CHAPTER I
INTRODUCTION

1.1 Background

"Cimol" is an abbreviation of "aci" (Tapioca flour), "goreng" (fried). It is known to only contain high amount of carbohydrates, due to the main ingredient used is tapioca flour. Its chewy and savory characteristic of "cimol" has make it one of favorite snack in Indonesia. The original flavor of "cimol" also is bland, therefore people often use excessive amount of MSG of food additive to increase it's taste varient and intensity.

"Cimol" main ingredient is tapioca flour which essentially makes it lack in nutrient content but contain excessive amount of MSG. Tapioca flour is a starchy flour that was extracted from cassava roots. Tapioca flour is high in carbohydrate and low in other nutrient component such as protein and fiber. Tapioca flour is used in food making to increase crisp and add crust in bread, add chewy texture in cookie making, and in general can lighten up the dough of gluten-free baked product (Brown *et al., 2015)*. In this research, original formulation of cimol which consist mainly on tapioca flour, water and flavorant will be added with seaweed powder (*E. cottonii, E. spinosum, and Gracilaria sp.*) to increase their overall nutritional content, and nutritional yeast and mushroom powder will also be incorporated as additional nutrition sources and natural flavorant.

Seaweed has a high fiber content, which consist of polysaccharides such as agar and carrageenan (Singh and Kaur, 2009). Indonesia owns various types of seaweed could be used for several purposes. Two of the groups with highest economical value are red algae and brown algae which was abundant in Indonesia sea water but not yet included as the major diet in main population in Indonesia (Dewi, 2012). By incorporating seaweed into the cimol, it is hope that the nutritional value of cimol will be increased.

Nutritional yeast is made from yeast that has been pasteurized/heat-treatment to kill the yeast, the pasteurized yeast is then dried using a drum dryer, grounded up into powder, flakes, or granules to be stored as ready to eat product. Nutritional yeast is usually used as a natural flavoring, because it possess distinct nutty and cheesy flavor, and a good source of protein. 30g of serving will provide 16g of protein content, approximately 50 to 60 % protein by weight. Proteins of yeast are rich in lysine and tryptophan, which are usually low in plant base products thus nutritional yeast can be the solution to fulfill the daily requirement of protein intake especially for vegan (Margel, 2005). Mushroom is commonly used as a natural flavoring in foods. Mushroom contain volatile and non-volatile compound that contribute to the aroma and polyols, sugar, carboxylic acid, and free amino acids contribute to the four basic taste and 5'-nucleotides contribute to the fifth taste in the mouth which is umami (Kalač, 2016).

In this research, the formulation of "cimol" will be enriched with other nutritional sources and natural flavorant to increase its nutritional and functional properties. The subtitustion of tapioca flour with seaweed powder is expected to

increase the fiber content and the addition of nutritional yeast and mushroom powder is hoped to increase the flavor and nutritional content of “cimol”.

1.2 Research Problem

“Cimol” is a tapioca flour based snack that are commonly consumed by people in Indonesia. However due to its deficiency in nutrition, this research is aimed to add other nutritional source such as seaweeds powder, nutritional yeast and mushroom extract. However, the addition of seaweed powder, nutritional yeast, and mushroom extract towards “cimol” might affected the physical characteristic and sensory acceptance of cimol. Therefore, in this research, the effect of seaweed flour, mushroom powder and nutritional yeast addition towards “cimol” physicochemical characteristic and sensory acceptance will be conducted.

1.3 Objectives

1.3.1 General Objectives

The general objective of this research is to enhance nutritional value of “cimol” by addition of seaweed powder, nutritional yeast, and mushroom extract.

1.3.2 Specific Objectives

1. To determine the effect of different type and concentration of three types of seaweed; *Eucheuma cottonii*, *Eucheuma spinosum*, and *Gracilaria sp*. toward the characteristic and acceptability of “cimol” product.

2. To determine the effect of different type and concentration of natural flavor (nutritional yeast and mushroom extract) toward the characteristic and acceptability of "cimol" product ,
3. To observe the physicochemical and nutritional changes of the newly formulated cimol compare to the original "cimol" formulation.

CHAPTER II
LITERATURE REVIEW

2.1 "Cimol"

"Cimol" as shown on Figure 2.1 came from the word *"aci"* and *"molor"*. The word "aci" basically means flour made from cassava, while the word "molor" can be seen by the basic physical characteristics of "cimol" which is chewy. The additional artificial flavor added to "cimol" give it an umami flavor making "cimol" one of the most favorite traditional snack in Indonesia. "Cimol" first came from West Java area where the market grew until today. Now many franchise businesses has taken "cimol" as their product (Anwar, 2012).

Figure 2.1 "Cimol"
Source: Anwar (2012)

2.2 Seaweed

The term seaweed is a collective names for macroalgae. Indonesia is consist of 70% sea water, thus the product of the sea is various and not yet used to it's maximum potential. Seaweed is divided into several groups, with two big groups with the highest economical value are *Rhodophyceae* (red algae) and

Phaeophyceae (brown algae) (Dewi, 2012). Seaweed in general contain high amount of nutritive value such as, fiber and minerals. But due to the diet usually applied in Indonesia, very few seaweed species are used as food sources (Venugopal, 2008).

Seaweeds are also known for their high mineral content. In general, marine algae are a much better source of iron than spinach and egg yolks. The primary mineral components in seaweeds are iodine, calcium, phosphorous, magnesium, iron, sodium, potassium, and chlorine. There are also other important trace elements, such as zinc, copper, manganese, selenium, molybdenum, and chromium. The mineral composition varies significantly from one seaweed species to another. For instance, *kombu* seaweed contains more than 1000 times as much iodine as *nori* (Tiwari and Troy, 2015).

Seaweeds are also abundant in vitamins, including vitamin A, B (B1, B2, B3, B6, B12, and folate), C, and E. Depending on the species, it may or may not contain vitamin D. Similarly, the concentrations of vitamins contained vary by species, as well as with the seasons of the year. Seaweeds contain little fat, with the green variety containing the least fat. It also contains taurine, which is an amino acid essential in the formation of bile salts to bind the cholesterol molecules. This way, excess cholesterol is excreted from the body, thus the cholesterol level in the body can be maintained (Fleurence and Levine, 2016).

2.2.1 *Eucheuma cottonii*

Eucheuma cottonii synonym of *Eucheuma alvarezii and Kappaphicus alvarezii Doty* is a carrageenan producing seaweed. The color of *Eucheuma*

cottonii is a general reddish brown or greenish-yellow color. *Eucheuma cottonii* has a characteristic of having a soft thalus with cylindrical or flat shape. Thorn and bump can be found all over the surface. In general, *Eucheuma cottonii* grow on a coral or shell of molusc (Anggadiredja *et al.*, 2006).

The taxonomy *Eucheuma cottonii* is as follows:

Kingdom: Plantae

Division: Rhodophyta

Class: Rhodophyceae

Order: Gigartinales

Family: Soliericeae

Genus: *Eucheuma*

Species: *Eucheuma cottonii*

Eucheuma cottonii as shown in Figure 2.2 contain kappa carrageenan which is hard and brittle gel, the strength of the gel can be increased by the addition of potassium ion. Addition of kappa carrageenan is also proven to increase the water retention capacity and reduce toughening effect in freezing storage of raw minced cod. Kappa carrageenan could easily react with other macromolecules which increases the viscosity and gel making process (Anggadiredja *et al.*, 2006). The chemical composition of *Eucheumma cottonii* is as in Table 2.1.

Table 2.1. Chemical composition of *Eucheuma cottonii*

Chemical Substance	Composition (%)
Moisture Content	13.90%
Ash	3.40%
Protein	2.60%
Fat	0.40%
Carbohydrate	5.70%
Fibre	0.90%
Carageenan	67.50%
Vitamin C	12.00%
Riboflavin	2.70mg/100g
Mineral	22.39mg/100g
Calcium (Ca)	2.30 ppm
Copper (Cu)	2.70 ppm

Source: BPPT (2011)

Figure 2.2 *Eucheuma cottonii*
Source: Anggadiredja (2011)

2.2.2 *Eucheuma spinosum*

First being discovered in Burma, *Eucheuma spinosum* is a seaweed that contain Iota carrageenan. The habitat of *Eucheuma spinosum* should be a clear water with sand and mud at the bottom, and the seaweed will stick onto a dead coral. The water should be at 28-36% salt concentration with a direct sunlight contact to undergo photosynthesis (Aditia, 2014).

The taxonomy *Eucheuma spinosum* is as follows:

Kingdom: Plantae

Division: Rhodophyta

Class: Rhodophyceae

Subclass: Florideae

Order: Gigartinales

Family: Solieriaceae

Genus: *Eucheuma*

Species: *Eucheuma spinosum*

As for the physical characteristics, *Eucheuma spinosum* has no distinct differences between roots, stems, and leaves. All part of *Eucheuma spinosum* is called as thallus with rough surface. The color of the seaweed in common are, greenish-yellow, greenish-brown, or reddish-purple due to the pigment in the seaweed such as chlorophyll, phycocyanin, carotene, and phycoerythrin. *Eucheuma spinosum* usually sized around 30 cm with a unique trait of the first thick two branches facing the sunlight (Aditia, 2014).

Eucheuma spinosum, as shown in Figure 2.3, contains iota carrageenan (65%), carbohydrate, fiber, fat, protein, water, and ash. The characteristic of iota carrageenan is softer yet more deformable gel, compare to kappa carrageenan. The elasticity of iota carrageenan can be increased by the addition of calcium ion. Iota carrageenan is able to give best functionality in the addition into seafood surimi products, the addition of iota carrageenan improved the elasticity of the gel and freeze/thaw stability. Iota carrageenan has a special characteristic called thixotropic, broken gel will reform if it was left for some time without interference. The composition of *Eucheuma spinosum* is as in Table 2.2.

Table 2.2 Chemical composition of *Eucheuma spinosum*

Chemical Substance	Composition
Moisture Content	21.90%
Protein	5.12%
Fat	0.13%
Carbohydrate	13.38%
Fibre	1.39%
Ash	14.21%
Mineral	52.85 ppm
Calcium (Ca)	0.180 ppm
Iron (Fe)	0.768 ppm
Copper (Cu)	-
Lead (Pb)	0.21 mg/100g
Vitamin B_1 (Thiamin)	2.26 mg/100g
Vitamin B_2 (Riboflavin)	43 mg/100g
Vitamin C	65.75%

Source: Aditia (2014)

Figure 2.3 *Eucheuma spinosum*
Source: Aditia (2014)

2.2.3 *Gracilaria verrucosa*

Gracilaria sp. is categorized as red algae (*Rhodophyta)* group with characteristic of cylindrical thallus, slippery, and have brown or gree-yellow color. *Gracilaria sp.* have lateral branches like a hair with length around 25 cm, thallus diameter 0,5-1,5 mm (Murdinah *et al.*, 2013).

The taxonomy *Gracilaria sp.* is as follows:

Kingdom: Plantae

Division: Rhodophyta

Class: Rhodopyceae

Order: Gigartinales

Family: *Gracilaria*ceae

Genus: *Gracilaria*

Species: *Gracilaria verrucosa*

In general, *Gracilaria verrucosa* live in shallow water between 10-15 meter below the surface. Naturally, *Gracilaria verrucose,* as shown in Figure 2.4, live on a substrate such as rock, sand, mud, dead choral, and wood. The growth rate of *Gracilaria verrucosa* is determined by the type of substrate, water movement characteristic, and chemical-physical characteristics of the water (Murdinah *et al.,* 2013). The chemical composition of *Gracilaria sp*. is as in Table 2.3.

Being different from the other two variants, *Gracilaria* sp contains polysaccharides in the form of agar, which forms odorless and tasteless gels. The properties of the gel allow this seaweed to be added into various food products without adversely affecting the food organoleptic properties (Tiwari and Troy 2015).

Figure 2.4 *Gracilaria sp.*
Source: Murdinah (2013)

Table 2.3 Chemical Composition of *Gracilaria verrucosa*

Chemical Substance	Composition
Moisture Content*	79.348 ± 0.307
Protein	3.576 ± 0.898
Fat	2.902 ± 0.034
Ash	21.852 ± 1.229
Carbohydrate	71.671 ± 2.093
Crude Fiber	5.167 ± 1.770

Source: Murdinah *et al.*(2013)
notes: * weigh based on wet weight

2.3 Tapioca Flour

Tapioca starch or flour is an off-white powder refined from cassava roots which is used due to its bland sensory properties and texture of the starch. The gelatinization temperature is between the range of 59-70 °C. Cooked tapioca starch form a stringy texture and it sets into a gel upon cooling. The usage of tapioca starch in dessert and food thickener is preferred due to neutral taste, improves expansion (such as extruded product). In the market tapioca flour is often called as “tepung kanji” have the characteristic of white color, very refined, and will form a gel upon cooking.

2.4 Nutritional Yeast

Nutritional yeast is a deactivated yeast that usually comes in a form of powder, flakes, or tablets. Commonly reffered as brewer's yeast, Nutritional yeast is a good source of protein and source of umami flavor. Yeast is also high in protein content. 30g of serving will provide 16 grams of protein content, approximately 50 to 60 percent protein by weight. Protein of yeast is rich in lysine and tryptophan, which is usually low in vegetables usually consumed by vegetarian to complement their diet (Margel, 2005). Protein is an essential element in our body, consist of amino acids which is connected through peptide bond. There are 9 types of essential amino acids that are needed by the body; isoleucine, leucine, lysine, methionine, phenylalanine, threonine, tryptophan, and valine. Generally, all 9 essential amino acids can be obtained through consuming animal base product such as egg, red meat, fish, chicken, and milk (Lewis, 2002).

In addition, nutritional yeast also contains glutathione and superoxide dismutase (SOD) which are important enzymes for prevention and control of cancer. The B vitamins are important for liver detoxification. Vitamin B1 decrease the effect of smoking, alcohol, and heavy metal toxic. Vitamin B2 help in the production of enzyme glutathione. Vitamin B3 is used for detoxification. Vitamin B5 is known as pantothenic acid which helps detoxification process of acetaldehyde produced from alcohol and overgrowth of *Candida.* Vitamin B12 also present in nutritional yeast, important vitamins which are usually only contained in meat, yet vegetarians need to get the vitamins through other sources,

such as nutritional yeast (Margel, 2005). Figure 2.5 refers to nutritional yeast in flake form.

Figure 2.5 Nutritional Yeast Flakes
Source: Mouritsen and Styrbaek (2014)

2.5 Mushroom

Mushroom is widely used as a natural flavoring for foods. The flavor of mushroom came from the taste and aroma. The taste of mushroom came from mixture of water-soluble substance such as free amino acids, 5' nucleotides, sugars, polyols, and carboxylic acid. The aroma of mushroom came from volatile and non-volatile compound (Kalač, 2016).

The taste of mushroom consists of four basic taste; sweet, sour, salty, and bitter. In specific, carboxylic acid contribute to sour taste, polyols, free amino acids and sugars contribute to sweet taste. Some free amino acids such as valine, isoleucine, and histidine contribute to bitter flavor. The umami flavor or commonly known as the fifth flavor also available in mushroom, consist of 3 5'-nucleotides; monophosphates of guanosine, xanthosine, and inosine (Kalač, 2016).

In this research, white oyster mushroom (*Pleurotus oestreatus*) is used. White oyster mushroom is widely consumed in Indonesia and can be bought easily in Indonesian market. In general, white oyster mushroom contain food

enhancing properties and good flavor. It also contain mineral such as potassium, phosphorus, calcium, iron and sodium. Thus, oyster mushroom could be used as a natural alternative flavorant for cimol (Ardiansyah *et al.*, 2014).