

# Food additives learning assistance for students at SMP Katolik Santa Clara Surabaya

Asistensi pembelajaran tentang zat aditif makanan untuk siswa di SMP Katolik Santa Clara Surabaya

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## ABSTRACT

The learning assistance was designed for teachers at SMP Katolik Santa Clara to develop food additives teaching materials for theoretical learning in the classroom and work in the laboratory to give students a deeper understanding of food additives. The methods applied in this learning assistance were assistance in preparing food additives theoretical teaching materials, designing food additives laboratory works, and delivering food additives teaching materials in the classroom. In addition, laboratory work videos on borax and colorants identification in food samples were also made to facilitate independent laboratory work for students at home amid the COVID-19 pandemic. The evaluation results proved that the students gained a thorough understanding of food additives by being able to explain the definition of food additives, mention the types of food additives, identify food additives listed on food packaging, and give examples of additives misused in food products as well as its adverse impacts on health. Moreover, supplementing laboratory works could improve students' understanding of the theoretical materials and provide a new atmosphere for students to learn new knowledge. Accordingly, the food additives materials were delivered to the maximum extent to the students.

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## 1. INTRODUCTION

Food is a primary need of all organisms to support life, including humans. Raw food materials, either from plants or animals, must be processed before consumption to reduce the number of microorganisms, retain quality, and extend shelf life (Augustin et al., 2016). However, processed foods

face challenges during processing and storage. Processing steps cause several degradations in food quality, such as discoloration (Moya et al., 2021), reduced foaming ability (Tang et al., 2022), and flavor loss (Meng et al., 2022). In addition, prolonged storage induces microbial contamination, resulting in changes in food's physical, chemical, and sensory properties (Delibato et al., 2018; Lee et al., 2018). Therefore, adding food additives deems necessary to maintain food products' quality (Pandey & Upadhyay, 2012).

According to BPOM Regulation No 11 (2019), food additives are defined as substances added to food to affect the properties or form of the food. However, this definition is too narrow and raises the possibility of substance misuse, such as adding textile colorant (e.g., rhodamine B) in beverage products to produce attractive colors. Therefore, a more comprehensive definition of food additives from FDA General Provisions (2018) is "Food additives include all substances not exempted by section 201(s) of the act, the intended use of which results or may reasonably be expected to result, directly or indirectly, either in their becoming a component of food or otherwise affecting the characteristics of food."

Food additives thus include all substances or mixtures that are not naturally part of food ingredients or consumed as food or drink. Food additives can directly or indirectly have the expected effect on the food product so that it becomes part of the food or changes the nature of the food product. Food additives can be derived naturally or synthetically and only need to be added in small amounts to affect food products significantly (Sharma et al., 2018). The maximum limit for the use of each category of food additives is regulated in BPOM Regulation No. 11 (2019).

Understanding food additives are necessary for everyone, including adolescents aged 12-15 who are already independent in determining the type of food they will consume. Therefore, to be aware of foods to consume, adolescents must have adequate knowledge of food additives, their proper application in food products, and the characteristics of food added with prohibited additives. This introduction can be effectively carried out in the school learning process, primarily through natural science-related subjects such as biology.

As a community service partner, SMP Katolik Santa Clara Surabaya is one of the junior high schools in Surabaya that teach biology to their students. Based on the communication with the partner, the community service team learned that food additive is one of the topics being taught in biology. In that regard, several aspects that can be further optimized to improve students' understanding of food additives are as follows: (1) Structured learning materials for learning food additives; (2) Practicum learning materials (in the laboratory or at home for topics that use methods with simple equipment) to support the understanding of food additives.

Food Technology Study Program, Faculty of Agricultural Technology, Widya Mandala Surabaya Catholic University, as the community service team mastering food additives, proposed to assist in designing teaching materials for learning food additives to SMP Katolik Santa Clara Surabaya. The outputs of this community service were a teaching module for teachers, a practicum module, and practicum videos. With these results, students are expected to understand food additives commonly found in everyday life and be more cautious in choosing food products to consume.

## **2. METHODS**

The community service was conducted by a lecturer team consisting of four lecturers of the Food Technology Study Program, Faculty of Agricultural Technology, Widya Mandala Surabaya Catholic University, with the community service partner of one Biology teacher and 61 grade 8 students of SMP Katolik Santa Clara Surabaya. The community service in the context of developing the competence of

students of SMP Katolik Santa Clara Surabaya in biology, especially in understanding food additives, had been carried out for five months (February-June 2022) and was performed in three main stages; preparation, implementation, and evaluation.

### Preparation Stage

The community service began by holding two meetings of focus group discussion (FGD) between the community service team and partner. The first FGD discussed the issues that can be optimized in delivering food additives topics in biology. This FGD was conducted online using the Zoom platform, considering the pandemic situation that made offline meetings at that time still not conducive to being held.

After obtaining the essential information from the first FGD, the community service team designed several solutions to optimize the food additives learning process. Then, the second FGD, which took place at the partner's location, focused on the presentation of solutions, discussion on the proposed learning designs and content of food additives learning materials, and planning to realize the solutions. Besides, the partner also introduced facilities in school that can be utilized in realizing solutions.

### Implementation Stage

The implementation of community service consisted of two main activities to realize the agreed solutions in optimizing food additives learning process. The activities' details are as follows:

**Table 1.** Implementation of community service

<b>Activity 1</b>	
Aspect	Structured learning materials for learning food additives
Solution	Assistance in designing teaching materials for learning food additives
Output	Food additives teaching materials in the form of a teaching module for teachers
<b>Activity 2</b>	
Aspect	Practicum learning materials (in the laboratory or at home for topics that use methods with simple equipment) to support the understanding of food additives
Solution	Assistance in elevating knowledge and skills to design and manage practicum activities in the laboratory
Output	Food additives practicum module and videos

### Evaluation Stage

The evaluation of the community service aimed to measure students' understanding of food additives, both theory and practice, which the teacher delivered in the classroom. The evaluation was carried out by distributing questionnaires regarding understanding the food additives topic to students who had completed learning the food additives. The data obtained were then processed to generate results in the form of percentages.

The measure of students' success in learning food additives in class is the ability to explain the definition and types of food additives, identify food additives listed on food product packaging, and provide examples and negative impacts of non-food-grade additives commonly misused in food products as well as its adverse impacts on health. In addition, an assessment was also carried out on

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students' understanding of the specific food additives commonly used in food products consumed daily, namely colorants, antimicrobial preservatives, antioxidants, sweeteners, and texture stabilizers.

The measure of students' success in practicum activities through videos is the ability to analyze borax contained in food products and distinguish the characteristics of natural, synthetic, and non-food-grade colorants. A comparison was also performed between learning enriched without and with practicum activities with respect to the learning method's attractiveness and the level of the topic's understanding delivered in class.

### 3. RESULTS AND DISCUSSION

The implementation of community service activities, including three main activities, was determined from the FGD carried out at the preparation stage (Figure 1).



Figure 1. FGD held in the preparation stage

#### Assistance in Designing Teaching Materials for Learning Food Additives

The development of the student's competence in biology, especially the food additives topic, was carried out by providing a structured teaching module for the teacher as conveyers of materials to students in biology subjects. The designed teaching module was systematically arranged in language that both teacher and students easily understand. Therefore, the materials are expected to be conveyed effectively to students (Prastowo, 2015).

The food additives teaching module composed by the community service team contains lessons with the structure referring to the *Modul Guru Ilmu Pengetahuan Alam SMP Kelas VIII* issued by the Ministry of Education, Culture, Research, and Technology of Indonesia as a guide in the teaching and learning process in the classroom (Zubaidah et al., 2017). Thus, this teaching module is expected to equip and assist teachers in fulfilling students' essential competencies related to food additives. In addition, the community service team also supplemented the teaching module with a description of the latest food additives issues.

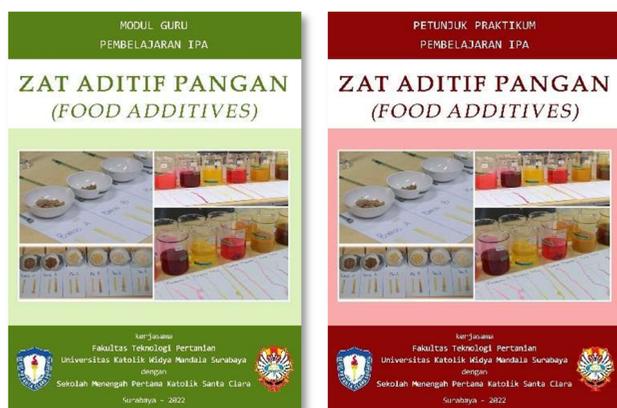
The food additives teaching module for teachers contains comprehensive descriptions of: (1) Definition of food additives; (2) Types and classification of food additives; (3) Uses of food additives; (4) Details of specific food additives, including colorants, preservatives (antimicrobial agents, antioxidants), sweeteners, and texture stabilizers (emulsifiers, thickeners, gelling agents, firming agents, and raising agents); (5) Misuses of food additives; (6) Effect of consuming non-food-grade additives on health.

The teaching module compiled was then proposed to the partner for review as a form of partner involvement in realizing solutions. The final result of the food additives teaching module for teachers (Figure 2) was reviewed until it was ready to be used by the partner in delivering materials to students.

## Assistance in elevating knowledge and skills to design and manage practicum activities in the laboratory

Practicum activity in the laboratory has an excellent potency for students to implement theoretical knowledge given by the teachers, thus can facilitate students in elaborating theory obtained in the classroom with results of experiment observed in the laboratory. Moreover, this activity also permits students to actively practice their practical scientific skills (Mustachfidoh et al., 2013).

Food additives practicum topics were designed by the community service team considering the availability of equipment in the partner's laboratory, ease of getting materials, and simple procedures without using hazardous chemicals that can be practiced independently at home. The practicum module composed by the community service team (Figure 3) covers several topics as follows: (1) Pigment extraction from food commodity; (2) Colorant identification; (3) Borax identification; (4) Sweetness level comparison between natural and synthetic sweeteners.



**Figure 2.** Food additives teaching module  
**Figure 3.** Food additives practicum module

In addition to the practicum module, the practicum video production was also carried out for several practicum topics. The resulting videos were expected to facilitate and enhance the understanding of the practicum's activity, especially during the COVID-19 pandemic, which urged students to learn online and perform their practicum at home instead of in the school's laboratory (Rohman et al., 2021). Therefore, students could gain adequate knowledge to conduct their practicum at home. The practicum topics made into videos were colorant and borax identifications, considering that both issues are tightly related to the common misuse of non-food-grade additives in commercialized food products. The video production took place at the partner's laboratory by utilizing and maximizing the use of equipment.

The colorant identification practicum aims to understand how to differentiate between food (natural and synthetic) and non-food-grade colorants. The experiment was performed by preparing various solutions (natural colorant from turmeric, beverages added with food colorants, synthetic food colorants, and textile colorants, e.g., rhodamine B and auramine yellow) and strands of thread. The threads were dipped into each solution for several seconds, withdrawn, and dipped into a soap solution for several seconds. The results showed that threads previously dipped in turmeric, beverages added with food colorants, and synthetic food colorant solutions experienced a significant discoloration compared to those dipped in textile colorant solutions after being washed in the soap

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solution (Harsito et al., 2021). Figure 4 depicts the documentation during the colorant identification video production.



Figure 4. Video production on colorant identification

The topic of borax identification provides an understanding of procedures to identify borax in food products using yellow-colored turmeric paper containing turmeric extract called curcumin. When it reacts with borax, curcumin will change its color to red (Rahma & Hidjrawan, 2021). This experiment was performed by cutting the food sample into small pieces, such as tofu, wet noodles, and meatballs, and mixing the food sample with water. The turmeric paper was then immersed in the water containing food sample for several seconds. The color change on turmeric paper from yellow to red indicated that the analyzed sample contained borax. The documentation during the video production on the borax identification topic can be seen in Figure 5.



Figure 5. Video production on borax identification

### Evaluation of Students' Understanding of Food Additives

The teacher adopted the outputs of community service, including a teaching module for teachers, a practicum module, and practicum videos of food additives in delivering food additives lessons to the students in two meetings with a 60-minute duration for each session (Figure 6). The community service team was also present during the learning process and evaluated the students' understanding of several aspects related to food additives. However, practicum activities were not performed due to the physical distancing regulation applied at the school, but the teacher still distributed both the practicum module and the videos to the students.



**Figure 6.** Food additives learning activity

A total of 61 students attended the learning process in the classroom and filled out the evaluation questionnaire via Google form distributed by the community service team. The questionnaire results in Table 2 indicated that students already understood the main concept of food additives by being able to explain the definition and types of food additives, identify food additives listed on food product packaging, and provide examples and negative impacts of non-food-grade additives commonly misused in food products. The next part of the questionnaire evaluated the student's understanding of specific food additives. The evaluation results in Table 3 show that students better understood the concept and differentiation of the nature (natural or synthetic) of several food additives, which are colorants and sweeteners, than antimicrobial agents, antioxidants, and texture stabilizers. From the evaluation results, the community service predicted that this phenomenon might happen as colorants and sweeteners are more commonly found and used in students' daily lives. In contrast, antimicrobial agents, antioxidants, and texture stabilizers typically use scientific terminologies which are less familiar to the students. With students learning about food additives in the classroom, the teacher had the chance to introduce other types of food additives that are less common for them but play essential roles in maintaining the food products' quality.

**Table 2.** Students' understanding of food additives after following the learning process (%)

Indicator	Strongly agree	Agree	Disagree	Strongly disagree
Students are able to explain the definition of food additives	29.5	70.5	0	0
Students are able to mention types of food additives	16.4	78.7	4.9	0
Students are able to identify food additives listed on food product packaging	26.2	67.2	6.6	0
Students are able to provide examples of non-food-grade additives commonly misused in food products	24.6	70.5	4.9	0
Students are able to provide negative impacts of non-food-grade additives commonly misused in food products	31.1	63.9	5.0	0

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**Table 3.** Students' understanding of various food additives after following the learning process (%)

Indicator	Strongly agree	Agree	Disagree	Strongly disagree
Students are able to explain the definition and purpose of using food colorants	24.6	67.2	8.2	0
Students are able to differentiate and give examples of natural and synthetic food colorants	21.3	63.9	14.8	0
Students are able to explain the definition and purpose of using antimicrobial agents	8.2	60.7	31.1	0
Students are able to differentiate and give examples of natural and synthetic antimicrobial agents	6.6	52.5	37.7	3.2
Students are able to explain the definition and purpose of using antioxidants	13.3	71.7	15.0	0
Students are able to differentiate and give examples of natural and synthetic antioxidants	21.3	57.4	21.3	0
Students are able to explain the definition and purpose of using sweeteners	44.3	55.7	0	0
Students are able to differentiate and give examples of natural and synthetic sweeteners	32.8	60.7	6.5	0
Students are able to explain the definition and purpose of using texture stabilizers, such as emulsifiers, thickeners, gelling agents, firming agents, and raising agents	14.8	57.4	27.8	0
Students are able to give examples of food additives that can improve and stabilize food texture	19.7	57.3	23.0	0

Besides theoretical learning, students were also evaluated regarding understanding of food additives obtained through practicum videos, which are colorant and borax identifications in food products. The evaluation results in Table 4 indicate that food additives enriched with practicum elevated students' understanding of the delivered food additives theory as students could directly visualize the theoretical knowledge. These results were also supported by diverse learning methods that provided a new atmosphere for students to learn new knowledge. Thus, the teacher could carry out the learning process holistically by elaborating comprehensive theory and practical activities and delivering the food additives materials to the maximum extent (Shana & Abulibdeh, 2020).

**Table 4.** Students' responses and understanding of food additives through practical learning using video media (%)

Indicator	Strongly agree	Agree	Disagree	Strongly disagree
Students better understand the differences in the characteristics of food (natural and synthetic) and non-food grade colorants	33.3	60.0	6.7	0
Students better understand non-food-grade additives (borax to be specific) misused for food	21.7	70.0	8.3	0
Practical activities at home/laboratory make the learning process more interesting	41.7	48.3	10,0	0
Practical activities at home/laboratory on food additives further enhance understanding of theoretical materials presented in class	46.7	50.0	3.3	0

#### **4. CONCLUSION AND RECOMMENDATIONS**

The optimization of food additives competencies and understanding for grade 8 students of SMP Katolik Santa Clara Surabaya was performed by providing structured teaching and practical learning materials. The development of these competencies has been pursued in a series of community service activities through assisting in making a teaching module for teachers and designing practical activities in the form of a practicum module and videos. Implementing the designed materials by the teacher in the classroom's theoretical learning process has enabled students to understand the food additives materials. Furthermore, enrichment of practical learning methods through video media also allowed students to visualize the obtained theoretical knowledge and gain a more holistic understanding of food additives. Accordingly, the learning assistance given by the community service team is expected to provide benefits for the partner in optimizing the development of student competencies in food additives learning aspects through comprehensive learning materials for students and further implemented in everyday life.

The hampered practicum activities during the pandemic can be realized if conditions are conducive to carrying out practical activities directly in the laboratory to maximize students' understanding of the theoretical material delivered in the classroom. Besides, the practicum video topics previously limited to identifying borax and colorants in food products can be expanded to other food additives not covered in this community service, such as antimicrobials, antioxidants, sweeteners, and texture stabilizers. In addition, the materials need to be updated regularly, especially in the section on the misuse of non-food grade additives, because the rules and regulations regarding this matter can change anytime. Furthermore, this information needs to be transferred to students to know the latest issues in food additives that are safe to consume.

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