threshold can cause cancer, irritation of the eyes and respiratory tract, damage to the central nervous system and blindness (WHO, 2002). The creative innovation used for formalin detection is by making a Digital Formaldehyde Meter by implementing Electronic nose technology. Electronic nose technology is a data acquisition technology with a data processing interface, usually used to solve problems in tool-making systems consisting of gas sensor arrays.

By considering the advantages of this instrument, we provide an alternative solution, namely applying the Electronic Nose as a formaldehyde detection tool. In the previous Digital Formaldehyde Meter design, only the calibration process was carried out on the device so that the real detection results were not known in solid or liquid samples. For this reason, it is necessary to test directly on solid samples and liquid samples so that the performance of the Digital Formaldehyde Meter is known.

2. METHOD

2.1 Types of research

The research method used in this study is the experimental method. The experimental method is a form of observation under artificial conditions, where these conditions are created and regulated by the researcher. That is, basically conducting an experiment to see the results, and the results of the experiment will confirm how the causal position is between the variables being investigated.

2.2 Research Variables

The variables in the study consisted of independent variables which were free food samples and were tested using formalin liquid.

2.3 Research design

Testing of Solid Samples and Liquid Samples in Design to determine the performance of the tool in direct testing. The Digital Formaldehyde Meter test method uses a solid sample (the sample is cut into 3 cm as much as 5 grams) tested placed in a closed container with a volume of 30 ml and a liquid sample with a volume of 30 ml, then heated for 1 minute and the results will be displayed on the LCD.

2.4 Sampling location

Tool making was carried out at the Mechatronics Laboratory of Agroindustry Machinery and Tools, Department of Agricultural Engineering, Brawijaya.

2.5 Time and Place of Research.

The process of making this tool was carried out for 6 months, namely from January 2013 to June 2013 and research at the Mechatronics Laboratory of Agro-Industry Machinery, Department of Agricultural Engineering, Brawijaya.

2.6 Tools and Materials

The tools used for research tests are digital Formaldehyde Meters and several types of materials as follows liquid formalin, some food ingredients and distilled water as a mixture and sample neutralizer.

2.7 Research procedure

The research begins with literature by preparing tools and materials and calibrating tools by testing solid and liquid samples with data analysis and conclusions for liquid samples starting with heating liquid samples then carried out with sensors and recording data. In testing solid samples through a size reduction process first, namely 3 cm of 5gr. The solid material that has been cut is soaked in pure formalin which has been diluted at 5 ppm, 10 ppm and 20 ppm. Soaking the material is carried out for 24 hours with the aim that the formalin can absorb optimally into the material.

2.8 Data analysis.

Testing of Solid Samples and Liquid Samples in Design to determine the performance of the tool in direct testing. The Digital Formaldehyde Meter test method uses a solid sample (the sample is cut into 3 cm as much as 5 grams) tested placed in a closed container with a volume of 30 ml and a liquid sample with a volume of 30 ml, then heated for 1 minute and the results will be displayed on the LCD.

3. RESULTS AND DISCUSSION

3.1 Research result

The test results showed that the average tool error for testing liquid samples was 2.78% while for solid samples it was 2%. Tests on several foods obtained from the market such as meatballs, sausages, and tofu have formalin levels that are safe for consumption, while marine fish are dangerous for consumption. In addition, it has also been confirmed that the "Digital Formaldehyde Meter" tool can be implemented to overcome the problem of cases of formalin abuse by knowing the formaldehyde content quickly and accurately.

3.1.1 Testing on Liquid and Solid Samples

In testing the liquid sample is done using a liquid sample in the form of formalin which has been diluted. In this test, three types of formalin dilutions were used, namely 5 ppm, 10 ppm, and 20 ppm. The results of the dilution are put into the heater device which is the part that functions to carry out combustion. During the testing process, 30 ml of sample was taken from each dilution. The test used a Digital Formaldehyde Meter for samples resulting from 5 ppm dilution.

Formaldehyde content (ppm) Testing and Dilution of Liquid Samples Dilution Testing obtained a measurement of 5.25 ppm. Whereas at a dilution of 10.05 ppm in pure formalin, when the detection was carried out, the result was 10 ppm. Furthermore, at dilution, the formalin concentration of 20 ppm was obtained, there was a difference in results when the test was carried out using a digital tool of 20.64 ppm on liquid samples. From the results of this test, it was found that the error rate in the sample test with 5 ppm dilution obtained an error rate of 4.76%. On the results of the 10 ppm sample test, the tool error rate was 0.5% and on the 20 ppm sample test results, the tool error rate was 3.1%. For the results of the liquid sample testing that has been carried out, the average tool error is 2.78%. plasma proteins.

Tests on solid samples used food ingredients in the form of meatballs which had been soaked beforehand using formalin which had been diluted by 5 ppm, 10 ppm and 20 ppm. Then it is put into the heater for the combustion and detection processes to be carried out. Testing using a Digital Formaldehyde Meter for samples resulting from formalin administration to 5 ppm solid samples obtained test results of 5.1 ppm.

Whereas for the administration of formalin to a sample of 10 ppm in pure formalin, when the detection was carried out, the result was 10.24 ppm. Furthermore, in the administration of formalin of 20 ppm, the results were obtained when the test was carried out using a 20.2 ppm tool. From the results of this test, it was found that the error rate in sample testing with 5 ppm dilution obtained an error rate of 1.9%. On the results of the 10 ppm sample test, the tool error rate was 2.34% and on the 20 ppm sample test results, the tool error rate was 1%.

3.1.2 Measurement of Formalin Levels in Food Samples

The Digital Formaldehyde Meter is a tool that is expected to be applied to determine the level of formalin in food samples. Measurement of formalin levels was carried out on several food products, namely meatballs, sausages, tofu and sea fish. These three types of food were taken as samples because based on BPOM (2011), meatballs and sausages are types of market snacks that contain the most formaldehyde. Protein levels from healthy fish and diseased fish can be seen in plasma samples of K dose.

Table 1. Results of the Formalin Concentration Test on Several Products on the Market

No	Products on the market	
	Meatball name	Detection results
1	Meatball	5.1
2	Sausage	0.01
3	Know	5

4	Sea food	15

From the test results it can be seen that some foods on the market that should not contain formalin actually contain formalin. In the meatballs after testing there was a formalin content of 5.1 The sausage contained formalin of 0.01 ppm, then in tofu there was 5 ppm of formalin while in marine fish it contained the most formaldehyde compared to other product samples, namely 15 ppm. When testing the device, for samples of meatballs, sausages and tofu, the green indicator on the Digital Formaldehyde Meter lights up.

This shows that the three samples contain formalin which is still within safe limits for consumption. In accordance with the International Program on Chemical Safety (IPCS) is 0.1 mg per liter or in one day the allowable intake is 0.2 mg. In marine fish, when testing, the red indicator light on the tool lights up.

3.2 Discussion

The test results showed that the average tool error for testing liquid samples was 2.78% while for solid samples it was 2%. Tests on several foods obtained from the market such as meatballs, sausages, and tofu have formalin levels that are safe for consumption, while marine fish are dangerous for consumption. In addition, dead protein will not be attacked by spoilage bacteria that produce acidic compounds. others are more durable.

Formaldehyde kills bacteria by making the tissue in the bacteria dehydrated (lack of water), so that the bacterial cells will dry and form a new layer on the surface. This means that formalin not only kills bacteria, but also forms a new layer that protects the layer beneath it, so that it is resistant to attack by other bacteria. If other disinfectants deactivate bacterial attacks by killing and not reacting with the protected material, formaldehyde will react chemically and remain in the material to protect against further attacks. Electronic nose technology is a data acquisition technology with a data processing link, usually done to solve the problem of a tool-making system consisting of gas sensor arrays (gas sensor array). Electronic nose is a portable system that has advantages such as small size and low operating costs. Previous research has widely used Electronic Nose for detection of environmental air safety, medical applications, and food safety (Zhang et al., 2009).,

4. CONCLUSION

Based on the exposure results obtained, it can be concluded that on the results of the tests that have been carried out for testing on solid samples the tool error rate is 2.78% while in liquid sample testing the tool error rate is 2%. And the results of the Digital Formaldehyde Meter measurement for the consistency of the term, please pay attention to some food samples, namely meatballs, sausages and tofu, which contain formalin at a safe threshold so that it is safe for consumption, while marine fish are not safe for consumption because they contain formaldehyde at a dangerous threshold.

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It is recommended that the Digital Formaldehyde Meter be developed further so that a useful tool for the wider community can be used to detect formaldehyde content in food effectively and efficiently. Based on the author's research, the development of a Digital Formaldehyde Meter tool can be carried out by using a membrane as a CO and H2 gas filter so that the results obtained are more accurate and the development of this Digital Formaldehyde Meter tool needs to be developed to serve as an alternative solution that can prevent the spread of formalin abuse cases, namely by detecting the presence of formaldehyde in food quickly and accurately.

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