Review Article

POTENTIAL EDIBLE FILM BIOCOMPOSITE (CANNA STARCH, NANOCHITOSAN AND FISH OIL) FOR EXTEND SHELF LIFE PANGASIUS SAUSAGES BASED ON ORGANOLEPTIC CHARACTERISTICS, WATER CONTENT, AND PH: A REVIEW

ABSTRACT

In general, commercial sausages can only last at room temperature for 1 day, because sausages are made from raw materials that are easily degraded in quality, especially fish sausages where fish are included in perishable foods that are easily degraded due to the high water content in fish which is suitable for microbial growth so a solution is needed to overcome these problems..Biocompote film made from fish oil, nano chitosan and canna starch has the potential to be used as a packaging substitute for casings that are more environmentally friendly and can extend the shelf life by analyzing pH, water content and organoleptic to determine the effect of the application of edible film on catfish sausages.

Keywords: sausage, catfish, edible film, fish oil, nanochitosan. canna starch

1. INTRODUCTION

Sausages are generally made from beef or chicken, there are few or even rare sausages made from fish meat, in fact fish meat has fiber that is more easily digested and contains good fatty acids.Utami et al. [1]. One of the food packaging materials that has a plastic-like shape, is made from biopolymer material, and is safe for human consumption, namely edible film. Apart from being safe for human consumption, edible film can be a good alternative to synthetic plastics for food packaging applications because it has biodegradable properties, can increase the shelf life of food, and is safe for health. Balti et al. [2].

Edible film is a thin edible sheet made of biopolymer and functions as a food product packaging. In general, there are 3 classes of biopolymers that are often used, namely hydrocolloids, lipids, and composites. Santoso et al. [3]. Princess et al. [4] Chitosan is a natural polysaccharide that is non-toxic and easily biodegradable. Chitosan has a shape similar to cellulose and the difference lies in the second C chain group. The ability to suppress bacterial growth is due to chitosan having a positively charged polycation which is able to inhibit the growth of bacteria and mold. (Mekawati et al. [5] Starch is often used in the food industry as a biodegradable film to replace plastic polymers because it is economical, renewable, and provides good physical characteristics. Kusumawati and Putri 2013 [6]. The high amylose content is an advantage of canna starch, because the amylose content has the ability to form gels and is suitable for producing the product desired by Sariyanti and

Utami[7]. One form of utilization of fishery industry waste that can be utilized is processing, namely fish oil. It is known that the heads and bones of fish contain fat which is rich in vitamin A and omega-3 fatty acids which are good for health. Fish oil also contains essential fatty acids that the body cannot produce naturally. There are two types of omega-3 fatty acids found in fish oil, namely docosahexaenoic acid (DHA) and eicosapentaenoic acid (EPA). Fish oil also contains high amounts of vitamins A and D, two types of fat-soluble vitamins (Apituley et al. [8] because the amylose content has the ability to form gels and is suitable for producing the desired product by Sariyanti and Utami [7]. One form of utilization of fishery industry waste that can be utilized is processing, namely fish oil. It is known that the heads and bones of fish contain fat which is rich in vitamin A and omega-3 fatty acids which are good for health. Fish oil also contains essential fatty acids that the body cannot produce naturally. There are two types of omega-3 fatty acids found in fish oil, namely docosahexaenoic acid (DHA) and eicosapentaenoic acid (EPA). Fish oil also contains high amounts of vitamins A and D, two types of fat-soluble vitamins (Apituley et al. [8] because the amylose content has the ability to form gels and is suitable for producing the desired product by Sariyanti and Utami [7]. One form of utilization of fishery industry waste that can be utilized is processing, namely fish oil. It is known that the heads and bones of fish contain fat which is rich in vitamin A and omega-3 fatty acids which are good for health. Fish oil also contains essential fatty acids that the body cannot produce naturally. There are two types of omega-3 fatty acids found in fish oil, namely docosahexaenoic acid (DHA) and eicosapentaenoic acid (EPA). Fish oil also contains high amounts of vitamins A and D, two types of fat-soluble vitamins (Apituley et al. [8] One form of utilization of fishery industry waste that can be utilized is processing, namely fish oil. It is known that the heads and bones of fish contain fat which is rich in vitamin A and omega-3 fatty acids which are good for health. Fish oil also contains essential fatty acids that the body cannot produce naturally. There are two types of omega-3 fatty acids found in fish oil, namely docosahexaenoic acid (DHA) and eicosapentaenoic acid (EPA). Fish oil also contains high amounts of vitamins A and D, two types of fat-soluble vitamins (Apituley et al. [8] One form of utilization of fishery industry waste that can be utilized is processing, namely fish oil. It is known that the heads and bones of fish contain fat which is rich in vitamin A and omega-3 fatty acids which are good for health. Fish oil also contains essential fatty acids that the body cannot produce naturally. There are two types of omega-3 fatty acids found in fish oil, namely docosahexaenoic acid (DHA) and eicosapentaenoic acid (EPA). Fish oil also contains high amounts of vitamins A and D, two types of fat-soluble vitamins (Apituley et al. [8] Fish oil also contains essential fatty acids that the body cannot produce naturally. There are two types of omega-3 fatty acids found in fish oil, namely docosahexaenoic acid (DHA) and eicosapentaenoic acid (EPA). Fish oil also contains high amounts of vitamins A and D, two types of fat-soluble vitamins (Apituley et al. [8] Fish oil also contains essential fatty acids that the body cannot produce naturally. There are two types of omega-3 fatty acids found in fish oil, namely docosahexaenoic acid (DHA) and eicosapentaenoic acid (EPA). Fish oil also contains high amounts of vitamins A and D, two types of fat-soluble vitamins (Apituley et al. [8]. According to researchLeger et al. [44]. EPA has potential as an antioxidant, and cardioprotective. The content of EPA and DHA also has benefits as anti-inflammatory and anti-arrhythmic substances which are beneficial for heart function (Endo et al. 2016).

2. BIOCOMPOSITE EDIBLE FILM

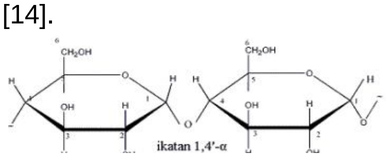
One of the food packaging materials that has a plastic-like shape, is made from biopolymer material, and is safe for human consumption, namely edible film. Apart from being safe for human consumption, edible film can be a good alternative to synthetic plastics for food packaging applications because it has biodegradable properties, can increase the shelf life of food, and is safe for health Balti et al. 2017 inSuryono et al. [45]. Quoting fromUtami et al.Based on its function, Edible packaging is divided into two groups, namely as a coating (edible coating) and in the form of sheets (edible film). One food packaging that has a plastic-like shape, is made from biopolymer material, and is safe for human consumption, namely edible film Balti et al. [2] Based on the components, edible films are divided into three categories, namely, hydrocolloids (containing polysaccharides, proteins, or alginates), lipids or fats (fatty acids, acylglycerols or waxes), and composites (made of hydrocolloids and lipids).Rosida et al. [9]Fats (lipids), carbohydrates (polysaccharides), and proteins (polypeptides) are components of the raw material for making edible films which have thermoplastic properties, making them easy to print as edible films. This polymer has the advantage of being biodegradable and renewableWidodo et al. [10].According to Nahwi 2016 inFebianti et al. [46] Food products such as fresh vegetables, fruits and even sausages can be packaged using edible film which functions as a barrier to the diffusion of oxygen gas, water vapor, carbon dioxide and flavor components because it creates internal conditions that match the needs of the packaged product, so it can inhibit decline in qualityMustapa et al. [17].

Table 1. Ingredients for Edible film

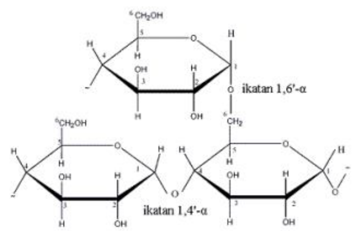
Edible Films	Characteristics of edible films	Source
Hydrocolloid (Protein, pectin, alginate, carbohydrates)	• advantages in the form of high adhesion to packaged food ingredients, selective to oxygen and carbon dioxide • The weakness is that it is stiff and easily cracked	Dewi et al. [11]
Lipids (fatty acids, fatty waxes)	• The advantages are good moisture barrier properties (moisture). • brittle weakness	Abhishaben et al. [12]
Composite (Combination of hydrocolloids and lipids)	increasing the advantages and overcoming the disadvantages of hydrocolloid and lipid films	Murdina et al. [13]

3. Canna Starch

According to Dewi et al [11], starch is a type of polysaccharide that can be found in nature in abundant quantities so it is easy to find, starch also has biodegradable properties, and is economical in price. Another advantage possessed by starch is that it has properties that are suitable for making edible films or edible coatings because it can form a film structure that is strong enoughWidodo et al. [10]. Starch is included in the hydrocolloid group which is commonly used as a basic material for making edible films. There are several advantages of edible films made from hydrocolloids, some of which include having the desired mechanical properties, as well as having the ability to protect food products from oxygen, lipids and carbon dioxide.Nofiandi et al. [14].



(a)



(b)

Figure 1. Chemical Structure of Amylose (a) and Amylopectin (b)
Source:Hassan et al. [15]

Starch also has an important role in making edible films, both as a binder and thickener[16]. Starch is composed of the components amylose and amylopectin. Due to the presence of amylose and amylopectin in starch, where amylopectin gives sticky properties and amylose gives gel propertiesMustapa et al. [17]. One of the raw materials that has the potential to be used as starch is starch from canna tubers, because canna starch has good physical and chemical properties, especially in a balanced amylose and amylopectin content, namely 24% amylose and 76% amylopectin (Santoso et al. [18] inSantoso et al. [19].Based on research conducted by Radnaduhita et al [47] the use of gathot starch in chicken sausage edible coatings obtained a pH value that was quite good even though it was not optimal, and the water content value still met the Indonesian national standard, namely a maximum of 67%..

4. Nano Chitosan

Chitosan or in chemistry it is called a unit (Poly-β-(1,4)-D glucosamine) is a carbohydrate polymer derived from deacetylation of chitin which is a natural biopolymer which has the second most abundant amount in nature after cellulose.Rumengan et al. [20]. The biggest chitosan producer is made from shrimp and crab shells. Chitosan is generally used in the industrial, pharmaceutical, food and cosmetic fields for several other uses, including as a stabilizer, thickener, texturizer and gelling agent.Mustapa et al. [17].

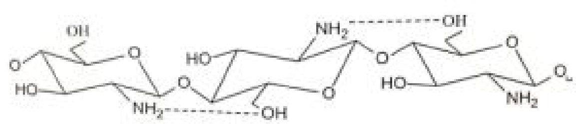


Figure 2.chitosan
Source: Rosida et al. [9]

Chitosan has potential as an edible film because it has good physico-chemical properties, is non-toxic, has good antimicrobial properties.(Ningrum et al. 2019). The antimicrobial activity of chitosan depends on several factors such as molecular weight (MW), degree of deacetylation (DDA), conformational structure, interaction between the positive charge (position C-2 of the glucosamine monomer) polymer, and the anionic component of chitosan.Bolívar et al. [22].

Nanotechnology can extend the shelf life besides that nanotechnology can also detect the presence of pathogens/pesticides/poisons. Many chitosan studies have been carried out by modifying both chemically by increasing the degree of deacetylation, and physically by changing the size of chitosan into nanochitosan which has better absorption capacity in acting as an antibacterial and antifungal compared to the ability of chitosan which has a regular size.Komariah [23].Based on the statement of Mohanraj et al [24], in general, nanoparticles have sizes ranging from 1-1000 nm. Synthesis of nano-chitosan can be carried out by several methods including ionic gelation and sonochemicalmethodsPrincess et al. [4].*Edible Films*Alemán et al. 2016 inBolívar et al. [20]. Based on other studies, it can be stated that chitosan can produce antibacterial activity in the form of higher gram-negative bacteria by decreasing the degree of deacetylation, molecular weight, and pH of chitosan Younes et al. 2014 inRumengan et al.[19].

5. FISH OIL

Fish oil is one of the essential oils that has many important nutrients needed by the human body, because fish oil contains about 75% unsaturated fatty acids and 25% saturated fatty acids.Yulianto et al. [25]. Fish fat or oil has special features when viewed from the composition of the fatty acid content, because fish oil has polyunsaturated fatty acids.*polyunsaturated fatty acids*(PUFA) in large quantities, which are known as omega-6, omega-3,Pandiangan et al.[26]. Palmitoleic, lauric acid, eicosapentaenoic (EPA), decosahexaenoc (DHA), arachidonic acid (ARA), alpha linolenic acid (ALA), and lauric acid(LA) are some examples of essential fatty acids needed by the body which can be found in salmon fish oil.

Apart from being beneficial for health, fish oil can also be used as a constituent of edible films, as according toAbhishaben et al. [27]Lipid-based edible films (fish oil) exhibit good moisture barrier properties of water vapor. Based on researchSantoso et al.[28]that the addition of unsaturated fatty acids to the solution had a significant effect on reducing the rate of water vapor transmission of the edible film. Generally fish oil extraction was carried out using the wet rendering method using solvent or steam (steam) and dry rendering without using a solvent Rozi et al. . [29] Below is a table of omega-3 fatty acids from various sources

Table 2. Sources of omega-3 fatty acids

Source	The amount of omega-3 content
Mackerel	2.5 gr
Herring	1.7 gr
Salmon	1.2 gr
Crustaceans/lobsters	0.2 gr
Squid	0.6 gr
salmon oil	19.9 gr
Cod liver oil	18.5 gr
Herring oil	11.4 gr

Source: Hope 2007 in Diana 2012 [30]

6. PATIN FISH SAUSAGE

Fish Sausage is a processed fishery product that uses raw materials in the form of crushed fish meat or surimi, at least 50%, which is mixed with flour and other additives, then put into sausage casings and undergoes a boiling or steaming process.Indonesian National Standards Agency [31].

Fish meat has several advantages, namely having fiber that is more easily digested, and has good fat content. However, sausages made from fish meat have deficiencies in perishable food properties or are prone to deterioration in quality in a relatively short timeUtami et al. [1]. Because fish meat has a high water content, meat with a high water content is a good substrate for bacterial growth because the bacteria's need for compounds can be fulfilled, which will later become a source of carbon, nitrogen, and other needs.Pradana et al. [32].

Generally nonmicrobialspoilageThe most common occurrence in sausages is oxidation, which leads to the use of chemicals such as sulfur dioxide or synthetic antioxidants, such as butylated hydroxytoluene (BHT), propyl gallate (PG), and butylated hydroxyanisole (BHA) to prevent oxidative reactions in sausages. Conversely, ingredients added to sausages such as

TVP, ISP, flour, and other vegetable proteins result in a decrease in the quality and shelf life of sausages. The decline in the quality of sausages can be seen by the presence of mucus, water, and milkPradana et al. [32]. Therefore a way is needed to be able to maintain the quality of the sausage, namely by using packaging that can inhibit the decline in the quality of the sausage, one of which is by using edible film.Based on the research conductedFreitas et*al*.(2019)by adding omega-3 fish oil to an edible film with a concentration of omega-3 (25%, 40%), the results were in the form of an edible film color that was acceptable to the panelists.Based on Purwamatja et al [48] the addition of chitosan solution can improve the texture of chicken meatballs.

7. PLASTICIZER

*Plasticizers*is one of the other components that make up edible films, in the form of low molecular weight compounds that have the benefit of softening the structure of edible filmsRosida et al. [9]. Plasticizers have a major role in increasing film flexibility, reducing porosity, cracking tendency and reducing brittlenessSofia et al. [32]. Plasticizers or commonly called plasticizers are added to the components of the edible film to improve the mechanical properties of the edible film. According toPutra et al. [33]The plasticizer has a function in reducing the stiffness of the polymer so that a flexible and elastic edible film is obtained.

Sorbitol, mannitol, and polyethylene glycol are the most commonly used plasticizers in edible films, but polyols such as glycerol are the most common due to their stability and compatibility with hydrophilic compounds.Monsalve et al. [34]. The glycerol plasticizer functions to increase elasticity by reducing the degree of hydrogen bonding and increasing the distance between the molecules of the polymer. Glycerol is a trihydroxy alcohol consisting of three carbon atoms. So, each carbon atom has an -OH group. Glycerol is a hydrophilic molecule that is relatively small and easily inserted between protein chains and forms hydrogen bonds with gluten groups and proteins.Rosida et al. [9].

8. CHARACTERISTICS OF SAUSAGES TO KNOW THE POTENTIAL OF EDIBLE FILM IN PATIN FISH SAUSAGES

8.1. pH

The measuring instrument used in measuring pH is a pH meter, a pH meter is a measuring tool that can provide information about the degree of acidity of a solutionHadiatna and Susana [35]. The degree of acidity can experience a change in value at a certain time. This change occurs erratically due to the influence of several factors. These factors include temperature, and the decomposition process of organic matter. On the pH meter there is a probe made of a non-conducting glass cylinder that functions as a sensor. This tool is able to measure the acidity contained in water, by utilizing the HCL compound which soaks the electrode wire (Onny 2017 inHadiatna and Susana [35].
pH analysis needs to be done because sausage is a food product that has characteristics suitable for microbial growth, so it is susceptible to damage. Sausages are made from meat raw materials which have a high water content of 68-75%, are rich in minerals, contain easily fermentable carbohydrates, and have a pH that allows for the growth of microorganisms, so one way to determine the decline in the quality of sausages is by measuring Soeparno'spH. , 2010 inEve et al. [36].

8.2. WATER CONTENT

Water content is the amount of water that is in an object, such as rocks, soil, agricultural materials, foodstuffs, food products, and so on.Prasetyo et al. [37]. In foodstuffs, the presence of water content is usually associated with quality and is a measure of whether the ingredients are dry or solid. Other benefits of the presence of water in a material include as an index of stability during the shelf life, as well as a determinant of organoleptic quality, especially in taste, texture, and tenderness. Winarno, [38].

Moisture content test is a very important test method in a food industry which functions to determine the quality and food resistance to possible damage. There are several methods that can be used to measure the water content of food, namely: distillation method (thermogravimeri), drying method, physical method and chemical method *(Karl Fisher Method)*David*et al.*[39].

8.3. SENSORY

Sensory characterization is a test that is carried out by using the human senses as the main tool for measuring the acceptability of a product. sensory test is a test that is very important to do, especially in the agricultural and food product industry. According to Zhao et al. [40] sensory tests provide very thorough assessment results, even in some assessments using sensory tests provide very thorough assessment results.
Based onGonçalves et al. [41] sensory test is divided into three groups, namely scale test and descriptive test, difference test (Different*test),*and acceptance test (Preference Test). Based onPermady et al. [42]descriptive test consisting of a scoring or scaling test, scoring test or scoring is one of the tests in organoleptic characterization that uses panelists to provide an assessment of the samples tested by measuring and comparing similar productsTarjoko et al. [43]. In the scoring method, numbers are used to assess the intensity of a product, either in increasing or decreasing order.
In the assessment of food ingredients, the characteristic that determines whether a product is acceptable or not is its sensory properties. The senses used in assessing sensory properties are the senses of sight (appearance), touch (texture), smell (aroma) and taste (taste) Suryono et al. [44].

7. CONCLUSION

Catfish has the potential to be used as raw material for sausages due to its delicious taste and good fatty acid content. Deterioration in quality of catfish sausages can be inhibited by using edible film as a substitute for sausage casings. The addition of fish oil concentrations to canna starch and nanochitosan edible films can have a better effect on the organoleptic, pH, and water content of the sausages.

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