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Media Design "Detector Marker" based on STEM with Dragon Fruit Peel Extract for Detection of Formaldehyde Additives at School in Agroecosystem Zone

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ABSTRACT
The use of prohibited food additives such as formalin is still often found, especially in the school environment. In fact, based on the 2012 Minister of Health Regulation No. 033, formalin is prohibited as a food additive. This phenomenon requires people to be quite observant in choosing food tools. In addition, many people think that the formalin content test can only be done through the laboratory, the formalin test can also be done by a simple reagent containing anthocyanin on dragon fruit skin. So, the researchers designed a simple STEM-based media with a natural formaldehyde-detecting ingredient, namely red dragon fruit peel extract. This design is divided into two parts, namely the design of simple STEM-based media and the manufacture of natural dragon fruit peel extract to detect the content of formaldehyde additives in food. The design was carried out by Grade VIII students at SMP Negeri 6 Jember. The final tool produced is a detector marker.

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1. INTRODUCTION

Natural Sciences (IPA) is one part that is studied by many students in the academic field. Science is a process of looking for various causes and effects of various phenomena that study nature and its contents (Aisah, 2020). Additives and addictive substances are material for grade 8 odd semesters and are KD 3.6 as knowledge and 4.6 as skills (Ristiani & Nuha, 2022). Additives are substances added to food during the processing, packaging or storage for a specific purpose (Inggrid and Yushardi, 2022). The types of additives are coloring agents, preservatives, flavoring agents, aroma enhancing agents, sweetening agents. Addictive substances are drugs and active ingredients which when consumed by living organisms can cause biological work and cause dependence or addiction that is difficult to stop and has the effect of wanting to use it continuously which, if stopped, can give the effect of extreme fatigue or extreme pain. Salni and Driliarosta, 2022). Types of addictive substances, namely, narcotic addictive substances, psychotropic addictive substances, non-narcotic and psychotropic addictive substances (Irwansyah et al., 2022).

The environment around the school is generally people who usually make businesses such as food stalls. Students' need for food is a major factor in the growing food stalls in the school environment. The variety of food in each school is generally the same, according to the tastes of today's young people who prefer fast food (Wijiastuti et al., 2020). In addition to containing compounds of nutritional value, fast food also contains compounds that are food additives known as Food Additives (BTM). Some packaged foods contain a lot of additives, namely an ingredient that can preserve food or change it with various techniques and ways (Enjelina and Erda, 2022). Even though this chemical substance is a toxic substance and a hazardous substance for humans, it is strictly forbidden to use it as a food raw material (Faoziyah et al., 2019).

The use of prohibited food additives is still common. Foods such as pentol and tofu basically contain protein and high water content which, if stored for a long time, will speed up the decay process (Hayat, 2022). Because many food manufacturers are getting around how to make the food they sell durable, durable and also still fit for sale so they don't suffer losses by adding formalin to food ingredients (Noorrela and Munggaran, 2021). Even though based on the 2012 minister of health regulation No 033 states that formaldehyde is prohibited as a food additive (Saputrayadi, 2018). This phenomenon requires people to be quite observant in choosing food tools.

It is hoped that junior high school students as the target of their research will be more observant in choosing cutlery (Karyantina & Mustofa, 2022). Education about the dangers of formalin is able to open up insight to the community, schools and hawker sellers, so that they pay more attention to the food preparation process (Claudia et al., 2022).

The results of the initial survey not everyone knows how to detect the presence of formaldehyde in food and its dangers to health. Most people think that the identification of these hazardous chemicals in food that can be verified must be done in a laboratory so that it is expensive, even though there are several simple ways that can be done without having to do it in a laboratory (Trisnawati and Setiawan, 2019). One effort that can be done is to integrate science learning with STEM (Science, Technology, Engineering, and Mathematics) to create tool ideas that can be a solution to these problems. A simple method for detecting the presence of these ingredients can use dragon fruit skin (Shofi et al., 2020). The formalin test can be carried out with a reagent containing anthocyanin on dragon fruit skin (Kusuma, 2019).

Based on the description above, the researcher will make a marker detector tool containing dragon fruit peel extract to detect formaldehyde in food. The purpose of this study is for students to know the dangers of formaldehyde in food ingredients for health and know how to identify the presence of formaldehyde in food using a simple media based on STEM.

2. RESEARCH METHOD

This research is an experimental research. According to Sugiono (2019) Experimental research aims to find the effect of certain treatments on others under controlled conditions. At this design stage it is divided into two parts, namely the design of simple STEM-based media and the manufacture of natural dragon fruit peel extract to detect the content of formaldehyde additives in food. The design was carried out by Grade VIII students at SMPN 6 Jember. The stages of STEM implementation in innovative science learning media consist of several stages, namely 1) Introduction to the scope of STEM in science learning, researchers describe the application of STEM learning in science learning. 2) Identification of challenges to learning science in the 21st century, researchers identify challenges or problems in the school environment that can be addressed through STEM-based media creation. 3) Designing STEM-based media according to the topic of the material to be raised, based on the problem found by researchers designing STEM-based media as alternative solutions in dealing with the these problems. 4) Revise STEM based media design, researchers made improvements to the refinement of STEM-based media. 5) Demonstrate STEM based media tools, researchers conducted the application of STEM-based media directly to the scope of the school namely SMPN 6 Jember.

3. RESULT AND DISCUSSION

The simple STEM-based media designed is detector marker. This design activity is based on STEM principles namely Science, Technology, Engineering, Art and Mathematics. The marker detector tool became the final media idea after going through several improvements and tools. This improvement aims to improve the use value of the detector marker as a formalin detection medium with natural ingredients dragon fruit peel extract and the latest modification of the tool. The results of STEM-based media improvements can be seen in Table 1.

Table 1. STEM-based Tools Idea Design

Tools Detector Pen Idea Sketch	Tools Detector marker Idea sketch
	

Table 1 shows the tool sketch ideas for STEM-based media. The initial sketch is a Detector Pen with the main tool, namely a Ballpoint which is motivated so that later it can be filled with skin extract for dragons. However, after going through various considerations, one of which was the small volume of the ballpoint pen so that the dragon fruit peel extract could not be stored in large volumes. Therefore, a new idea is needed for a modification tool that can become a medium from dragon fruit peel extract with a larger storage volume so that it is more practical and efficient for students. Detector marker is the final idea of STEM-based media which is a simple modification tool that collaborates used markers with dropper pipettes. Detector markers can be storage media for dragon fruit peel extracts that are designed to be practical and efficient so that they can be made directly

by junior high school students using materials and tools that are very affordable. The procedure for making detector markers and natural ingredients of dragon fruit peel extract is in Table 2.

Table 2. Procedure for making STEM-based media

Tool Manufacturing Procedure Detector marker and Dragon Fruit Peel Extract	**Documentation**	**STEM integration**
Presentation of additive material and an introduction to the STEM tool for the formalin identification test		*Science:* Students understand the concept of formaldehyde as a prohibited additive Students understand the concept of anthocyanin content as a natural substance for detecting formaldehyde.
Prepare tools and materials to be used		*Engineering*: Students develop a design for a Detector marker by using a pipette and used markers as a medium for extracting dragon fruit skin. *Arts*: students develop as creative a tool design as possible by paying attention to the use value, practicality and efficiency of the tool. *Mathematics*: students pay attention to measurements in making Detector marker tools Students pay attention to the volume measurement in making dragon fruit peel extract *Technology*: Students tested the Detector marker they designed as a simple tool to detect formaldehyde content in food samples
Discarding the contents of the whiteboard marker		
Cut the back cover of the marker		
Insert the dropper into the marker		
Detector marker ready to use,		

Cut 20 grams of red dragon fruit skin into small pieces using a knife,	
Pour 200ml of water into a beaker glass	
The extraction process was carried out by the maceration method, namely soaking for 1X24 hours.	

The results of data analysis show that in the design and manufacture of detector markers there is a STEM component which is of course utilized in learning. The STEM component in the detector marker can be used at school in agroecosystem zone (junior high school level learning), especially in science subjects with the topic of Additives and Addictive Substances which contain material about a prohibited additive, namely formalin. However, according to the research results of Amala and Yushardi (2022), even though they have obtained this material, there are still many students who buy food and drinks that contain additives, so teachers need to teach material additives and addictive substances more clearly and provide examples of real negative impacts on students. . The STEM approach invites students to understand phenomena that occur that are close to them, so that students will want to know more, want to learn and understand what is happening, the causes, and the impacts that are caused and try to overcome them (Supriyatin et al., 2023). This is of course in line with the principle of making detector markers that are able to motivate students to understand the phenomenon of widespread abuse of formalin additives by traders in the school environment, so that students can immediately associate, connect and even be able to find solutions to problems that arise, in this learning model students are taught to think critical.

The STEM approach encourages students to learn to explore all the abilities they have in their own way. STEM will also bring out different and unexpected works from each individual or group (Mu'minah, 2020). The work in the form of a detector marker is one of creativity by utilizing simple tools and materials, namely markers, dropper drops, and natural ingredients dragon fruit peel extract. Grouping students in STEM requires personal and interpersonal responsibility for the learning that occurs, this process will build students' understanding of the material being studied (Puspadewi et al., 2022). Testing formalin in a simple way is very conditional for students. In addition to detector markers and red dragon fruit peel extract, students can also use a variety of tools and simple materials for simple formalin testing.

Red dragon fruit (Hylocereus polyrhizus) is much loved by the public and it is very easy to find its existence in agricultural cultivation or agribusiness activities. The interesting thing about red dragon fruit is the benefits of the fruit skin which can be used as a natural dye in food and drinks (Ayun, 2022). Dragon fruit, which has red flesh, has the potential that the anthocyanin content obtained from dragon fruit can be used as an alternative to synthetic dyes (Dewi, 2019). Apart from being an alternative to synthetic dyes, anthocyanins can also be used as an active ingredient in the manufacture of cosmetics, because anthocyanins also act as antioxidants (Rahmawati and Aji, 2022). In plants, anthocyanins are important color givers and are the most abundant and have striking colors. This color depends on the functional group that is bound and the pH it has (Indriastuti, 2022).

So far, the use of dragon fruit peel plants has been limited to the fruit flesh, while other parts, especially dragon fruit skin, have not been widely used (Anggraweni and Sari, 2022). Red dragon fruit skin has a natural dye pigment, namely Anthocyanin. Anthocyanins are the most important and widespread dyes in plants. This strongly colored and water-soluble pigment is the cause of almost all pink, maroon, red, purple and blue anthocyanins can be grouped into the flavanoid group (Rantesalu, 2022).

Chemically there are several factors that affect the stability of anthocyanins, one of which is protein. If the anthocyanin source reacts with the protein it will cause a color change, forming precipitate or vapor (Lestari et al., 2021). Red dragon fruit skin contains nutrients, such as carbohydrates, fats, proteins and dietary fiber. The extract from the skin of this red dragon fruit actually contains anthocyanin levels of 26.4587 ppm (Widyasanti et al., 2018). Anthocyanins are dyes that play a role in giving a red color, which has the potential to be used as natural coloring agents for food and can also be used as an alternative to synthetic colors that are safer for health. Anthocyanins found in red dragon fruit skin can be used to detect borax content and formaldehyde in food. The results of anthocyanin extraction from dragon fruit skin will then be used as a color indicator in borax analysis (Wakidi et al., 2022).

Based on the results of the research, it shows that in the process of designing and manufacturing detector markers and dragon fruit peel extract, there are components of the STEM approach that can be utilized in learning. The convenience of using natural materials or dragon fruit peel waste can be increased and made more practical in detecting formalin by formulating it in the form of a detector marker. This detector marker is more practical in use and also safer because the level of contamination by microorganisms is lower because it is used by dripping without direct contact with hands like other topical preparations. The use of dragon fruit skin as a formaldehyde detector is still little done, even though the use of dragon fruit skin is fairly easy to find, economical, and practical. For science teachers, this can be an alternative for learning at the junior high school level, especially in the subject matter of additives and addictive substances. Utilizing tools and materials that are easy to reach makes learning more meaningful and hones students' skills in solving any problems that occur in their surroundings. This is very important considering that STEM-based learning will be able to prepare generations to face the times and be able to compete in the 21st century era..

4. CONCLUSION

Based on the research that has been done, it can be concluded that the detector marker is the final idea as a medium for dragon fruit peel extract to detect formaldehyde content in food samples at school in agroecosystem zone. Extract from red dragon fruit skin contains anthocyanin level of 26.4587 ppm which is used to detect the formaldehyde content in food. The results of anthocyanin extraction from dragon fruit skin will then be used as a color indicator in formalin analysis. Anthocyanins have a pH of about 2-3, almost the same as the pH of formalin. One of the factors that affect the color of anthocyanin remains stable when it reacts with formalin because it is acidic. Detector markers can be storage media for dragon fruit peel extracts that are designed to be practical and efficient so that they can be made directly by junior high school students using materials and tools that are very affordable. The STEM components contained in the process of designing detector markers and making red dragon fruit peel extract can be utilized in learning at the junior high school level, especially in the material of additives and addictive substances, namely a simple test to detect formaldehyde in food.

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