



Application of Food Additives in the Fisheries Processed Products Development

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Authors' contributions

This work was carried out in collaboration among all authors. Author J designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors FS and FZD managed the analyses of the study. Author FNF managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

The purpose of writing this article is to examine throughout searching articles and other literature on the types and classifications of food additives, the development of processed fishery products, and the application of food additives in processed fishery products. Based on search results from various articles and other literature it can be concluded that the classification of Food Additives according to the Regulation of the Minister of Health of the Republic of Indonesia No. 722 / Menkes / Per / IX / 88 [1] are as follows: dyes, artificial sweeteners, preservatives, antioxidants, anti-stick, flavor and aroma, acidity regulators, bleach or flour, emulsifiers, stabilizers and thickeners, hardeners and sequestrants. Fishery products can be developed to increase added value and zero waste.

Keywords: Added value; fish balls; fish nuggets; carrageenan; gelatin.

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1. INTRODUCTION

Food Additives, are materials added to food to influence the nature or form of the food. BTP may or may not have nutritional value, which is intentionally added to food for technological purposes at the time of manufacture, processing, treatment, packaging, storage and transportation of food which is expected to produce a component or affect the nature of the food, either directly or indirectly (Regulation of the Minister of Health of the Republic of Indonesia No.33 of 2012).

Food additives is deliberately added to a food product to make it more attractive, the taste and texture more perfect and of higher quality [2]. The purpose of using food additives is to increase or maintain nutritional value and quality of storage capacity, make food ingredients easier to serve and also facilitate food preparation [3].

The use of food additives is becoming increasingly important, in line with the development and advancement of production technology [4]. The use of food additives can aim to improve the quality of the development of a product [5]. The use of good food additives in processed fishery products will provide many benefits to improve the quality of processed fishery products. On the other hand, if the use of additional materials is not in accordance with the regulations, it can also have negative consequences for the processed fishery product. The purpose of writing this article is to examine through searching articles and other literature on the types and classifications of food additives, the development of processed fishery products, and the use of food additives in processed fishery products.

2. TYPES AND CLASSIFICATION OF FOOD ADDITIONAL MATERIALS

Food additives can be interpreted as ingredients that are added and mixed during the food processing which aims to improve product quality [6]. Food additives can be divided into two major parts, namely food additives or additives intentionally and accidentally [6] Intentionally additives are ingredients that are given intentionally for specific purposes and purposes, for example to increase nutritional value, consistency, control acidity or alkalinity, improve taste, change shape and appearance and so on.

Meanwhile, accidental additives are ingredients that are found in food in very small amounts as a result of the food processing process. When viewed from its origin, food additives can come from natural sources (eg lecithin); and can also be synthesized from chemicals that have similar properties to similar natural materials, both from their chemical composition and metabolic properties (eg ascorbic acid) [6].

The classification of Food Additives permitted for use in food is according to the Regulation of the Minister of Health of the Republic of Indonesia No. 722 / Menkes/ Per / IX / 88 [1] are as follows:

2.1 Dye

Dye is one of the food additives that can improve or give color to food. The addition of colorants to food can be done to uniform food colors, cover color changes during processing, give an attractive impression to consumers or overcome color changes during storage. There are rules regarding the use of this dye, but many food producers still use dyes that can be harmful to health, such as the use of dyes for textiles or paints which generally have a lighter color, are more stable during storage, and are cheaper in price. Another alternative to using synthetic dyes is to use natural dyes such as turmeric, pandan leaf extract or suji leaves and other natural ingredients that are safer.

2.2 Artificial Sweeteners

Artificial sweeteners are one of the food additives that give food a sweet taste, which has no or almost no nutritional value. Artificial sweeteners are often added to food or drinks as a substitute for sugar, because artificial sweeteners have several advantages compared to natural sweeteners, such as, the price is cheaper, the taste is sweeter, does not contain calories / contains lower calories, making it suitable for consumers who suffer from diabetes (diabetes), can help sharpen acceptance of sweetness. In the food processing process, there are several commonly used artificial sweeteners such as aspartame, saccharin, sorbitol, and cyclamate.

2.3 Preservative

Preservatives are food additives that can prevent or hinder the process of fermentation, decomposition or acidification of food caused by

microbial growth. The use of preservatives in food must be precise, both in type and dose. There are several preservatives that are commonly used, such as benzoates, propionates, sulfites, and sorbates.

2.4 Antioxide

Antioxide is a material that can prevent or inhibit the oxidation process of the entry into food so that it can prevent rancidity. Antioxidants that are allowed to be used in food include ascorbate, BHA, BHT, TBHQ, propellar error, and tocopherol.

2.5 Anti-stick

Anti-stick is a food additive that can prevent the clumping of food products in the form of powders such as flour. The anti-deflative role in food is not direct, but is found in the materials used to make food such as wheat flour, sugar, powdered milk, and so on. Some of the anti-inflammatory materials that are permitted for food include magnesium carbonate, magnesium silicate, magnesium oxide, aluminum silicate, calcium aluminum silicate, and calcium silicate.

2.6 Flavor and Aroma

Flavors are used to add, add or enhance flavors and aromas. One of the flavor and aroma flavorings known in Indonesia is MSG, or cooking spices in various brands. The flavoring contains a compound called monosodium glutamate (MSG). The role of glutamic acid is very important, including to provide taste to food and can stimulate and deliver signals between brain cells.

2.7 Acidity regulator

Acidity regulators, namely food additives that can maintain, acidify or neutralize the degree of acidity of a food. There are several acidity regulators that are permitted for use in food, including lactic acid, citric acid, sodium bicarbonate, potassium and aluminum amonym / potassium / sodium sulfate.

2.8 Bleach or Flour Pematang

Bleach or flour dough is a food additive that can speed up the process of bleaching and / or ripening of flour so that it can improve the quality

of food products during baking, for example in making bread, crackers, biscuits and cakes. Some of the bleaching or flour binders that are allowed for food include ascorbic acid, potassium bromate, sodium stearyl-2- lactate.

2.9 Emulsifiers, Stabilizers and Thickeners

Emulsifiers are food additives that are used to help form and strengthen a more homogeneous preparation system in a food, so that the product remains stable, does not separate between the fat and water, has a compact texture, and does not melt. The emulsifying, stabilizing and thickening ingredients that are allowed to be used in food include agar, gelatin, dextrin, alginate, gum, carrageenan, lecithin, CMC, and pectin.

2.10 Hardener

Hardener is one of the food additives that serves to harden or prevent the softening process of food. Some hardeners that are permitted for food such as calcium gluconate, calcium chloride, and calcium sulfate.

2.11 Sequestrant

Sequestrant is a material that can bind metal ions contained in food, so that it can further strengthen the texture, aroma and color of the food. Some of the sequestrant materials that are permitted for use in food include phosphoric acid, iso propyl citrate, calcium disodium edetate (EDTA), monocalium phosphate, and sodium pyrophosphate.

Food additives can be extracts of natural ingredients or results of chemical synthesis. Materials derived from nature are generally harmless, while artificial or synthetic food additives poses a risk to health if they are misused. Household scale food producers or small industries use additives that are declared hazardous to health for cost reasons. It is not uncommon for food products to be added with substances that are not used for food but for other industries, for example for textiles and paints. The POM (Food and Drug Administration) found many products that contain formaldehyde. Formalin is a disinfectant, killer of pests, and is often used to preserve corpses. Textile dyes such as Rhodamine B are also often found in crackers and shrimp paste.

According to the Regulation of the Minister of Health of the Republic of Indonesia Number 722 / MenKes / Per / IX / 88 [1], there are several food additives that are prohibited from being used in food such as sodium tetraborate (borax), formalin (formaldehyd), brominated vegetable oil, potassium chlorate, chloramphenicol, nitrofurazone, Diethylpirokarbonate, P-Phenethylcarbamide, and salicylic acid and their salts. Meanwhile, according to the Regulation of the Minister of Health of the Republic of Indonesia No.1168 / Menkes / Per / X / 1999 [7], in addition to the additives above, there are still some chemical additives that are also prohibited, such as rhodamine β (red dye), methanyl yellow (yellow dye), dulsin (sweetener sitetic), and Calcium Bromate (hardener) [4].

The following describes the regulations regarding food additives that food product manufacturers need to know. There is one of the Minister of Health Regulations which regulates the use of food additives, namely the Minister of Health Regulation No. 772 / Menkes / Per / IX / 88 concerning Food Additives. In principle, this Regulation of the Minister of Health contains several main points, namely :

1. The type and maximum amount of various kinds of food additives that are permitted to be used in food as well as the types of food that can be added to the food additives.
2. Types of additives that are prohibited from being used in food, namely:
 - a. Boric acid and its compounds
 - b. Salicylic acid and its salts
 - c. Diethylpyrocarbonate
 - d. Dulsin
 - e. Potassium chlorate
 - f. Chloramphenicol
 - g. Brominated vegetable oil
 - h. Nitrofurazone
 - i. Formalin (formaldehyde)
3. For food containing food additives, the name of the food additives group must be stated on the label, and on the food label containing food additives, the antioxidants, artificial sweeteners, preservatives, dyes and flavor enhancers must also include the name food additives and special index numbers for dyes.
4. On the food additives container, a label that meets the provisions of the

Regulation of the Minister of Health of the Republic of Indonesia concerning Food Label and Advertising must be attached. In addition, the food additives label must also include:

- a. The word "Food Additive"
- b. The name food additives, especially for dyes, the index number is also included.
- c. Food additives group name.
- d. Manufacturer registration number.
- e. Product registration number, for food additives that must be registered.

Apart from the aforementioned regulations, the Regulation of the Minister of Health of the Republic of Indonesia No. 772 / Menkes / Per / IX / 88 also includes various prohibitions, including the following:

1. It is prohibited to use food additives for certain purposes, namely:
 - a. To hide the use of materials that are wrong or that do not meet the requirements.
 - b. To conceal a method of work that is in conflict with a mode of production that is good for food.
 - c. To hide food damage.
2. It is prohibited to produce, import or distribute food additives which is prohibited and has not received approval from the Food and Drug Supervisory Agency.
3. It is prohibited to circulate food additives which is produced by an unregistered producer.
4. It is prohibited to distribute food and food additives that do not meet the requirements for labeling.
5. It is prohibited to use food additives beyond the maximum limit of use stipulated for the respective food concerned.

3. FISHERIES PRODUCT PROCESSED DEVELOPMENT

Product development is an adjustment activity that is oriented to market or consumer needs in the form of new products, modified products, and imitative products [8]. The development of processed fishery products is an effort to improve

quality and nutrition, diversify the types of fishery products processed from raw materials that have been / have not been utilized and increase the added value or selling value [9]. Value added is an effort to change the form to a new one in terms of appearance, texture, taste, and taste [10]. The purpose of product development is to increase people's consumption power, increase profits, expand marketing, and change people's lifestyles. In carrying out the process of developing processed fishery products.

Fishery product development includes the evolution of existing products, expansion of trademarks, new ideas that are already good, new categories, and new businesses.[9]. Based on international regulations stated in the "Code of Conduct for Responsible Fisheries FAO / WHO", the Directorate General of Capture Fisheries states that fisheries development policies / strategies in the field of post-harvest processing technology are addressed by improving quality and developing added value of products which include the following aspects:

- Reducing depreciation (loss) while increasing its value and utilization.
- Optimizing the use of captured fish (non-economic fish, bycatch and industrial processing by-products) by developing value-added products.

SDG's (Sustainable Development Goals) provide direction in addition to improving quality and nutrition, product development must optimize zero waste processing.

The development of value-added products aims to increase the selling value of fish and optimize the use of fishery resources. The increased selling value has a positive impact on the income of fishermen, cultivators, processors and consumers as well as on state income from the fishery product processing sector [11].

Value added products that can be developed include:

- Surimi, fish meat which is removed from the remaining ingredients, such as bones, scales, skin, then washed and ground. Surimi is also an intermediate product, namely surimi can be processed again into final products such as kamaboko, nuggets, meatballs, fish ham.



Fig 1. Surimi

Source: www.pngdownload.id [12]

- Kamaboko, a fish processed product made from surimi or crushed meat from Japan in the form of gel, is chewy and elastic [13].



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Fig 2. Kamaboko

Source: www.shutterstock.com [14]

- Fish nuggets, fish nuggets or breaded fish are processed products from surimi / meat / fish fillets which undergo a battering and breading process.



Fig 3. Fish Nugget

Source: www.kompas.com [15]

- Fish balls, preparations made from surimi mixed with flour and spices. The dough is molded into circles and boiled.



Fig. 4. Fish ball

Source: id.pinterest.com [16]

- Fish sausage, an emulsion product of ground fish meat that is cured / salted, plus binder and oil and spices, is chewy with a uniform cylinder shape using a special wrapper, namely casing.



Fig 5. Fish Sausage

Source: www.santeaja.com [17]

- Fish ekado, a processed product made from surimi with the addition of flour and spices. The dough is wrapped in dumpling sheets and tied with chives.



Fig 6. Ekado

Source: www.selerasa.com [18]

- Panko ebi, food made from shrimp and covered with panko flour and then frozen / fried in hot oil.



Fig 7. Panko Ebi

Source: www.justonecookbook.com [19]

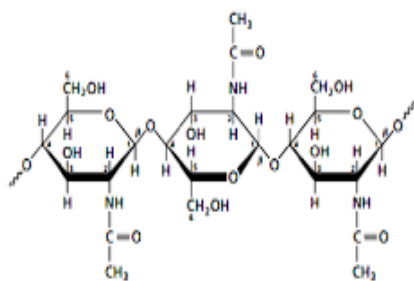
- Gelatin is a type of protein obtained from natural collagen found in skin and bones [20].



Fig 8. Gelatin

Source: kkp.go.id [21]

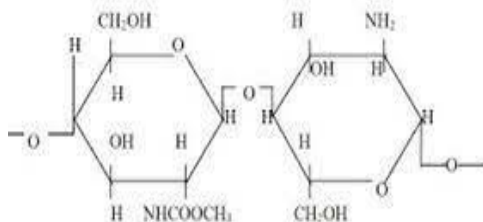
- Chitin and chitosan are processed by-products from shrimp waste. Chitin polymers are composed of monomer monomers; 2-acetamide-2-deoxy-D-Glucose (N-acetyl glucosamine) [22]. Chitosan [poli- (2-amino-2-deoxy- β - (1-4) - D-glucopyranose)] is a poly aminosaccharide compound which is synthesized by partially removing the 2-acetyl group from chitin [poly (2-acetamido-2- deoxy- β - (1-4) - Dglucopyranose)], a linear biopolymer with 2000- 5000 monomer units, bonded to each other by β - (1-4) glycosidic bonds [23]. Chitin and chitosan have very broad uses in everyday life, for example as adsorbents of heavy metal waste and dyes, preservatives, anti-garnishes, cosmetics, pharmaceuticals, flocculants, anti-cancer, and anti-bacterial [24,25,26,27].



Struktur Kitin
(Moran et al., 2012:244)

Fig 9. Chitin Structure

Source: www.dictio.id [28]



Gambar. Struktur Molekul Kitosan

Fig 10. Chitosan structure

Source:www.balaipontianak.ditjenbun.pertanian.go.id [29]

- Fermentation is a process of chemical change in an organic substrate through enzyme activity produced by microorganisms [30]. Examples of fermented products made from fishery processing are fish sauce, bekasam, peda, shrimp paste, fish paste.



Fig 11. Bekasam

Source: www.kompasiana.com [31]



Fig 12. Peda

Source: www.lalaukan.com [32]



Fig 13. Shrimp paste

Source: www.idntimes.com[33]



Fig 14. Fish sauce

Source:pickybest.id[34]



Fig 15. Fish Petis

Source: www.dunia-perairan.com[35]

4. USE OF FOOD ADDITIVES IN FISHERY PROCESSED PRODUCTS

Fish meatballs are a form of high economic value fishery product development made from ground meat added with spices, flour, and food additives, then the process of crushing meat, making dough, molding, and boiling is carried out [36]. One of the parameters that determine the quality of fish balls is the level of chewiness. The level of elasticity of meatballs with good quality is meatballs which have the ability to break when there is a pressure force [37]. The nutritional content of good quality meatballs is that they contain sufficient nutrients to meet nutritional needs in the body [37]. The constituent components of fish balls consist of fillers and binders. A common filler used in fish balls is tapioca flour. However, the use of tapioca flour itself is still not sufficient to increase the strength of the gel, so it is necessary to add a binder that can improve the quality of the fish balls produced [38]. Several types of food additives can be used as a binder which aims to increase the binding capacity of water and oil, stabilize emulsions and help maintain the structure of processed meat products. Transglutaminase (TGase) is an enzyme included in the transferase group that plays a role in gel formation and elasticity of products made from ground meat and surimi [39].

In the research of Nugroho et al. [38], who conducted research with the title Physical Chemical Characteristics of Trash Fish Meatballs with the Addition of Transglutaminases at different concentrations resulted in a fairly good effect on fish meatballs. The process of adding food additives to fish meatballs starts with the process of ground fish meat then adding transglutaminase according to the treatment, tapioca flour, salt, garlic, pepper, and ice cubes and stir until evenly distributed. After that, the dough is taken and shaped round with a weight of 15 grams. The first boiling process was carried out at 40°C for 1 hour to activate the TGase enzyme. Then the second boil is carried out with a temperature of 90°C until the meatballs float on the surface, indicating that the fish balls are cooked. After that, it was drained for 15 minutes and vacuum packed. The addition of transglutaminases with different concentrations to trash fish meatballs had an effect on hedonic, moisture content, microstructure, and gel strength. Trash fish meatballs with the addition of transglutaminase, the most preferred by the

panelists was treatment C with a confidence interval of $7.11 < \mu < 7.38$ (like), the more the amount of transglutaminase added, the more elasticity of the fish balls increased, in this case the treatment with gel strength. the highest was owned by treatment C with a value of 750.734 g.cm.

Fish nuggets are one of the processed fish meat products which are made by grinding fish meat until it is smooth then adding spices and mixing with binders, molded in various shapes, steamed, cut, coated with batter and breading, then can be fried or fried directly. can also be stored in the freezer first for frying and consumed at a later date [40]. This nugget is included in the type of ground meat, in various developed countries the meat is used as a product of simple processing which can be consumed as daily food. In making fish nuggets, the binder is in the form of tapioca flour or cornstarch, but the two flours give the result of a nugget texture that is less dense or not chewy enough [40]. One way to improve the texture of the nuggets is to add carrageenan. Carrageenan itself is a food additive that functions as a condenser where the elasticity of carrageenan in forming a gel is distinguished from strong to brittle with soft and elastic types [41].

In the research of Sanjaya et al. [40] who examined the effect of different carrageenan additions on the quality of Siam Jambal fish nuggets, the results showed that the addition of carrageenan with different amounts had a significant effect on the quality of jambal Siamese fish nuggets seen from the organoleptic characteristics (appearance, aroma and texture), water content, protein content and has no effect on taste values. The results of the folding test carried out in each treatment have different multiples and flexibility, both with the A value of treatment A0 and A1, the plate is folded to $\frac{1}{2}$ then becomes $\frac{1}{4}$, the nugget plate has a few fractions, in A2 with a value of B, whereas in A3 with an AA value the plates are folded to become $\frac{1}{2}$ then become $\frac{1}{4}$, the nugget plate has no broken.

Seaweed is one of the potential marine product commodities to be developed, one of which can be developed into seaweed jelly candy. However, the carrageenan content in *Eucheuma cottonii* seaweed is quite fragile, so food additives such as gelatin are needed to produce a strong gel and a chewy texture to produce better quality

jelly candy [42]. Gelatin itself is a food additive that functions as a gelling agent, emulsifier, thickener, purifier, water binder, and coating [43]. In Susanty and Pujilestari's research [42] which examined the effect of adding gelatin on the physicochemical properties of *Echeuma cottonii* seaweed jelly candy, it was found that the addition of gelatin had an effect on the strength of *Echeuma cottonii* jelly candy gel. The greater the concentration of gelatin added, the greater the strength of the gel. In this study, the best combination was the combination of *Echeuma cottonii* filtrate treatment 40% and 12% gelatin, with a gel strength of 73.459 g / mm², an attraction of 0.068 MPa, a reduction sugar of 5.62%, 40.04% sucrose, 29% moisture content and ash content 0.34%. In addition, the combination of *Echeuma cottonii* 40% and gelatin 8% was also a combination that met the panelists' expectations in the hedonic quality test of taste and texture. The greater the concentration of gelatin added, the greater the strength of the gel. In this study, the best combination was the combination of *Echeuma cottonii* filtrate treatment 40% and 12% gelatin, with a gel strength of 73.459 g / mm², an attraction of 0.068 MPa, a reduction sugar of 5.62%, 40.04% sucrose, 29% moisture content and ash content 0.34%. In addition, the combination of *Echeuma cottonii* 40% and gelatin 8% was also a combination that met the panelists' expectations in the hedonic quality test of taste and texture. The greater the concentration of gelatin added, the greater the strength of the gel. In this study, the best combination was the combination of *Echeuma cottonii* filtrate treatment 40% and 12% gelatin, with a gel strength of 73.459 g / mm², an attraction of 0.068 MPa, a reduction sugar of 5.62%, 40.04% sucrose, 29% moisture content and ash content 0.34%. In addition, the combination of *Echeuma cottonii* 40% and gelatin 8% was also a combination that met the panelists' expectations in the hedonic quality test of taste and texture.

5. CONCLUSION

Classification of Food Additives according to the Regulation of the Minister of Health of the Republic of Indonesia No. 722 / Menkes / Per / IX / 88 [1] are as follows: dyes, artificial sweeteners, preservatives, antioxidants, anti-stick, flavor and aroma, acidity regulators, bleach or flour, emulsifiers, stabilizers and thickeners, hardeners and sequestrants. Fishery products

can be developed to increase added value and zero waste. The use of food additives in product development efforts has been applied to fish meatballs, namely the transglutaminase enzyme, fish nuggets, namely carrageenan, and jelly candy, namely gelatin. The use of food additives in processed fishery products can increase added value to fishery products, which is the goal of product development.

CONSENT

As per international standard or university standard, respondents' written consent has been collected and preserved by the author(s).

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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