Bioplastic Technology as Packaging Innovation

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Abstract. This study aims at explaining bioplastics’ use as a substitute for plastic base materials. Besides, it is also expected to help sustainable packaging innovation. The use of plastics continues to increase over time. Although plastic is difficult to decompose, its durability makes it still used for various product packaging. Contrary to its use, this resilience becomes an obstacle in protecting the environment from accumulating plastic waste. There are various solutions to replace plastic material with something more environmentally friendly. One of them is the use of bioplastics from cassava peels. This material, called bioplastic, is an innovation to protect the environment in environmentally friendly plastic. This innovation opens up opportunities to be used as a business that connects producers and customers through new technologies and products. The descriptive method used in this research was carried out in two stages: first, in the form of data collection techniques in the form of literature studies through internet resource searches. Second, based on the data obtained, it is used as a reference for determining visual information for packaging made from bioplastic. The visualization process uses Photoshop Creative Cloud 2018 software. The result is an illustration showing the characteristics of the bioplastic material derived from cassava peels and an environmentally friendly plastic material. An illustration in the form of information leads to the formation of conceptual businesses to increase buyer interest and the tendency to use bioplastics.

1. Introduction

The use of plastics as products or packaging for consumer products has become commonplace. Without realizing it, the use of plastic is inseparable from people’s habits, both as a product used such as plates or cups and in the form of packaging. Various packaging for everyday products such as powder, lotion, bath soap, laundry soap, or others also uses plastic. Its strong, durable, and lightweight nature is the reason for choosing this material. However, this condition impacts the environment because of its character, which is not easily broken down. The initial idea as a durable material becomes a threat when the amount exceeds what is needed. The idea of replacing plastics has emerged, such as creating a material equivalent to plastic but has fewer negative risks. Bioplastic production is one of the main solutions to reduce problems associated with conventional plastics. They are made from natural materials that can decompose in nature when in contact with microorganisms [1]. Naturally, biodegradable polymers must be broken down into small molecules that are non-toxic and harmful because they are quickly damaged by nature [2]. This bioplastic can be produced in the long term because the basic material is abundant in Indonesia, namely cassava peel. The starch in cassava peels is a natural polymer and additive to modify the starch to make it completely biodegradable [3]. Therefore, starch is considered as one of the main promising ingredients in sustainable bioplastic innovation from cassava peels [4]. Concern for sustainability encourages market demand creation, which unconsciously requires innovation to create new markets [5, 6]. Bioplastic product innovation will attract attention and
influence consumer choice and expand consumer reach [7]. The main aspect required is an attractive final product design [8]. Bioplastic innovations include plastic bags, shopping bags, food wrappers, glasses, raincoats in the form of ponchos designed with attractive images.

Bioplastics are considered ideal plastic substitutes for certain types of conventional plastic packaging because petroleum-based plastics leave behind a solid waste material that is difficult to decompose, creating severe global environmental pollution problems. Bioplastics certainly have more advantages than conventional plastics because they come from plants, other biomass, microbial fermentation, or chemical synthesis (Khan 12) [9]. Despite the increasing awareness of sustainability, market demand, and regulations regarding plastics, the development of the bio-plastic packaging industry is still in its early stages. One of the obstacles is the weakness of bioplastics' performance when applied to various kinds of packaging. For example, certain bioplastic packaging's barrier properties, which are very important to protect food products from the outside environment, are often below conventional plastics (Benetto 1) [10]. Bioplastics can also be classified similarly to conventional plastics based on material properties such as in terms of strength and toughness. Based on this, plastic materials can be divided as thermosetting (meaning the cap material is hard and durable) or thermoplastic (compared to thermosetting materials, the material is less rigid) [11]. This study described how innovations in the bioplastics business based on cassava peel starch can play a central role in connecting producers and customers through the development of new technologies and products.

To be a business that produces promising environmentally friendly products, attractive packaging innovation is needed. The purpose of this study is to explain that using bioplastics as a population of plastics is expected to help sustainable embedding and increasingly sophisticated packaging and packaging innovations that will generate public interest in choosing bioplastics. The method used in this research is descriptive method with data analysis techniques, namely literature study and internet search. The method used in this innovative bioplastic packaging design process uses the Photoshop CC 2018 application. Besides, we also design a bioplastic distribution process so that it can be known to the wider community.

2. Method

A descriptive research method is used to get clear results regarding the use of bioplastics as product packaging. The data collection technique is in the form of literature study through the internet regarding bioplastic research development. The data obtained is an initial stage to explain the picture of the development of bioplastics. The second stage is determining the importance of information regarding bioplastics' properties and quality after becoming packaging. Bioplastic materials are similar to plastics, it needs to be marked using visual elements in the form of images. Therefore, people can distinguish between conventional plastics and bioplastics. This stage is carried out by determining an icon that is a sign that the bioplastic material comes from natural fibers and is easily biodegradable. Furthermore, the creation of the image is enhanced using the Photoshop CC 2018 software.

3. Results and Discussion

3.1. Bioplastic Product Innovation

The cultivated bioplastic comes from natural materials, which is an innovative product. Innovation is a form of creativity in developing or creating new products that are valuable and supported by a business model [6]. Innovation, in this regard, is carried out by developing and producing various environmentally friendly bioplastic products and attractive designs. It aims at attracting consumers to use its product. The price of this bioplastic product is somewhat more expensive than conventional plastic. Therefore, there are still many people who choose to use conventional plastic. Many people do not know about the existence of bioplastics. Whereas the use of bioplastics can reduce traditional waste of plastic and improve environmental conditions, various innovative bioplastic products continue to be produced and developed. It is started from plastic bags, shopping bags, food wrappers, fruit and vegetable wrappers, bioplastic cups, to poncho raincoats that are processed from cassava peel starch. In the manufacturing process, plasticizers become additional materials to increase the strength and elasticity of bioplastics. Although this bioplastic product is not much different from ordinary plastic products in terms of shape, we make this product more
attractive. So that from plain bioplastic sheets we make innovations so that these bioplastic sheets can be used as products that can help people in their daily lives (See Figures 1 and 2).

![Bioplastic Sheet before Processing](image1)

**Figure 1.** Bioplastic Sheet before Processing [16]

In Figure 2, there are several examples of bioplastic products developed from cassava peel starch in the form of glasses, plastic bags, gloves, and poncho raincoats.

![Bioplastic Products After Processing](image2)

**Figure 2.** Bioplastic Products After Processing

3.2. **Bioplastic Design**
We designed a picture that supports environmentally eco-friendly products. The interest in food products with environmentally friendly characteristics and certifications has grown in recent
decades. The 'Go green' products that most consumers consider to be low-process, grows na grow, and is healthy.

However, available products that are environmentally friendly are still limited, which makes the use of environmentally eco-friendly products less. Besides, with the development of technology, innovation is also growing. From a plain bioplastic bag, the technology can help to design these bioplastics with attractive designs. Therefore, with the presence of bioplastics with product innovation and attractive designs that describe the raw materials of these products, it is hoped that it will be able to help generate interest from the public to use attractive and environmentally eco-friendly products (See Figure 3).

![Figure 3. Bioplastic Product Packaging Logo](image)

The meaning of the logo above is to use environmentally eco-friendly products and products made from environmentally friendly raw materials such as bioplastics which can be innovated into various products not only as plastic bags.

Plastic bags and shopping bags are plastic waste that is often found in many places. It is because many people often use them. Plastic bags are usually used to differentiate in the shop because of their size. It is different from the shopping bag, which can carry more items because of its relatively large size. In accordance with the logo used, this bioplastic bag's design is also designed with an environmentally friendly product atmosphere so that people seeing this product will know that this product is environmentally friendly (See Figure 4).

![Figure 4. Plastic Bag Design](image)

Plastic cups are also plastic waste, which is widely known because of their disposable use, for example for drinks. This bioplastic glass innovation is intended so that it is used not once or can be stored as decoration because of the attractive product image design. In accordance with the logo used, the design of this bioplastic glass is also designed with an environmentally friendly product
atmosphere. When people see this product they will know that this product is an environmentally friendly product (See Figure 5).

![Figure 5. Plastic Cup Design](image)

Food, fruit, and vegetable packaging can also be produced from cassava peel starch. The use of bioplastics as packaging for fruits and vegetables can maintain and increase the freshness of fruits and vegetables [13]. A bioplastic food packaging from cassava starch is a food packaging that can be directly consumed. For direct consumption, packaging that is developed is in the form of bioplastic packaging sausages [14].

An innovative raincoat called the bioplastic poncho is also produced, seeing the plastic raincoat waste poncho when the rainy season arrives and many people use it only once. Its relatively large size will be challenging to decompose by nature. The innovation is also in the form of several image designs on the product. Under the logo used, this poncho raincoat design is also designed with an environmentally friendly product atmosphere. When people see this product they will know that this product is an environmentally friendly product (See Figure 6).

![Figure 6. Bioplastic Ponco Design](image)

Gloves are also one of the products that can be produced from cassava starch. During the Covid-19 pandemic, many people used gloves for shopping at supermarkets or carrying out other activities to reduce direct contact with surrounding objects. The innovation here focuses on making people interested in using bioplastic products produced from cassava peel starch with a variety of products and attractive designs, but at affordable prices. In accordance with the logo used, the design of this bioplastic glove is also designed with an environmentally friendly product.
atmosphere so that when people see this product, they will know that this product is an environmentally friendly product (See Figure 7).

![Glove Design](image)

**Figure 7. Glove Design**

### 3.3. Product Distribution Design

An innovation that has been introduced and commercialized can generate a lot of development, processes, and technology. When they are developed on a small scale, the emergence of ideas will be different and there will be many problems when they are applied on an industrial scale. Therefore, when starting a product design, it must be adjusted and considered both technology and process for the industrial scale. When the products that have been produced enter the market, the price offered will be slightly higher than those of synthetic plastic bags. Initially, the target market may be aimed more at people who have a back-to-nature concept or industries or companies that prefer biodegradable packaging products. This product's price can continue to decline if technology and process development continue so that the selling price and production price are cheaper. Product design is currently still in the form of a lab-scale, using simple materials and tools to produce a thermoplastic. The product design needs to be tested physically (tensile strength, long time to decompose, etc.). In addition, it is also necessary to carry out an analysis if it is scaled up to the industrial stage, cost analysis, and so on. However, until the laboratory stage, this design is feasible and can be used as a plastic substitute circulating today [15].

The concept of a product affects the level of marketing and consumer purchase value. For that, it is necessary to understand the things that will appeal to the visualization of a product's concept. Visualizing the concept of a product requires visual communication design skills. It means that the design of design needs to pay attention to aspects in making the concept of visualization so that it can be communicative and become a special attraction for consumers. Elements in visual communication design include images, colors, and words (typography). The product concept by introducing new and unusual innovations will certainly affect the purchase value of consumers.

Digital marketing is a process of planning and executing concepts, ideas, prices, promotions, and distribution. In simple terms, it can be interpreted as the development and maintenance of mutually beneficial relationships between consumers and producers. The marketing of products through digital media has many advantages and benefits that can be obtained. Some of the advantages of marketing through digital media include the speed of distribution to consumers, easy evaluation, wide reach, cheap, and effectiveness when compared to conventional marketing to reach consumers. Consumers are everyone who uses or buys a good or service that is within the scope of society for personal gain, other people, or others. In addition, it is not for resale.

A product design to reach consumers must go through several processes. The process begins with product design, concept, and visual design. Then, visual communication, digital media, and reaching consumers is shown in Figure 8.
4. Conclusion
Nowadays, the trend of using bioplastics is getting wider. However, it is still difficult for many people to switch from conventional plastics to bioplastics because they are more expensive and difficult to reach. Thus, innovation is needed to get their interest in using products made from bioplastics and with easy access or find. Innovations with designs designed with a contemporary atmosphere are expected to make them interested in buying. The digital marketing provided will make it easier for them to own this bioplastic product.

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