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Training on Identification of Hazardous Food Preservatives and Utilization of Chitosan as A Natural Preservative

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Abstract

Food preservation with borax and formaldehyde is still widely practiced. The use of borax and formaldehyde as food preservatives has a negative impact on health. Knowledge and skills to identify borax and formaldehyde content using simple, cheap, and easy techniques need to be trained. A simple technique for testing borax uses the turmeric method, while formaldehyde uses young papaya sap. The public also needs to be given an alternative, safe way of preserving food with chitosan. Participatory methods were used in this activity. The activity stages begin with preparation and socialization, training, monitoring, and evaluation. The activity was attended by 23 people on the first day and 17 people on the second day, including cadres of the FKK, PKK, Karang Taruna, Elderly Forum, LPMK, and culinary UKM. There was a significant increase in the knowledge of training participants with an N gain of 0.58, including the moderate or quite effective category. Participants also responded positively. Participants have the skills to detect borax using the turmeric method and formaldehyde using papaya sap. Training participants are also skilled in using liquid chitosan as a natural food preservative. The conclusion of this activity is that the training participants increased their knowledge about dangerous food preservatives, had the skills to detect borax and formaldehyde in food ingredients with simple technology, and applied liquid chitosan as a natural preservative.

Keywords: Identification, borax, formaldehyde, food, FKK, Semarang

INTRODUCTION

The use of food preservatives aims to inhibit decomposition, acidification, damage, and fermentation processes in food. This process is caused by the microbial activity of bacteria and fungi. Some food preservatives that are safe to use are sulphur dioxide, sorbic acid, sorbitol, benzoic acid, malic acid, and tartaric acid. However, for various reasons, many suppliers and traders of fresh food prefer to use dangerous preservatives such as formaldehyde and borax. Formaldehyde and borax are carcinogenic, disrupting the reproductive system and damaging the nervous system, kidneys, and liver (Hoque et al., 2016; Mamun et al., 2014; Jing et al., 2021). Use of borax exceeding 10–20 gr/kg body weight for adults can cause poisoning and even death (Mubarokah et al., 2023).

The negative effects due to the use of borax and formaldehyde have been responded to by the Ministry of Health by issuing PERMENKES RI No. 033 of 2012 concerning food additives (BTP), which does not allow the use of borax and formaldehyde as BTP. However, the use of dangerous food preservatives is still common. The BPOM RI report identified the test results of 24,906 food samples, showing that 3,442 (13.82%) samples were proven not to meet food safety and quality requirements. The research results succeeded in identifying 221 samples containing borax, 304 samples containing rhodamine B, and 115 samples containing formaldehyde. Several research results in Indonesia, including in Semarang, found that borax and formaldehyde were found in various types of food (Anjani et al., 2019), including various student

snacks (Utami & Santi, 2018; Muharrami, 2013; Berliana et al., 2021), also detected in meatballs and wet noodles (Nurlailia et al., 2021; Nurkhamidah, 2017; Muthi'ah & Qurrota, 2021; Erliyanti et al., 2021), salted fish, tofu, and sausages (Habibah, 2013; Nurkhamidah, 2017; Maifita & Handayani, 2020). The use of formaldehyde in fish and marine products in Indonesia is known to have reached 66% of the total 786 samples studied (Lathifah et al., 2019).

Borax has the chemical names sodium biborate, sodium pyroborate, and sodium tetraborate. In the form of a fine, transparent crystalline powder or white granules like salt. This substance is an impure form of boric acid. Borax is a chemical compound composed of the heavy metals boron (B) and oxygen (O). Borax decomposes easily in water to form sodium hydroxide (NaOH) and boric acid. Boric acid is a weak acid with its alkaline salt, which is basic and has a molecular weight of 61.83 (Wulandari Agung & Farida, 2020). Borax, when added to food, will cause the texture of the food to become chewy. Meanwhile, formaldehyde is in the form of a solution with a sharp odour containing 30–50% formaldehyde gas in 10–15% methanol. Formaldehyde is used in industry as a disinfectant and antiseptic for viruses, bacteria, and fungi. Formaldehyde is also known as a preservative for corpses and research animals. The use of formaldehyde will preserve food ingredients that will be sold.

One area in the city of Semarang where many residents are involved in the culinary sector is the Pleburan sub-district in the South Semarang sub-district. The Pleburan sub-district area is close to the business and culinary centre at Simpang Lima. The number of residents based on December 2022 data is 4507, consisting of 2,215 men and 2,292 women. The location of Pleburan Village is relatively close to the government centre and the Simpang Lima area as a business centre. In the trade and services sector in Pleburan sub-district, there are 319 trade facilities and 29 facilities in the service sector. There are various forms of business, such as mini markets selling necessities, including culinary businesses, which are very developed.

Data in the Pleburan sub-district shows that there are 35 people involved in the food service sector, including sellers of chicken noodles, meatballs, sausages, chicken porridge, soto, catering, and market snacks, from stall scale to restaurant scale. The results of interviews conducted in March 2023 with three Pleburan residents who work as food traders concluded that food traders rely on supplies of food from markets close to the Pleburan sub-district area, including Sendiko Market on Wonodri and Peterongan Market. Traders believe that their food ingredients are of good quality because they are fresh and not rotten, so they never think about the possibility of borax and formaldehyde in the food they sell.

Because borax and formaldehyde content are still found in food and have negative effects on health, the ability to detect borax and formaldehyde content in food needs to be known to the public. Food traders and housewives provide food for the family. A simple detection technique for borax content is tested using turmeric, known as the turmeric method, while the formaldehyde test uses young papaya sap. For accuracy, it can be confirmed with a borax and formaldehyde kit. Curcumin can detect the presence of borax because it is able to break down the borax bonds into boric acid and bind it to form a complex boron-cyanocurcumin, which will be brownish red in alkaline conditions (Gryniewicz & Ślifirski, 2012; Muharrami, 2013; Erliyanti et al., 2021). Foods containing borax will be brownish-red if tested with curcumin. Papaya sap is used to identify formaldehyde. Papaya sap will clump if dropped into boiled water from foods containing formaldehyde (Nurkhamidah, 2017).

So that wet food ingredients remain durable, it is necessary to find a preservation method that is effective and safe for health. One of the natural preservatives is chitosan. Chitosan comes from shrimp or crab shells, which are converted into chitin by deproteination and demineralization. Chitin will change to chitosan if deacetylation is carried out (Kurniasih & Kartika, 2011). Chitosan is a natural preservative that has been proven to be able to preserve wet food ingredients. Research results prove that a solution of 1.5% chitosan in 2% vinegar can preserve fish (Nirmala et al., 2015), chicken meat (Harjanti, 2014), and fish meatballs (Erlina, 2021). This is because chitosan has a positive charge so that it can inhibit the growth of bacterial microbes and is able to bind with negatively charged compounds such as proteins, polysaccharides, nucleic acids, heavy metals, and others (Magani et al., 2020; Erlina, 2021).

Based on the description above, the aim of this community service activity is to increase public knowledge and awareness about the presence of dangerous ingredients in food and their effects on health, train skills in detecting borax and formaldehyde content in food using simple,

cheap, and accurate methods, and apply chitosan as a food preservative. One of the strategic target audiences to receive training is the Forum Kesehatan Kelurahan (FKK), who is tasked with planning, determining, coordinating and driving activities as well as monitoring the evaluation of health development in villages/districts. The UNNES PkM team plays a role in providing knowledge and, at the same time, making awareness efforts to inform partners about the presence of dangerous ingredients in food and the negative effects on health if the body is chronically exposed. Apart from that, the team will also train their ability to detect the dangerous ingredients borax and formaldehyde using simple technology, as well as how to safely preserve food ingredients using the natural preservative chitosan.

METHOD

Implementation of community service activities (PkM) is carried out using a participatory method, namely that all parties involved in this activity actively participate and contribute to carrying out the activity. The activity plan is prepared jointly by the service team to determine the priority scale of activities to be carried out. The stages of PPM activities consist of the preparation and socialization stages, including coordination and outreach with the chairman and members of the Pleburan sub-district FKK regarding the activities to be carried out and the implementation schedule. The PkM team prepares training materials and prepares tools and materials to support training activities.

The training implementation stage is divided into two stages. The first stage is providing material on the dangers of using food preservatives, which are dangerous to body health, and what preservatives are permitted by BPOM. Also provided was material on the role of chitosan as a natural preservative. Before training, a pretest is carried out. The second stage includes practical training on the use of liquid chitosan as a natural preservative, training on detecting borax content using the Turmeric method using turmeric, as well as training on detecting formaldehyde content in foods using papaya sap. At the end of the second stage of activities, a post-test was carried out to measure the achievement of the training results and fill out the participant response questionnaire. Pre- and post-test results were analysed with N-Gain.

To ensure that the program being implemented does not have significant obstacles, monitoring and evaluation are carried out in the middle of the program and at the end of program implementation. Monitoring in the middle of the program to detect program implementation and obstacles that may arise. Evaluation at the end of the program to analyse the success of the program.

RESULTS AND DISCUSSION

Provision of materials for dangerous food preservatives and natural preservatives, chitosan

On July 25 and 26, 2023, community service activities were carried out at the Pleburan sub-district hall in the South Semarang sub-district. The activity was not only attended by FKK cadres but also extended to representatives of PKK cadres, LPMK, youth organizations, elderly forums, and representatives from culinary SMEs in the Pleburan sub-district. On the first day of the activity, 23 people participated. This activity was welcomed by the Pleburan sub-district because it was considered very strategic to increase the competence of cadres, especially FKK cadres, to increase the knowledge and awareness of residents in the Pleburan sub-district about the dangers of dangerous food preservatives contained in the food consumed daily.



Figure 1. Opening of training on identifying dangerous preservatives in food and the potential of chitosan as a natural preservative at the Pleburan sub-district hall

Before the training, a pretest was carried out first to determine the participant's level of understanding about the food preservative formaldehyde, borax, its effects on health, and the use of chitosan as a natural preservative. The average pre-test score shows that the training participants' understanding of the material has only reached 64. Based on this score, it can be stated that some of the training participants already understand, because information about the use of formaldehyde and borax as food preservatives has been widely reported through mass media and social media, even though the government. BPOM has also repeatedly announced a ban on the use of these materials. However, regarding its effect on health, most participants did not understand it. Likewise with chitosan, all participants stated that they did not know well about chitosan and its benefits. This is because chitosan is not widely known among the lay public due to the lack of information about this material.

Training materials at both training stages were provided by the LPPM UNNES community service team. The first training session was filled with briefings on dangerous food additives. This material provides information about various types of dangerous food additives, the physical characteristics of food ingredients that contain dangerous preservatives, and the effects of these ingredients on health if exposed in the long term. Apart from that, it also provides information on how to avoid it and reduce the negative effects if you cannot avoid it, including by not consuming these foods too often, taking antioxidants, and exercising. In this session, the participants actively participated by listening, taking notes, and asking various questions related to the material presented.

The next session was filled with knowledge about chitosan as a natural preservative. In this session, information was provided about chitosan, what it is made from, and its ability to act as an anti-bacterial so that it can be used as a food preservative. Because it comes from organic materials, namely crustacean shells (shrimp and crab), which are processed by deacetylation, chitosan is safe to use and has no toxic effects. It is also explained that its application as a food preservative can be in powder or liquid form. The powder form is applied by mixing it with food ingredients such as meatballs and nuggets, and for food ingredients, you can use chitosan in liquid form. The results of trials using liquid chitosan by soaking food ingredients in a 5% liquid chitosan solution can preserve raw chicken meat stored outside the refrigerator for 24 hours and up to 3 days if stored in the refrigerator (refrigerator). Just like in the first session, in the second session, the participants were still enthusiastic to find out more about chitosan, including how to get it. Chitosan is widely sold in online shops at affordable prices, so it has the potential to be implemented by ordinary people.



Figure 2. Providing material about the dangers of borax and formaldehyde for health and the potential of chitosan as a natural preservative by the PkM team

Training on borax and formaldehyde identification techniques

In the second session of the training, techniques for identifying borax and formaldehyde found in food ingredients were trained using simple ingredients, namely turmeric and papaya sap. Test results with these materials are confirmed using a test kit to test their accuracy. This session was guided by the PkM team. To facilitate the technical implementation, the participants were divided into five groups, each guided by one member of the service team. Before practicing identification, the participants were explained how to make material to identify borax by using turmeric liquid smeared on a toothpick and how to use papaya sap as a testing material for formaldehyde. Then the participants practiced identifying the contents of various dangerous food preservatives from various prepared food samples. These food ingredients include meat, chicken, meatballs, wet noodles, shrimp, gendar, lopis, and others. Some participants also brought food ingredients from their respective homes to identify whether they contained dangerous preservatives or not. The test results with the natural ingredients turmeric and papaya latex were confirmed with a borax and formaldehyde test kit prepared by the service team.



Figure 3. Explanation of borax and formaldehyde identification techniques and food samples that will be tested by the PkM team, assisted by students.

A food sample is positive for containing borax if the colour changes on the toothpick from turmeric yellow to dark brownish yellow, while the sample is declared positive for containing formaldehyde if, after the food sample is dripped with boiled water, it will curdle. This result is confirmed with a borax test kit, which will show a brownish colour if the food sample is positive for containing borax and will be coloured from pink to dark pink if it contains formaldehyde.



Figure 4. Practice of identifying borax and formaldehyde in food samples by training participants

After carrying out the practice of identifying borax and formaldehyde, each group reported their identification results. Several food ingredients have tested positive for containing borax or formaldehyde. These results made FKK cadres and other training participants aware that borax and formaldehyde were proven to still be contained in the food they consumed. This condition made residents aware that if they could not avoid consuming these foodstuffs, then what they had to do was not consume them too often, consume antioxidants, and exercise diligently. This will help the body eliminate these dangerous materials through the excretory system and overcome free radicals that arise with the antioxidants consumed. The body's endurance or immune system can also be improved by exercising diligently.



Figure 5. Representatives of the participant group present the results of identifying borax and formaldehyde content in food ingredients.

Knowledge about the dangers of borax and formaldehyde contained in food is important for FKK cadres to know because they are the spearheads in making people aware of the importance of maintaining health and a healthy environment. Likewise for participants who come from PKK cadres, youth organizations, and representatives of UKM engaged in the culinary sector. Participants in this training can disseminate the knowledge and skills they gained during the training to residents in their respective environments.

Results of pre-test and post-test analyses and questionnaires

The increase in knowledge and skills of the training participants is reflected in the post-test results, which reached an average score of 85 from only 68 previously. The results of the N-

Gain analysis of the pre- and post-test results produced a score of 0.58, or 58%. These results are in the moderate and quite effective category. It is hoped that this increase in knowledge will support the implementation of this knowledge in society. However, monitoring and evaluation still need to be carried out so that the knowledge gained is useful for a wider audience.

The results of the questionnaire analysis of participants' opinions about this training were processed descriptively. The results showed that all participants stated that this training was very useful because it increased their knowledge about the dangers of borax and formaldehyde preservatives contained in food ingredients for health. They can practice techniques for identifying borax and formaldehyde content using simple technology. They also know about the natural preservative chitosan. They also stated that they would apply the results of this training in their daily lives and wanted to disseminate the knowledge they had to other residents.

Monitoring and evaluation were carried out by the PkM team to find out the extent of the implementation of the results of community service activities. The results of interviews with the FKK chairman on September 7, 2023, or about one month after the training, have disseminated knowledge of the dangers of foods containing borax and formaldehyde and how to identify them in a simple way at the FKK management level in Pleburan sub-district in the form of FGD. The next task is for each administrator to disseminate it to their respective residents. Based on the results of monitoring and evaluation, no significant obstacles were found in the process of disseminating training results to the community.

All training participants increased their knowledge about the presence of dangerous ingredients in food ingredients and their effects on health if consumed continuously. The increase in participants' knowledge was proven by the N gain score reaching 0.58, or 58%, which is in the moderate and quite effective category. Training participants are also able to detect borax and formaldehyde content in food ingredients using a simple, cheap, and accurate method. All participants were able to apply the natural preservative chitosan to preserve food ingredients. The knowledge and skills they have will be disseminated to other community members.

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