CARRIER MATERIALS FOR DRY PROBIOTICS (A REVIEW)

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ABSTRACT

To increase the yield of aquaculture commodities, many biological agents have been used, including the introduction of probiotic bacteria. Probiotics are living microorganisms that, when given to a host organism in sufficient quantities, will enhance its health. It is necessary for probiotic bacteria to meet a number of criteria in order to be used, including resistance to bile salts and low pH, ability to survive in the digestive system, production of antimicrobial compounds, ability to adhere to intestinal cells, mass production, ability to remain stable and viable in the environment for extended periods of time both in the laboratory and in the field, and a significant positive effect on the host. Among the difficulties faced by probiotic products in liquid preparations is the inadequacy of large-scale storage and delivery for liquid probiotics. This led to the development of new probiotic products in dry formulations (powder). The encapsulation method can be used to maintain and improve the qualities of probiotic bacteria. It is very significant to notice the role of the carrier material in the encapsulation process. Depending on the bacterial carrier emulator's physical and chemical characteristics, the drying environment, and the type of spray drying employed, the coating material will have an impact on the final output. Maltodextrin, talc, activated carbon, and rice flour are a few substances that can be utilized as coating materials in the production of dry probiotic products.

Keyword: *aquaculture, carrier, encapsulation, maltodextrin, probiotics*

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1. INTRODUCTION

Increasing aquaculture activities, especially shrimp commodity, requires the implementation of good aquaculture management, one of which is in terms of managing the quality of aquaculture media. One of the commodities developed for this purpose is probiotics. Many biological agents, including the introduction of probiotic bacteria, have been employed to boost the yield of shrimp commodities. Probiotics, according to [1], are live bacteria that, when administered in large enough doses, will improve the health of the host organism. Similar definition is stated by [2], who defined probiotics as living microorganisms which when consumed by the host will have a beneficial effect on it by improving the microbiota environment in the digestive system.

It was further stated that probiotics are live microbial agents that are able to provide benefits to the host by modifying the microbial community or associating with the host, improving nutritional value by using feed, increasing host response to disease, and improving environmental quality. It all started when probiotics developed and immediately significantly affected the production performance of various industrial sectors, one of which was in the field of agro-complex (agriculture, animal husbandry and fisheries). According to [3], probiotic bacteria begin to create antimicrobial substrates during the exponential phase. But after the cell enters the stationary phase, the majority of bacteriocins are generated in significant amounts. By creating pores in the bacterial cell, bacteriocins can decrease the permeability of the cell membrane of harmful bacteria, causing the cell membrane to leak and compromise the integrity of the cell membrane. Pathogenic bacterial cells will have their growth impeded and will eventually perish.

2. TYPES OF PROBIOTIC PREPARATIONS

Initially, probiotic preparations were available in liquid preparations, in the form of liquid probiotics. Its application is widely used in agricultural activities (oil palm, cassava, secondary crops). Tracing the results of the use of liquid probiotics shows that its use is able to answer the needs of agricultural activities for biological products and is able to increase agricultural production. The next challenge is the problem of water quality and disease in the fisheries sector. Based on the literature study, there are similarities between the microbes utilized in agriculture and fisheries. The microbes applied in probiotics are from the *Lactobacillus (Lactobacillus fermentum, Lactobacillus plantarum* and *Lactobacillus acidophilus)* groups, and *Bacillus (B. subtilis, B. clausii, B. cereus, B. coagulans* and *B. licheniformis)*. Meanwhile, according to [4], groups of bacteria that include in probiotics are *Bacillus* sp., *Photobacterium* sp., and *Lactobacillus* sp. *Lactobacillus* is a microbe that has beneficial effects on health, normal flora in the digestive tract and stimulates the immune system [5], while *Bacillus* has a high proteolytic activity [6]. According to [4] *Bacillus* sp., *Photobacterium* sp., and *Lactobacillus* sp. are bacterial species that contain probiotics. Probiotic bacteria must meet certain requirements in order to be used, such as being resistant to low pH and bile salts, living in the digestive system, producing antimicrobial compounds, adhering to intestinal cells, being mass-produced, remaining stable and viable in the environment for extended periods of time under storage conditions and in the field, and having a significant beneficial impact on the host [7], [3], [8]. More than 45 antibacterial compounds can be produced by *Bacillus* sp. bacterium. Bacteriocin, amino acids, and non-amino acids are among the antibiotic compounds created [9].

The use of probiotics in the field of fisheries is done by adding probiotics in cultivation media (water) or mixed into feed. The application of probiotics not only functions as a biocontrol agent to reduce disease attacks or bioremediation to improve environmental quality, but can increase the nutritional value of feed and the rate of nutrient absorption so as to enable shrimp to achieve maximum growth. Application of probiotic bacteria can be done with artificial feed and natural feed enrichment [10]. Several research results show that liquid probiotics can increase productivity in shrimp culture.

Probiotic products in liquid preparations face a number of challenges, one of which is the distribution and large-scale storage constraints that are inadequate for liquid probiotics. Subsequently based on this, probiotic product innovations began to appear in dry preparations (powder) therefore that they can be distributed further between islands, have efficient storage places and have a longer shelf life [11]. [12] stated that to stabilize cells, increase the viability and stability of bacteria in production, storage, and digestion, encapsulation technique (coating with a carrier material) can be used.

The provision of dry probiotic preparations is carried out using spray drying technology, where drying is carried out with a relatively high drying temperature with an inlet temperature of 110^{o}C and an outlet temperature of 68^{o}C, brief drying time, and the final product is a stable powder [13]. The final product of the spray drying process is microencapsulated with has the advantage of protecting the core material by using a coating material. Dry powder from spray drying which contains a large number of live microorganisms is a suitable form for storage purposes and applications in the development of functional foods [14].

3. CARRIER MATERIAL FOR ENCAPSULATION

In order to make up for any potential loss of probiotic bacteria while in the digestive tract, the minimum number of probiotic strains need to be included in food products is 10^6 CFU/g, or 10^8 CFU/g of probiotic strains must be consumed daily [15]. The encapsulation approach can be utilized to enhance and maintain the characteristics of these probiotic bacteria. Encapsulation is a technique for covering a substance so that it can be shielded from outside influences. Microbes can be shielded from harmful environmental impacts such heat and toxins by being enclosed in bacteria [16] [17] [18]. The coating material must be non-toxic, simple to apply, reasonably priced, and the encapsulated substance must have essentially the same physiological characteristics after encapsulation as it did before [18].

The carrier material in the encapsulation process is very important to note. [16], stated that the coating material for spray drying will affect the resulting product, depending on the physical and chemical properties of the bacterial carrier emulator, drying conditions and spray drying used. Several materials can be used as coating materials in the manufacture of dry probiotic preparations, including the following:

Maltodextrin

Maltodextrin is a saccharide polymer with various carbon chains. Maltodextrin is produced from the partial hydrolysis of starch obtained from various sources such as corn, potatoes, oats, rice, wheat, or tapioca [19]. Maltodextrin is often used in encapsulation because it has good coating properties, namely being able to form emulsions and low viscosity [20]. Maltodextrin is also often employed because it can be readily available in large quantities and is easily obtained, can undergo rapid dispersion, has high solubility, is able to inhibit crystallization, has strong binding power, and is stable in oil-in-water emulsions. Maltodextrin has a good ability to inhibit oxidation reactions so that the resulting microcapsules have a better shelf life than other coatings [21]. According to [22], maltodextrin can preserve flavor stability during the drying process and is utilized in the encapsulation process to shield components that are vulnerable to oxidation and heat.

The functional properties of maltodextrin are determined by molecular weight and DE such as viscosity ability and browning ability. Maltodextrin is used to form solids and viscosity, and to bind water [19]. Maltodextrin with low DE is more effective as a fat binder compared to high DE. A high DE value will give a lower viscosity [23].

Talc

Talc is a very soft mineral with a chemical composition of $3Mg.4SiO_4H_2O$, and usually occurs as a secondary mineral resulting from hydration of magnesium bearing rock, such as peridotite, gabbro, and dolomite. According to [24], gibbsite and kaolinite are related with the mineral soil type talc and it has a higher degree of stability than clay minerals Talc has smooth, slippery properties, absorbs oil and grease, low electrical conductivity, high heat conductor, and high conductivity [25]. According to [26], the interaction of the type of formula that uses talc has an impact on the storage of bacterial formulations, in addition to the long storage formulation, talc can also affect the viability of bacteria.

Activated carbon

Activated carbon is a carbon compound that can be produced from materials containing carbon or from charcoal which is specially treated to get a wider surface. The surface area of activated carbon ranges from 300-3500 m^2/gram and this is related to the internal pore structure that causes this activated carbon to have absorbent properties. Activated carbon can absorb certain gases and chemical compounds or can be termed as selective absorption properties. The activated carbon produced depends on the material used, for example, coconut shell produces soft charcoal and is suitable for purifying water. In the field of fisheries and aquaculture, this activated carbon can be used for purification, removal of ammonia, phenol nitrite and also heavy metals [27].

Rice Flour

Rice flour is one of the alternative basic ingredients of composite flour consisting of carbohydrates, fats, proteins, minerals and vitamins. Rice flour is a semi-finished product for further industrial raw materials. It takes 12 hours to make rice flour by soaking the rice in clean water then draining, drying, mashing and sifting using an 80-mesh sieve [28].

The main component contained in rice is carbohydrates. These carbohydrates consist of starch in large portion as well as sugar content, cellulose, hemicellulose and pentose. Starch contained in rice is 85-90% of the dry weight of rice, pentose is 2.0-2.5% and sugar are 0.6-1.4% of the weight of broken rice. Therefore, the properties of starch are factors that can determine the physicochemical properties of rice [29]. In addition to starch, rice also contains protein, vitamins (especially the aleurone), minerals, and water. Rice starch is composed of two carbohydrate polymers, namely, amylose (starch with an unbranched structure) and amylopectin (starch with a branched structure and tends to be sticky). Rice is rich in B vitamins; it also contains less fat and minerals. The protein contained in rice flour is higher than rice starch, namely rice flour by 5.2-6.8% and rice starch 0.2-0.9% [30]. According to [31], approximately 8.7 percent protein is found in rice flour, which is a component with a high protein content.

4. CONCLUSIONS

Probiotics are added to cultivation media (water) or blended into feed when used in the field of fisheries. Probiotics can be applied to raise the nutritional value of feed and the rate of nutrient absorption, which will allow aquaculture commodities to develop as much as possible in addition to acting as a biocontrol agent to lessen disease attacks or a bioremediation agent to improve environmental quality. Probiotics typically contain the bacterial species *Lactobacillus* sp., *Photobacterium* sp., and *Bacillus* sp. The distribution and large-scale storage limits that are insufficient for liquid probiotics are one of the difficulties faced by probiotic products in liquid preparations. Following this, advancements in probiotic products started to show up in dry preparations. Encapsulation technique (coating with a carrier material) can be used to stabilize cells, increase the viability and stability of bacteria in production, storage, and digesting. The encapsulated substance must essentially retain its pre-encapsulated physiological properties after being coated, and the coating material must be non-toxic, easy to use, and inexpensive A few ingredients that can be used as coating materials in the creation of dry probiotic products include maltodextrin, talc, activated carbon, and rice flour.

5. REFERENCES

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