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Consumer perceptions of edible packaging made of gelatin as chili powder packaging

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Abstract. Edible packaging is a massive trend product which production will influence new perceptions about packaging. There has not been much research on consumers' perceptions of edible films, so it is necessary to determine the acceptance. Chili powder packaging is one of the edible film applications in the food industry. Edible packaging applications replacing chili powder plastic packaging can reduce plastic consumption, increase the feasibility and maintain chili powder quality. However, certain materials utilization can affect the perception, such as gelatin. Unsavory perception about gelatin edible packaging, such as its halal legality, will detain its production and development. Thus, this research aimed to analyze consumers' perception of edible packaging made of gelatin as chili powder packaging. This research was conducted using a survey method by Google Forms questionnaire working 215 respondents and organoleptic preference test employing randomly selected 101 untrained panelists. Based on observations, most respondents have positive knowledge and perception about edible packaging made of gelatin as chili powder packaging. The panelists accepted the product color, viscosity, aroma, and taste, respectively 87%, 77%, 72%, and 69%. Taken together, the findings highlight the perception and acceptance of gelatin edible packaging to replace chilli powder undegradable packaging.

Keywords: perception, edible packaging, preference, survey, gelatin.

1 Introduction

Plastic is a packaging material that can increase consumer appeal because it is easy to shape, color, and label [1]. The use of plastics as packaging cause environmental pollution. From 1950-2018, 6.3 billion tonnes of plastic were produced with a recycling rate of 9% [2]. Therefore, we need new environmentally friendly packaging, such as edible packaging. Edible packaging is a thin layer that can be eaten and used as food packaging to prevent food quality deterioration.

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Polymers, edible packaging composer, can be derived from biomass and divided into polysaccharides, proteins, and lipids. One of the abundantly available proteins is gelatin because it comes from livestock by-products. Forty-six percent gelatin is derived from pork collagen. The adjacency of pork collagen and gelatin will raise unpleasant perceptions that edible packaging is not halal to be consumed. Perception is the result of human interaction with the environment. Positive perceptions will increase the opportunity of several choices in elections [3], such as food choices.

Chili powder consumption in Indonesia reaches 3.05 kg/capita/year [4]. The large consumption of chili powder can be an opportunity to apply edible packaging as a chili powder packaging. Chili powder is added in small quantities so that it requires small-surface edible packaging. Edible biopolymer packaging will be dissolved, so it is practical and leaves no waste.

Currently, the mass production of edible packaging has been carried out in Indonesia. Edible packaging is also a trend in society to reduce environmental plastic waste. Based on the stimuli and information, people will have a particular perception of edible packaging. Edible packaging applications as chili powder packaging must consider consumer perceptions according to consumer needs. Therefore, this study analyzed consumer perceptions of edible packaging made of gelatin as chili powder packaging.

2 Materials and Methods

The ingredients used were gelatin powder, glycerol, drinking water, and chili powder from the local market. The tools used include pans, spoons, scissors, plates, scales, thermometers, ovens, stoves, sealers, refrigerators, baking sheets, plastic gloves, parchment paper and questionnaires. The research was carried out in two stages, namely: preliminary research and primary research. Preliminary research was conducted to find out how to use appropriate tools and materials to make edible packaging. The primary research aimed to determine the public's perception of edible packaging made from gelatin as a chili powder packaging.

The manufacture of edible packaging consisted of weighing, mixing, cooling, molding, drying, sealing I, filling and sealing II. Firstly, gelatin powder, glycerol and water were weighed with 20, 20, 100 g, respectively. Mixing was taken at a temperature of $75 \pm 5^\circ\text{C}$ for 2 minutes then cooled to a temperature of 30°C . After that, gelatin and glycerol were poured onto a 10 x 15 cm baking sheet lined with parchment paper. The gelatin and glycerol solutions were dried at a temperature of $75 \pm 5^\circ\text{C}$ using an oven. The dried edible packaging was cut into four pieces measuring 5 x 7.5 cm and folded. The bottom and sides of the edible packaging are pasted together to form a 5 x 3.25 cm pouch. Edible packaging was filled with 2 g of chili powder and heat sealed.

The survey was conducted using questionnaire as the instrument. The raw questionnaire was distributed to 30 respondents. The collected data was tested to determine its feasibility through validity and reliability. A validity test can be done using Pearson (product-moment coefficient of correlation) which is formulated as follows.

$$r_{xy} = \frac{n \sum x_i y_i - (\sum x_i)(\sum y_i)}{\sqrt{\{(n \sum x_i^2 - (\sum x_i)^2)\{n \sum y_i^2 - (\sum y_i)^2\}}}}$$

Reliability test can be done by determining the value of Cronbach's alpha and formulated as follows.

$$\alpha = \frac{k}{k-1} \frac{s_t^2 - \sum_{j=1}^k s_j^2}{s_t^2}$$

Each question with a validity and reliability score less than 0.8 will be eliminated. The questionnaire then distributed questionnaires through social media. Minimum The

minimum number of respondents should be 200 people and were picked through random selection. Survey respondents recently had a high school degree, a minimum age of 17 years, and consuming chili powder at least once a week. Survey instrument testing was done by examining the validity and reliability by 30 people. Testing the level of acceptance was arranged by using a hedonic questionnaire. An acceptance test was conducted to determine the panelists' acceptance of edible packaging color, viscosity, taste and aroma. Acceptance rate test using 100 untrained panelists as sensory panelists. Sensory panelists should have a high school degree, a minimum age of 17 years, and were consumers of chili powder. Panelists filled the questionnaire using the hedonic scale containing seven scales from 1 (very dislike) to 7 (very much like). The panelists were given two kinds of sample: diluted and undiluted. Diluted samples were made by dissolving one edible packaging made of gelatin in 200 g water as solutions. Diluted sample were used to test aroma, taste and viscosity. Undiluted edible packaging made of gelatin filled with chili powder were used to test color acceptance. Survey responses and acceptance tests were processed descriptively.

3 Discussion

Characteristics of respondents intend to determine the diversity of respondents by gender, age, and last education (Table 1). Adolescence is a moment when humans like to explore new environments and make important transitions [5]. Adolescents are a good target market because they will promote innovations, such as chili powder packaging using edible packaging made from gelatin. Respondents have an age range of 17 years (teenagers) to 54 years (elderly). The adolescent age group has the highest number, namely 189 people or 88% of the total respondents compared to the adult age group of 26 people (12%). By gender, male adaptability is higher compared to women [6]. Men are able to adjust and acquire new things compared to women. However, women commonly have a role in domestic affairs, such as food preparation. The proportion of female respondents is more than that of men. Respondents consisted of 143 women (67%) and 72 men (33%). Respondents characterized with a high level of education will have much information to consider when deciding on the acceptance of an innovative product. Respondents with a recent high school education or equivalent are expected to have better information quality than those with a high school diploma or equivalent or lower. Most respondents had a senior high school education or equivalent (182 people or 84%). Respondents with the latest education higher than high school or equivalent are 33 people (16%) with details of undergraduate as many as 32 people (97%) and postgraduate as many as one person (3%).

Table 1. Respondents Characteristics

Characteristics	Number (people)	Percentage
Age		
Adolescent (17-24-year-old)	189	88
Adult (25-49-year-old)	26	12
Total	215	100
Gender		
Male	72	33
Female	143	67
Total	215	100
Recent education		
High school	182	84
Higher than high school	33	16
Total	215	100

Respondents have an excellent perception of the mechanism of edible packaging made from gelatin in maintaining the quality of chili powder (Fig. 1). Maintaining taste is the highest mechanism delivered by 117 or 54% of 215 respondents. Taste is an essential parameter in product acceptance. Chili powder is expected to have a distinctive taste to be accepted by consumers [7]. Capsaicinoids cause the hot taste of chili powder. Exposure to heat and oxygen can reduce the levels of these compounds [8]. The decrease in capsaicinoid levels occurs due to heat-resistant oxidizing enzymes released during the crushing process [9]. Respondents perceive that edible packaging as packaging for chili powder can prevent water absorption by chili powder. A total of 115 people, or 53% of the 215 respondents, have this perception. Water absorption by chili powder will cause caking or clumping and mold growth [10]. Clumping of chili powder granules occurs due to the absorption of moisture. The absorption of moisture by chili powder grains can cause the formation of liquid bridges between particles and cause chili powder to stick to one another in the crystallization process [11]. Clumping of powdered materials causes a decrease in quality by preventing dry particles from flowing. Chili powder processed through the initial boiling of chili for 20 minutes has a 5-10% water content [12]. Increasing the water content up to 15% can support mold growth in chili powder [10]. The growth of mold in chili powder causes a decrease in the quality and safety of food ingredients. Chili powder contains many volatile compounds that give it its distinctive aroma. The volatile components of chili powder are acetic acid, propanal, N-methyl pyrrole and two methyl-propanal [13]. Edible gelatin film has good gas retention and oxidation stability retention [14]. The addition of plasticizers can fill the space between gelatin particles, reduce the pores' surface area, and inhibit the transfer of air and water vapor from outside to inside and vice versa. Packaging chili powder with packaging that cannot hold gas well will cause chili powder to release volatile compounds that contribute to a distinctive aroma. Responses regarding edible packaging as chili powder packaging can prevent loss of aroma were given by 86 people or 40% of 215 respondents. Improper packaging can also cause chili powder to go rancid. As many as 37% of 215 respondents or 80 people considered edible packaging suitable to prevent rancidity. Fresh chili contains palmitic acid and linoleic acid [15]. Linoleic acid is an unsaturated fatty acid that is susceptible to oxidation. Oxidation of unsaturated fatty acids will cause the formation of free radicals and hydroxyperoxides. The formation of these compounds causes the oxidation of pigments and flavors. Hydroxyperoxides can also undergo polymerization to form dark-colored polymers. Fatty acid oxidation can also cause a rancid aroma in food [16]. The public recognizes a rancid aroma as a sign of a decrease in the quality and safety of consumption of food products.

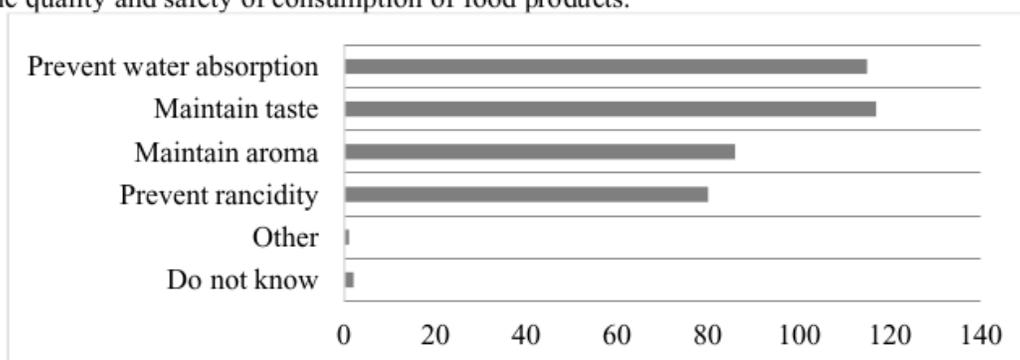


Fig. 1. The Mechanism of Edible Packaging Made of Gelatin in Maintaining Chili Powder Quality

Respondents' perceptions to increase their convenience of consuming chili powder can be seen in Figure 2. The consumer will not need to take out the trash. The use of edible packaging as packaging can provide a new trend for packaging that is environmentally friendly. The community has known that waste has a negative role in the environment [17]. Furthermore, trying to participate in managing waste actively. Today's society is

increasingly aware that piles of garbage are a problem that must be solved immediately. This awareness was assessed from 146 people or 68% of 215 respondents who responded that edible packaging leaves no waste. The utilisation of edible packaging can be a breakthrough that involves the community to reduce environmental waste. Respondents have understood that edible packaging can be consumed and degraded not to burden the environment. The perception that arises from the application of edible packaging as packaging for chili powder is that it is available in single-use sizes. One hundred five people, or 49% of 215 respondents, responded that the availability of products in single-use packaging could increase consumer convenience.

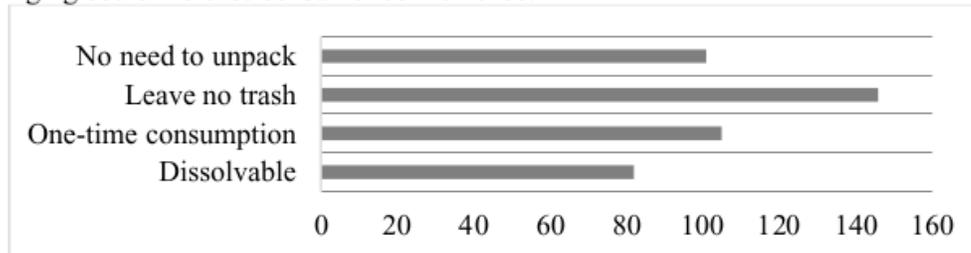


Fig. 2. The Mechanism of Edible Packaging Made of Gelatin to Improve Consumer Convenience

One-time packaging is considered more convenient to use [18]. The use of single-use packaging does not make manufacturers withdraw packaging for refilling. Single-use packaging makes it easier for consumers to measure the amount of product needed for consumption and does not require storage space. Edible packaging application as packaging for chili powder for one-time consumption will increase efficiency for consumers, simplify the distribution of producers and be beneficial to the environment. The application of edible packaging as packaging for large products is considered less effective because of the significant contamination risk. The application of edible packaging as chili powder packaging will increase consumer convenience. Consumers do not need to use sharp objects to tear the edible packaging. Difficulty in opening the packaging is a characteristic of packaging that does not function properly. Edible packaging can be dissolved in warm water with a minimum temperature of 49°C. A total of 101 or 47% of the 215 respondents responded that the mechanism could increase consumer convenience. Manufacturers have used various other types of packaging, such as zipped pouches and bottles, but they are less effective when used to pack small products.

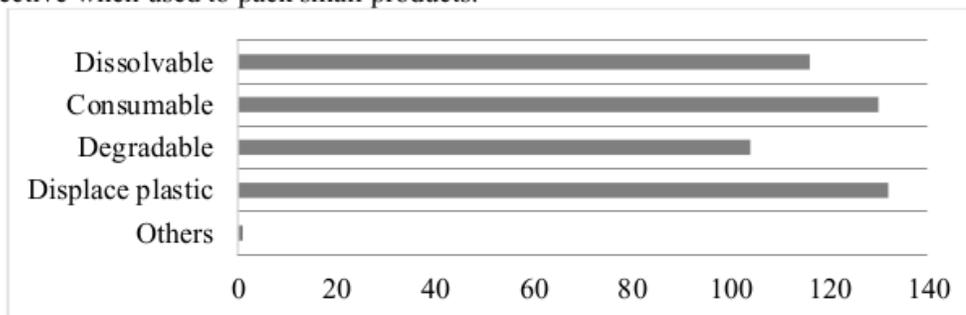


Fig. 3. Mechanism of Edible Packaging Made of Gelatin to Reduce Environmental Pollution

The mechanism of edible packaging in reducing pollution due to waste is shown in Figure 3. The statement dominated respondents' responses that the application of edible packaging on chili powder can reduce plastic use, as many as 132 people or 61% of 215 respondents. Respondents who consumed more than one sachet of chili powder only amounted to 25% so that the weight of packaged chili powder could be reduced to one serving. Respondents also considered that edible packaging can reduce environmental pollution because it can be consumed (60% of 215 respondents), soluble in warm water at a minimum temperature of 49°C (54% of 215 respondents) and degraded (48% of 215 respondents). Edible packaging made from gelatin for chili powder is safe for consumption

because it is made from food ingredients, namely gelatin and glycerol. The high solubility is due to hydrophilic components [19]. These hydrophilic components enable edible packaging components to bind with water or dissolve. The use of warm water can accelerate the solubility of edible packaging because heat increases the movement of molecules so that bonds between hydrophilic groups and water occur faster. Respondents affirmed that edible packaging is made from gelatin as chili powder packaging has a good degradation ability.

Respondents' interest in consuming edible packaging made of gelatin as chili powder packaging regarded in Figure 4. Most respondents are curious in trying edible packaging made of gelatin as chili powder packaging (90% or 194 people). Environmental awareness is the most prominent basis for people to try edible packaging made from gelatin as chili powder packaging. Respondents also responded that edible packaging is an innovation in packaging. The respondent's curiosity may increase consumption desire. Practicality is the third reason for the respondents to try edible packaging. Respondents know that using edible packaging made of gelatin as a chili powder packaging is easy to do, particularly by dissolving the product into a food broth. Responses regarding changes in taste and the ability of edible packaging to maintain the quality of chili powder only came from two respondents. Respondents are sceptical about the ability of edible packaging as packaging because it is easily degraded. Gelatin, the main ingredients, is used as a medium for microbial growth. Contamination that occurs in edible packaging causes the product to be unfit for consumption. Respondents think about halal gelatin as a raw material in the manufacture of edible packaging for chili powder. The halal legality can be the basis for 10% of the 215 respondents who are not interested in consuming edible packaging made from gelatin. Female respondents are more interested in trying edible packaging because it can increase the practicality in food preparation to facilitate domestic affairs.

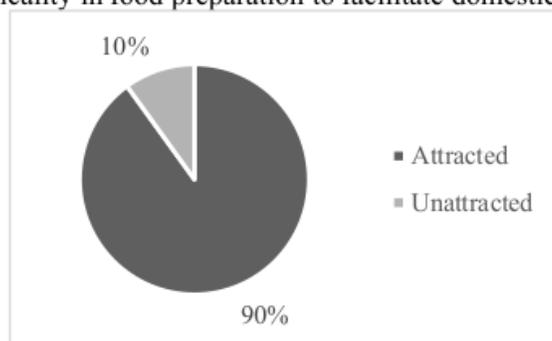


Fig. 4. Respondents' Interest in Consuming Edible Packaging Made of Gelatin as Chili Powder Packaging

Acceptance analysis was carried out to determine consumer scoring of the product [20]. The acceptance test is carried out through a preference test because the public will accept products with a high preference value. Acceptance analysis was carried out by distributing two samples. First, the edible packaging that had not been dissolved. Second, the edible packaging that had been dissolved. Acceptance analysis was carried out to 101 panelists (Table 2) based on four parameters, specifically: color, viscosity, aroma and taste.

Table 2. Panelists Characteristics

Characteristics	Number (people)	Percentage
Age		
Adolescent (17-24-year-old)	23	23
Adult (25-49-year-old)	78	77
Total	101	100
Recent education		
High school	23	23
Higher than high school	78	77
Total	101	100

Color is a sensory attribute that the panelists first see. Color determines the quality of food ingredients [21]. Gelatin and glycerol as raw materials for making edible packaging will cause the coating to brown. The brown color is caused by the thermal process between carbohydrates and amino acids to form melanoidin [22]. The average value of the panelists' preference was 5.48 (Figure 5), with the majority of the panelists (85%) liking the color of edible packaging made of gelatin applied to chili powder. Panelists' preference for color is based on the transparency of the packaging, which allows panelists to see the contents of chili powder. Viscosity is one fluid property that describes the resistance to flow [23]. The application of gelatin as edible packaging for chili powder will increase the viscosity of the chili powder solution. The addition of gelatin at a specific concentration will cause increased molecular contact and limit the movement of particles. Only 14% of the 101 panelists did not like the thickness of the solution because they felt it was still too runny. The average value of the panelists' preference for the viscosity of the solution made from gelatin and chili powder was 5.18 (Figure 5), with 77% of the panelists liking the viscosity of the solution. Gelatin can form a gel at a concentration of 0.5% [24]. The addition of gelatin was 2.5% from the dilution of 20 g of gelatin into 100 ml which was then dissolved in 200 g of water. The addition of gelatin in edible packaging to the sample solution causes the solution to be more viscous than plain water. Based on this assessment, the panelists can accept the edible packaging based on the product viscosity parameters at room temperature.

Aroma is a chemical stimulus smelled by the olfactory nerves in the nasal cavity [21]. Gelatin has a bovine smell typical of cows [25]. It is feared that the fishy smell will affect the panelists' acceptance of the consumption of chili powder. The results of the organoleptic test on the aroma of the solution of gelatin and chili powder can be seen in Figure 5. The majority of panelists (72%) liked the aroma of the solution of gelatin and chili powder. Based on the specifications, gelatin contains sulfur dioxide, which has an odor. The smell is unpleasant or less liked by consumers. Only 17% of the 101 panelists did not like the aroma of the solution made from gelatin and chili powder. The average value of the panelists' preference is 4.92 or neutral.

Taste is a sensory response to sweet, bitter, sour and salty tastes [26]. Taste is an essential parameter for consumer acceptance and is chosen to accept new products [12]. The taste will significantly affect the preferences and acceptance of the panelists. The use of gelatin will add to the umami taste due to the content of glutamic and aspartic acids [27]. The taste test was carried out after the panelists were given instructions to test their preference for the taste of the solution made from gelatin and chili powder in addition to spicy taste. The test was carried out by tasting the solution made from gelatin and chili powder. The majority of panelists liked the taste of the solution of gelatin and chili powder, which was indicated by giving a high score, as shown in Figure 5.

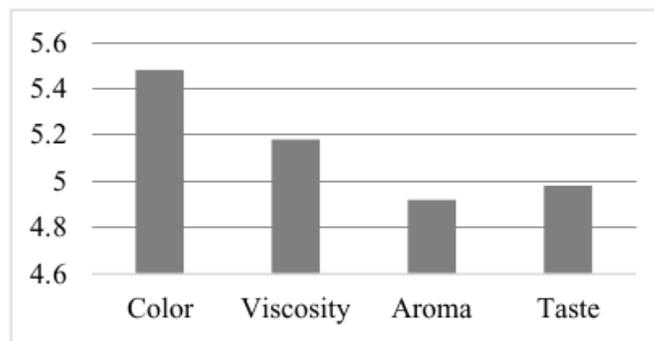


Fig. 5. Panelist Acceptance Rate of Edible Packaging Made of Gelatin as a Chili Powder Packaging

The taste of the solution made from gelatin and chili powder was liked by 69% of the total panelists, while 16% of the total panelists did not like the taste of edible packaging. The panelists' average preference for taste was 4.98 (Figure 5) or neutral. The addition of gelatin as edible packaging does not affect increasing certain flavors in the chili powder solution. The level of glutamic acid in the product solution was lower than the umami taste detection threshold. The umami taste detection threshold was 300 mM [28] or 5.0733%. The level of glutamic acid in the product solution amounted 0.2699% so that the panellists could not taste it. According to Trachootam et al. (2018) [29], people with a spicy taste preference have a higher taste threshold due to two factors: the direct effect of spicy taste on the sensitivity of the taste buds and the indirect effect of using spices in spicy food. Based on this preference value, the application of edible packaging as chili powder packaging can be accepted by consumers based on taste parameters.

Based on these findings, the future for gelatin edible packaging as chili powder packaging is promising. However, it requires a persistent, cost-effective, and multi-disciplinary approach to increase its shelf life. It would be interesting in the future to add antimicrobials agents or primary packaging to avoid contaminations. Those future findings will help to predict a product's possible future commercialization from the laboratory to the marketplace. Gelatin edible packaging commercialization as chili powder packaging will be advantageous to the manufacturer and society for reducing plastic waste.

4 Conclusion

The research results can be concluded as follows: consumers had good perception, consisting of maintaining and improving chili powder quality and reducing environmental pollution, and consumers interested in applying edible packaging to pack chili powder. The application of edible packaging on chili powder was accepted with an average score of color, viscosity, aroma, and taste, respectively 5.18, 5.48, 4.92, and 4.98.

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