













## Increasing the Economic Value of Hydrogel as an Alternative Planting Media at Madrasah Aliyah Swasta Muhammadiyah Sidomulyo

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### ABSTRACT

Hydrogel technology can be used as a solution for indoor growing media. Hydrogel is a three-dimensional polymer network with cross-linked hydrophilic polymers, which are capable of swelling or storing water and physiological solutions up to thousands of times their dry weight, and are not easily soluble. To increase knowledge about ornamental plant cultivation using hydrogel media, a service was carried out by using partners at the Madrasah Aliyah Swasta Muhammadiyah Sidomulyo. This service aims to provide solutions to partners in the form of alternative hydrogel-based planting media made from alginate that are environmentally friendly which can be used as moisture and nutrient control agents. This goal is achieved through outreach activities, training, and the application of alternative planting media on ornamental plants. The target of the results to be achieved is to increase the economic value of hydrogels and to foster the entrepreneurial spirit of the students of Madrasah Aliyah Swasta Muhammadiyah Sidomulyo.

**Keyword:** Hydrogel, Growing Media, Alginate, Economical



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## 1. Introduction

Here The availability of water and nutrients is one of the requirements for plants to grow well. This is generally a problem in several regions in Indonesia, especially during the dry season. Under these conditions, the quantity and quality of groundwater can be reduced, which can inhibit plant growth. Therefore, it can be concluded that a good planting medium is one of the main factors in plant growth [1].

One of the growing alternative growing media that can be used for plant cultivation is using hydrogels. Hydrogel is a material consisting of a cross-linked network made of hydrophilic polymers that can absorb water and nutrients because it has a certain capacity in storage [2]. Hydrogel synthesis is widely done using synthetic monomers, modification of natural polymers such as cellulose derivatives [3]. They are produced from chemically or physically cross-linked polymers and they can find applications in various fields such as drug delivery, wound dressing, tissue engineering, heavy metal absorption, implants, and contact lenses [4].

Various polymers used in biomedical applications have important functional properties including biocompatibility and biodegradability. Among the materials established as polymers, *alginate* is an attractive polysaccharide. In addition, alginate has low toxicity, and is relatively inexpensive [5] thus it is favored for environmental applications due to its high carboxyl group content [6]. *Na-alginate* is used due to its gelling properties and non-toxicity [7]. The hydrogels in this activity were prepared by dropping 2% by weight sodium alginate into a 1% by weight calcium chloride solution. Calcium chloride causes the alginate to crosslink so that it diffuses through the alginate gel layer. When the calcium reaches the inside of the beads, it will cause the alginate there to crosslink and become a gel [8].

Modern Muhammadiyah Islamic Boarding School Kwala Madu Langkat which is located on Jalan Tanjung Pura KM 32, Kwala Madu Sugar Factory Intersection, Sidomulyo Village. This school has a vision and mission to encourage santri / female santri graduates to be able to explore superior creative economic fields. [9] so that graduates can become entrepreneurs who can utilize simple technology into appropriate products. Scientific advances have played an important role in the development of plant technology so that it can be used as a way to improve plant growth and development and can also be utilized as an entrepreneurial field.

In this service, hydrogel is applied as an alternative planting medium in kangkong vegetable plants and ornamental plants. The kale plant is one of the plants that can be cultivated and is thought to require sufficient organic matter. [10] and belongs to the *Convolvulaceae* tribe. Land kale has a different color from the water kale plant stem. Land kale has a greenish-white stem color, while land kale has segments that are larger than kale that grows in water. [11]. In vegetable crops the hydrogel is mixed with soil, forming an amorphous gelatin-like mass on hydration and is proficient in absorption and desorption for a long time, thus acting as a slow supply of unused water in the soil [12]. Hydrogels increase the moisture content in the soil and provide water during dry seasons. [13].

Cultivation of ornamental plants can be done by generative or vegetative propagation [14]. Ornamental plants have a high economic value, so the need for high quality is also needed so that ornamental plants can be utilized as an alternative source of community income, especially during the current pandemic. [15]. With this planting media, it will save the use of as much as when compared to conventional planting media.

The mechanism of water absorption depends on the diffusion of water into the 3D hydrogel network and the consequent relaxation of the polymer chain. The phenomenon of water transport in swelling hydrogels is significantly influenced by different factors, including the chemical composition of the hydrogel, the equilibrium moisture content, and the degree of swelling [16]. Hydrogels can be used as a material for absorbing water that is environmentally friendly by utilizing natural resources around us. [17].

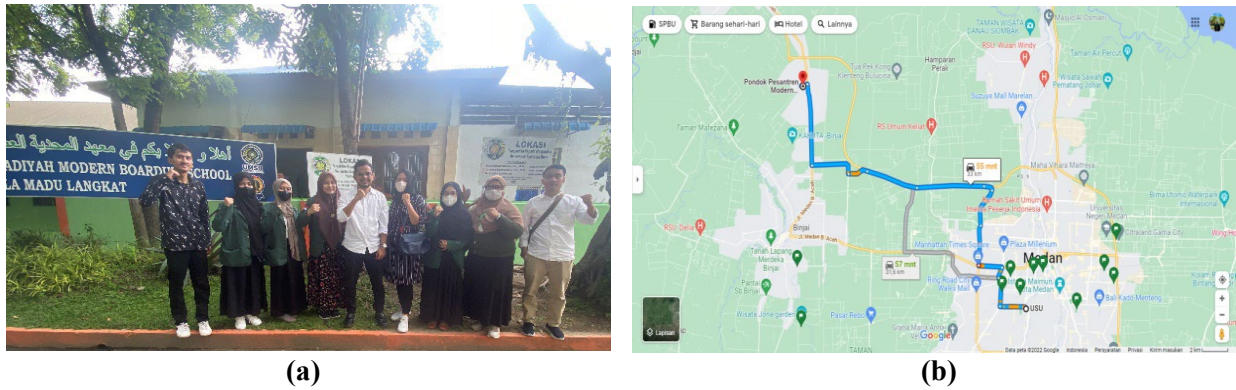
## 2. Implementation Method

### 2.1. Tools and Materials

The tools used in the manufacture of hydrogels are *hotplate*, stative, separatory funnel, *magnetic bar*, beaker glass, spatula, and sieve. The materials used are *sodium alginate*,  $\text{CaCl}_2$ , urea, and distilled water. In addition, the tools used for planting media are *polybags* and shovels. The materials used are soil, compost, husks, kale plants and ornamental plants.

### 2.2. Community Service Location

Community service was carried out at Madrasah Aliyah Swasta Muhammadiyah Sidomulyo which is located on Jalan Tj. Pura No.Km 32, Kwala Begumit, Kec. Stabat, Langkat Regency, North Sumatra. the partner location is 33 km from the Universitas Sumatera Utara with a travel time of about 55 minutes by car via the Medan-Binjai Toll Road, as shown in Figure 1 below.



**Figure 1. (a)** Madrasah Aliyah Swasta Muhammadiyah Sidomulyo, **(b)** Partner network location map of Universitas Sumatera Utara

2.3. *Hydrogel manufacturing process*

a. Preparation of solutions (*sodium alginate*,  $\text{CaCl}_2$ , and urea)

*Natirum alginate* solution was prepared by dissolving 2wt% *sodium alginate* (2 g *sodium alginate* in 100 ml distilled water) in a beaker glass until homogeneous by stirring using a *magnetic bar*. Then, the homogenized *sodium alginate* solution was stored in the refrigerator.  $\text{CaCl}_2$  solution is made by dissolving 2wt%  $\text{CaCl}_2$  (2 g  $\text{CaCl}_2$  in 100 ml distilled water) in beaker glass until homogeneous. Meanwhile, urea solution was made by dissolving 1wt% urea (2 g  $\text{CaCl}_2$  in 100 ml distilled water) in a beaker glass until homogeneous. Next, 2 wt%  $\text{CaCl}_2$  solution was mixed with 1 wt% urea solution that had been made separately before.

b. Formation of *gel beads*

The formation of *gel beads* occurs when the *sodium alginate* solution is dripped using a separatory funnel into a beaker glass containing a mixture of  $\text{CaCl}_2$  solution and urea solution while rotating with a *magnetic bar*. This is due to the crosslinking process between the *sodium alginate* solution that is dripped into the  $\text{CaCl}_2$  solution so that *gel beads* are formed. This process is carried out until the sea of *sodium alginate* that is dripped runs out and then the *gel beads* are allowed to stand for 15 minutes. After that, the *gel beads* can be filtered using a filter. Hydrogel is ready to be applied to the planting media.

**3. Result and Discussion**

The development of planting media is currently very diverse, one of which is the use of hydrogels as a planting medium. Hydrogel is one of the alternative planting media used to reduce the intensity of watering on plants. Hydrogels function to store water and nutrients needed by plants that will be released slowly according to the needs of the plant. Hydrogels can also still be used in combination with soil growing media. The advantages of using hydrogels include that they can absorb and store water and nutrients optimally so as to reduce the frequency of watering in plants so that it does not need to bother and is more economical. The material for making hydrogels is also very diverse, one of which we use in this service is a hydrogel based on sodium alginate as a gelling agent and  $\text{CaCl}_2$  as a crosslinker that is more environmentally friendly and biodegradable. In this community service activity, socialization of hydrogel as a planting medium is carried out starting from the introduction of tools and materials, demonstration of hydrogel making, to the application of hydrogel as a planting medium in kale plants and ornamental plants to students of Madrasah Aliyah Swasta Muhammadiyah Sidomulyo as can be seen in Figure 2 below.



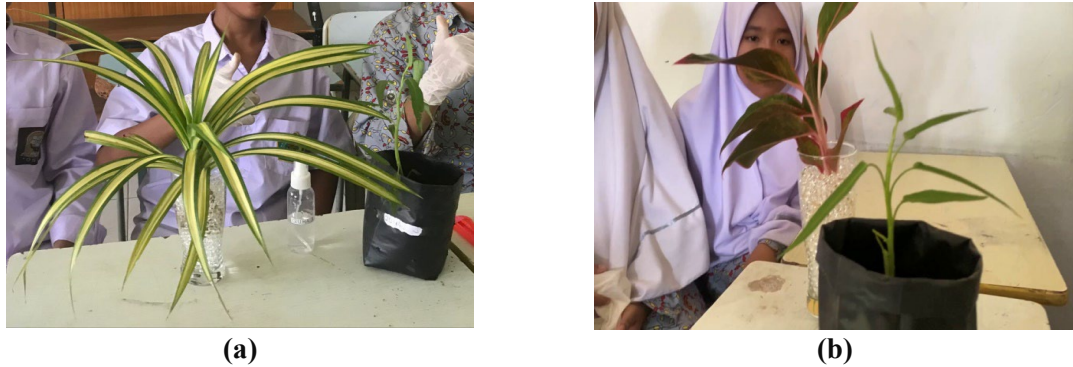
**Figure 2. (a)** Socialization of hydrogels, **(b)** Demonstration of tools and making hydrogels



Furthermore, in this service, plant preparation and preparation of various planting media were carried out for two types of plants, namely kangkong plants and ornamental plants.

a. Plant preparation

The plants that will be applied in this service are kale plants and ornamental plants (aglonema and paris lilies). Kale plants were chosen because these plants are easy to grow and have a relatively short harvest time of about 30-40 days. While aglonema ornamental plants are used because these ornamental plants are easy to find and can live in water as seen in Figure 3.



**Figure 3. (a)** Kale plants and ornamental plants (paris lilies) **(b)** Kale plants and ornamental plants (aglonema)

b. Preparation of growing media

Planting media used for kale plants are soil mixed with compost and husk in a ratio of 2: 1 soil and compost and 10% husk placed in *polybags* as high as 10 cm that has been allowed to stand for 1 night before planting time and also the addition of hydrogel in the soil. While the planting media used in ornamental plants is only hydrogel placed in a glass container. The application of planting media was done directly by students of Madrasah Aliyah Swasta Muhammadiyah Sidomulyo as shown in Figure 4.



**Figure 4.** Making kale plants and ornamental plants by students

The participants of the hydrogel making training were very enthusiastic in this service activity. This can be seen from Figure 5.



**Figure 5.** Enthusiasm of the Hydrogel Making Training Participants

#### 4. Conclusion

- The manufacture of alginate-based hydrogels has been successfully carried out at Madrasah Aliyah Swasta Muhammadiyah Sidomulyo.
- Alginate-based hydrogels that are environmentally friendly and safe to use can be used as alternative growing media that can store water and nutrients for plants so that their use can reduce the frequency of watering plants.
- Alginate-based hydrogels have been successfully tested using kale and ornamental plants.
- Hydrogels can be applied to vegetable, medicinal and ornamental plants. Making hydrogels is expected to increase economic value and foster the spirit of entrepreneurship.

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