THE USE OF CHEMICAL ADDITIVES FOR FISHERIES PRODUCT PRESERVATION

Penggunaan Bahan Tambahan Kimia untuk Pengawetan Produk Perikanan

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ABSTRACT

Preservation is a common practice in processed food products including fisheries product. The purpose of preservation in food is not only maintain the quality of food but also to prolong the shelf life of food itself. Preservatives can be divided into two groups i.e. natural and chemical preservatives. The chemical preservatives potentially used in fishery industry are nitrite, sulfur dioxide, benzoic acid and, sorbic acid. These preservatives have their own characteristics on inhibition of microorganisms. Food characteristic such as pH, and a_w are the key factors on the activity of antimicrobial agent.

Keywords: preservatives, chemicals, antimicrobial, food, fisheries product

ABSTRAK

Penggunaan bahan pengawet sudah lazim dilakukan untuk produk olahan pangan termasuk produk perikanan. Bahan pengawet termasuk bahan tambahan makanan yang bertujuan untuk menjaga kualitas dan memperpanjang daya simpan produk. Bahan pengawet dapat dikelompokkan menjadi bahan pengawet alami dan bahan pengawet buatan atau yang dikenal dengan bahan pengawet kimia. Beberapa bahan pengawet kimia yang potensial digunakan dalam produk perikanan adalah nitrit, asam benzoat, asam askorbat, sulfur dioksida dan pengawet dengan cara disemprot. Bahan-bahan pengawet tersebut memiliki karakteristik dan daya hambat yang berbeda terhadap mikroorganisme. Hal ini dipengaruhi oleh beberapa faktor antara lain pH, a_w dan karakteristik produk makanan itu sendiri.

Kata Kunci: pengawet, kimia, antimikroba, pangan, produk perikanan

INTRODUCTION

Food preservation is a methods to keep food products under control to maintain their quality (Prokovop & Tanchev, 2007). Food preservation has been known as an antimicrobial agent. The use of proper antimicrobial as a preservative agent was determined by which food will be preserved and what the microorganism targeted (Davidson & Branen, 2005). Sometimes, combination of some microbial agents need to give strong effects to microorganisms (Leistner, 2000).

Food preservation issue becomes more serious due to unsafe food causing disease worldwide. In Indonesia, the use of chemical preservatives is regulated in Health Minister's legal rule (PerDepKes RI.722/Per/IX/88) year of 1988. This legal rule explained about the definition of food preservatives, their usage in food and the amount allowed in most of food products. However, in term of food preservatives application in industry, the use of them was strictly regulated by government authorities, in Indonesia was controlled by The National Agency of Drug and Food Control (Badan Pengawas Obat dan Makanan). In other countries, the use of preservatives also regulated and controlled by government authorities such as FDA (Food Drug Administration) in United States, FSA (Food Standard Agency) in United Kingdom, FSANZ (Food Standards Australia New Zealand) in Australia and New Zealand and many other authorities which are belong to particular country. According to Prokovop & Tanchev (2007), perhaps 40,000 people died every day due to inadequate diets. These high numbers supposed to be a warning for people that should give more concern on food safety.

The use of chemical preservatives in food industries will steadily increase due to low cost, ease of incorporation into products and relatively low toxicity when used in appropriate dose. This advantages subsequently caused by chemical preservatives become widely used worldwide. Preservatives will not be useful to the food industries unless it is inexpensive enough and has the ability to pay for itself based on reducing spoilage and minimizing food borne illness (Davidson & Branen, 2005)

This paper will discuss about some preservative agents as an antimicrobial for fishery products such as nitrite, sulfur dioxide, some organic acids with and without spray and dip technique. Also, their microbial agents associated with their mechanism inhibited microorganisms, the targeted microorganism, and the use of them in food and toxicology aspects which will cover the limitation of use in food, health effects, and daily intake.

CHEMICAL ADDITIVES

NITRITE

Monograph of Nitrite

Nitrite (NO_2) is commonly used in fish and meat curing as an antimicrobial agent as well as antioxidant (Rahman, 2007). It is available in white to pale yellow solid form. As a form of salt, nitrite could be found as $NaNO_2$. Nitrite is soluble in water as well as in ammonia solution but do not dissolve completely in alcohol and other solvents. As salt associated, nitrite is widely used as antimicrobial agents in food industries (Davidson et al., 2002).

The outbreak of food poisoning caused by *Clostridium botulinum* was frequently appeared due to inadequate heating process caused *botulinum* spore remain alive in a jar. The common way to eliminate these bacteria and its spores can be conducted by using high temperature sterilization or anti-microbial agents such as nitrite. According to the Committee on nitrite and Alternative Curing Agents in Food (1982), there are several advantages of nitrite addition in the products; one of those is its ability to inhibit the growth of *botulinum*. Another study showed that in case of spore, nitrite acts to inhibit the germination and outgrow of heated spore by residual nitrite in product (Duncan & Foster, 1968; Adam & Moss, 2008).

However, nitrite has no effect on yeasts and fungi (Luck & Jager, 1997) but one study revealed that fresh pork added with nitrite and stored at 5 °C for 28 d, produced no aflatoxin and no growth of mould (Obioha et al*.,* 1983).

Mechanism of Preservation

The antimicrobial mechanism of nitrite inhibit the bacteria is not clear (Sebranex & Bacus, 2007), because of many factors played in antimicrobial activities (Thomkin, 2005). On the cured fish and meat products, Sebranex & Bacus (2007) tried to explain that nitrite oxide generated from the reaction between nitrite and meat would supposed as an antimicrobial agent.

Thomkin (2005) described that the botulinal, the effectiveness of nitrite as an inhibitory agent is dependent on several factors such as pH, sodium chloride concentration, reductants, and iron content. Generally, the antimicrobial agent of nitrite increases when the pH of product is lowered (Roberts, 1975; Prokovop & Tanchev, 2007; Adam & Moss, 2008). It is associated with nitrous acid which has pKa around 3.4 that supposed as active agent (Adam & Moss, 2008). Castellani & Niven (1955) reported that nitrite is required about 4000 ppm to inhibit *Staphylococcus aureus* at pH 6.9, but decreased to 400 and 80 ppm at pH 5.8 and 5.05, respectively.

Application in Fisheries Products

At the beginning of curing process in fish and meat products, nitrite used for preservation alone but nowadays as a mixture with common salt, i.e. sodium and potassium (Adam & Moss, 2008; Belitz et al*.,* 2009). Due to the ability to inhibit the growth of microorganisms, nitrite widely used as antimicrobial agents for most of fisheries products such as dried fish, semi-preserved fish, and other fisheries processing products.

Actually, nitrite could be applied for most of fisheries product such as smoked fish, cured fish, dried fish and any semi-preserved fish products. The ability of nitrite to inhibit the growth of *C. botulinum* would be the best consideration to make this preservative as the main chemical preservative in fisheries products. However, the amount of nitrite used in food should not exceed the amount allowed due to health effects and to hinder the 1970s nitrosamine outbreak happened again.

Many studies of using nitrite in food have been published. Thomkin (2005) reported that adding nitrite caused the herring to be redder in color, but no difference were noted for flavor or texture. Nitrite also had the ability to delay the depletion of trimethylamineoxide (TMAO). Hyytia et al. (1997) found that the addition of sodium nitrite could be delayed or prevented toxin production by *C. botulinum* type E in vacuum-packed of cold-smoked trout having 3.4% salt in the water phase. In one study with 166 ìg/g sodium nitrite, toxin was detected in 4 wk at 4 °C with a high inoculum level (20,000 cfu/kg) and after 4 wk with a low inoculum (800 cfu/kg). In case of the ability to prolong the shelf life, Tomkin (2005) showed that the addition of nitrite increased shelflife of fish and was considered acceptable by 3 or 4 wk at 4 °C.

Nitrite is more common used as food additives such as meat and poultry products. However the issue of safety products which was discovered in the 1970s about nitrosamins formation in cured meat became a serious problem (Sebranex & Bacus, 2007). Regarding to this issue, strict level of the use of nitrite in food has been established. For instance, the amount allowed for nitrite in meat products is around 50–125 g/kg products (FSANZ, 2010).

Nitrite could become toxic and cause carcinogenic (Sebranex & Bacus, 2007) if it is consumed in large amount. According to JECFA (1995) *in* Thomkin (2005), the allowed daily intake of nitrite for human body is 0-3.7 and 0-0.06 mg/kg body weight for potassium nitrite and sodium nitrite, respectively.

SULFUR DIOXIDE

Monograph of Sulfur Dioxide

At the beginning, sulfur dioxide (SO_2) has been used as an antiseptic, sanitizer or disinfectant. Due to its ability as an inhibitor for microorganism growth, sulfur dioxide was developed into antimicrobial agents. Low in toxicity made this compound acceptable worldwide as antimicrobial agents (Wedzicha, 2001). Sulfur dioxide which is a colorless gas with an extremely suffocating odor is especially common to the volcanic areas. It is fairly soluble in water, existing mainly as sulfur dioxide molecules, with some molecules associated with water (Ough & Were, 2005). It is available commercially as a salt and could be found as sodium bisulfite ($NaHSO_3$) and sodium metabisulfite ($Na_2S_2O_5$). The dried salts are easier to store and less of a problem to handle than gaseous or liquid sulfur dioxide.

Mechanism of Preservation

The most important thing in antimicrobial activity of SO_2 is pH (Ough & Were, 2005). According to Prokovop & Tanchev (2007), SO_2 strongly active at low pH and also shows that bisulphate has greater inhibiting than sulfite ion. There are three disassociation parts of equilibrium SO_2: undissociated sulfurous acid (H_2SO_3), hydrogen sulfite HSO^-_3 and sulfite ions (SO^{2-}_3) (Luck & Jager, 1997). Among of three equilibrium parts, the most strongly antimicrobial activity is undissociated sulfurous acid (Rehm & Wittmann, 1963 In Luck & Jager, 1997).

Sulfur dioxide is not only as an antioxidant to inhibit enzymatic and non-enzymatic reaction in foods but also as an antimicrobial agent (Adam & Moss, 2008). The unionized sulfur dioxide (SO_2) has 100-1000 times in antimicrobial activity (Adam & Moss, 2008). Most of bacteria, yeasts, and moulds are sensitive to SO_2 (Adam & Moss, 2008). SO_2 is more effective agent to inhibit Gram-negative bacteria than that of Gram-positive bacteria (Robert & McWeeny, 1972) especially *Escherichia coli* and *Salmonella* (Ough & Were, 2005). However, the antimicrobial activity of SO_2 affect yeast depending on the species. Some species are resistant to SO_2 such as *S. cerevisiae, Z. bailii, S. ludwigii,* and *Schizosaccharomyces japonicas* (Delfini, 1989 In Ough & Were, 2005).

Application in Fisheries Products

The uses of sulfur dioxide on fisheries products are generally for fresh products, crustaceans or canned fish. In case of fresh product, the addition of sulfur dioxide in fresh shrimp is to preserve the color as well as antimicrobial agent (Dengate, 2009). According to Gould (2000), sulfur dioxide used to prevent black spot on crustaceans.

Since sulfites preserved the color of fresh products, this preservative could be used widely for fisheries products. Fisheries industries which export fresh product are supposed to make this preservative in their ingredient list. The addition of sulfur proposed to maintain the physical appearance of the product, thus the price will remain high even though has been kept out for days. The use of sulfur dioxide as an antimicrobial in food products could be seen in Table 1.

Nowadays, the use of sulfites in foods began to be restricted. The maximum allowable amount of sulfur added in food showed in Table 1. In Australia, the use of sulfites in fresh fish products is no longer allowed except for processed products (Anon., 2010). In Indonesia, the sulfites tolerances sre set by Indonesian National Standard (SNI 1995) which the maximum amount of sulfur dioxide allowed in food is 500 mg/kg. Moreover, based on FSANZ (2010), the maximum amount of sulfur dioxide added in meat products is up to 500 mg/kg. Moreover, the amount of daily intake for human is around 0.7 mg/kg body weight per day (FAO, 1974).

SORBIC ACID

Monograph of Sorbic Acid

Sorbic acid (CH_3-CH=CH-CH=CH-COOH) is a natural compound which was originally isolated by A. Hoffman from mountain as fruit juice over a century ago. Due to its ability against on microorganisms as an antimicrobial agent, a chemical synthesis of sorbic acid was carried out in 1940 (Sofos, 1989). Sorbic acid form colorless flakes or needles when crystallized and its solubility in water at room temperature is only 0.15 g per 100 ml (Stopforth et al., 2005). Sorbic acid as a preservative possesses important advantages; it has virtually no effect on the taste and the odor of

Table 1. Application of Sulfur Dioxide in Fisheries Products and other Food as an Antimicrobial Agent

*The use of sulfur in particular countries; Source: Adopted from Gould (2000) & Dengate (2009).

food items (Ovcharova 1966 *in* Sergeeva et al., 2009). It is commercially available as a salts i.e. calcium, sodium, and potassium sorbate

Sorbic acid is known as antimicrobial to inhibit yeast, mould, and bacteria (Sofos, 2000). It has more power to kill moulds and yeasts than bacteria (Prokovop & Tanchev 2007). However, the extent of microbial inhibition ability depends on types, strain and species of microorganism (Stopforth et al., 2005). Some microorganisms are resistant to sorbic acid due to their ability to metabolize this compound (Stopforth et al., 2005).

Mechanism of Preservation

According to Sofos (1989), inhibit ion activity of sorbic acid are mostly to yeast in genera *Endomycopsis, Brettanomyces, Torulaspora, Pichia, Candida, Cryptococccus, Zygosaccharomyces, Hansenula, Kloeckera, Rhodotorula, Saccharomyces, Sporobolomyces, Torulopsis,* and *Debaryomyce.* However, the optimal inhibition activities at low pH and intermediate water activity (a_w) (Restaino et al., 1982). As well as yeast, most species of moulds are inhibited by sorbic acid such as *Mucor, Penicillium Rhizopus, Trichoderma and Fusarium* (Stopforth et al., 2005).

Moreover, sorbic acid is also able to inhibit most of bacteria such as genera *Acetobacter, Enterobacter, Bacillus, Campylobacter, Clostridium, Escherichia, Klebsiella, Lactobacillus, Micrococcus, Pseudomonas, Salmonella, Staphylococcus, Vibrio,* and *Yersinia* (Sofos, 2000). However, inhibition ability to inactive *Listeria monocytogenes* is depend on pH and concentration (El-Shenawy & Marth, 1988). Inhibition activity of sorbic acid for bacteria is occurred at concentration 50-10,000 ppm, lower for yeast which is around 25-500 ppm and 100-1000 for moulds (Prokovop & Tanchev 2007).

Sorbic acid is also able to kill spore while the spore is germinating (Sofos, 1989). Some microorganisms in certain condition are resistant to sorbic acid. Most of yeast belong to *Saccharomyces, Torulopsis, Brettanomyces, Zygosaccharo-myces,Candida,* and *Triganopsis* are resistant to sorbic acid (Restaino et al., 1982). This condition is associated with the ability of yeast to adapt the weak acid environment (Piper et al., 1998).

Application in Fisheries Products

Sorbic acid is commonly used in fish as well as meat, vegetable, fruit, drinks, bake goods and confectionery. The amount of sorbic acid allowed in food products showed in Table 2. For fisheries products, sorbic acid was combined with benzoic acid to preserve fish sauce and the amount used was 3 g/L and 0.2 g/L, respectively (Suprapti, 2008). Another study showed that 0.1% sorbate (sorbic acid as salt) combined with 0.1% benzoate solution could preserve brined shrimp for 59 d, which is longer than the preservation (31 d) achieved by the most effective bacteriocin (nisin) tested (Einarsson & Lauzon, 1995).

Since sorbic acid is available as a salt, the best use of this preservative for Indonesian artisanal fishermen is to preserved dried fish. It has the ability to inhibit most of yeast, mostly found in dried fish products. Therefore, the combination of sorbic acid and any other preservative such as nitrite would give the best to the shelflife of this product. Nitrite has the ability to inhibit the growth of *C. botulinum* in case of mishandling or contamination while processing dried fish. On the other hand, sorbic acid would preserve dried fish from any bad yeasts and moulds.

Table 2. Common Applications of Sorbates as Antimicrobial Agents in Food Products

Source: Adapted from Sofos (1989).

Based on FSANZ (2010), the maximum amount of sorbic acid added in meat product is up to 1500 mg/kg and SNI (1995) stated around 3000 mg/kg. Moreover, World Health Organization (WHO) set up the amount of daily intake for human which is around 25 mg/kg of body weight per day (Stopforth et al., 2005).

BENZOIC ACID

Monograph of Benzoic Acid

Benzoic acid is found naturally in apples, cinnamon, cloves, cranberries, plums, prunes, strawberries, and other berries (Davidson et al., 2002). Benzoic acid (molecular weight 122.1) occurs in pure form, colorless or white needles or leaflets. It is soluble to a limited extent in water (0.18, 0.27, and 2.2 g dissolves in 100 ml water at 4, 18, and 75 °C, respectively). The advantages of its low cost, ease of incorporation into products, lack of color, tastelessness and relatively low toxicity subsequently caused benzoic acid to become one of the most widely used preservatives for fisheries and food products (Chipley, 2005). Commercially, benzoic acid is available in the form of whitish, soft crystals having a silk-like gleam. It could be found as sodium benzoate and benzoic acid.

Mechanism of Preservation

Among other chemical preservatives, benzoic acid is the oldest used in food, drug, and cosmetic industries (Chipley, 2005). However, the use of benzoic acid is limited in food which has natural acidity. It is associated with the quality of undissociated acid which decreased while the pH increased (Chipley, 2005). The relationship between sodium benzoic and pH in inhibiting bacteria growth can be seen in Table 3.

According to Adam & Moss (2008), benzoic acid strongly inhibit yeasts and moulds due to its strong acid property (pKa 4.19). As a result, the antimicrobial action of this compound is only effective in preserving acid products (Luck & Jager, 1997). Being used as sodium salt, benzoic acid is effectively against bacteria, yeast, and moulds around 50-1,800 ppm, 20-7,000 ppm and 20-10,000 ppm, respectively (Prokovop & Tanchev 2007).

Application in Fisheries Products

Benzoic acid was generally used to preserve surimi, minced fish, and other minced fish products. It is also inhibit the toxin from fisheries products. Heruwati et al. (2008) reported that baby tuna soaked in 0.1% benzoic acid for 30 min resulted in the inhibition of histamine formation up to 88,9% at 8 h in room temperature storage. Ponce de Leon et al (1994) found the shelflife of sardines stored in acid brine containing 0.3% sodium benzoate which was three times longer than the control.

Among the preservative agents mentioned above, benzoic acid is the safest preservative used in food. Both sodium benzoate and benzoic acid are used in a wide range of preservative applications because of the combination of bactericidal, anti fungi, anti mould, and bacteriostatic action with low toxicity and tastelessness. There for, in case of fisheries industries, this preservative could be applied in any kind of fisheries products such as dried product, canned product, and semi-preserved product. This preservative not affected the flavor of products since it is tasteless.

The maximum amount of benzoic acid allowed in fisheries products based on FSANZ (2010) and BSN (1995) is up to 400 mg/kg and 1000 mg/kg, respectively. The maximum amount of benzoic acid allowed in various food products can be seen in Table 4. Furthermore, according to Pollard (1990), average daily intake for benzoic acid is allowed around 5 mg/kg of body weight.

FOOD PRESERVATION TECHNIQUE: SPRAY ACID PRESERVATION

The use of spray and dip acid in meat, poultry, fruit, and vegetables has been applied widely (Cords et al., 2005) but not quite common for fisheries products. Cao et al. (2006) showed that harvested Ya

Table 3. Effect of Benzoic Acid on the Growth of Some Important Food Spoilage Yeasts at Different pH Values

Note: NG, no growth in the absence of benzoic acid; - no growth in the presence of 250 mg of benzoic acid/L; Source: Adapted from Praphailong & Fleet (1997).

Li pear (*Pyrus bretschneideri*) which is sprayed with salicylic acid in some concentrations had a good resistance to pathogen. The antimicrobial activity of compound is influenced by some factors such as type of products, pressure of spray, temperature of spray, concentration of antimicrobial, temperature storage after treatment, and whether the product was chilled before treatment (Cords et al., 2005).

Preservation Technique

The mechanism of antimicrobial activity in acid spray and dip is similar to traditional way. The antimicrobial was sprayed out into the food products to kill pathogenic microorganisms. One of antimicrobial used in spray methods is organic acid (Cords et al., 2005). Dipping methods is similar to

Table 4. Maximum Permitted Levels (ppm) for Benzoic Acid and Salts in Foods in Selected Countries

Note: [a] In the United States, a maximum level of 1000 ppm benzoic acid or salts may be used for all products listed. A maximum level of 2000 ppm may be used in orange juice for manufacturing. Orange juice not used for manufacturing may not contain a preservative (federal standards of identity); [b] Soft drinks for consumption after dilution; [c] Soft drinks for consumption without dilution; [d] Good manufacturing practice. Source: Adapted from Chipley (1993).

spray methods using acid solution as a dipping media for products preserved. Omar (1998) used 1.25% sodium metabisulfite as a dipping media for frozen shrimp preservation. The frozen shrimp dipped in the media for 1 min.

Application for Fisheries Products

Acid spray and dipping methods is not quite popular for fisheries products preservation even though this method seemed to be more efficient and effective in inhibiting of microorganisms. The acid layer on the surface will protect the products from pathogen and insects. Perhaps this methods could hinder the use of illegal substances such as anti-mosquito spray which is frequently being used by the fisherman to protect dried salted fish from flies. Omar (1998) reported that frozen shrimp dipped in 1.25% sodium metabisulfite can inhibit the growth of microorganisms. The maximum amount allowed used for frozen shrimp and cooked shrimp are 100 mg/kg and 30 mg/kg, respectively (BSN, 1995)

According to Cutter & Siragusa (1994), organic acid sprayed into lean and adipose beef can inhibit the growth of *E. coli* and *Pseudomonas fluorescens.* Another study also showed that organic acid can inhibit the growth of microorganism in poultry carcass during chilling temperature (Cords et al., 2005). However, this antimicrobial gives no effect to *Salmonella* cells that are attached to the surface (Tamblyn & Conner, 1997).

FOOD PRESERVATION IN INDONESIA

Nowadays, food industries in Indonesia is growing quite rapidly, which subsequently takes effect to the use of food additives as a preservative. The uses of chemical food preservatives in Indonesian food industries are common. It can be said that almost 90% of the food industries uses preservative to prolong the shelflife of products (Anggrahini, 2008). However, unintentionally mistake related to the use of preservative may cause health problems for the consumers. So, the amount of ADI (Acceptable Daily Intake) of preservatives should be strictly considered to assure the safety of product and also the shelf life itself.

According to PerDepKes No.722/1988, preservatives allowed used in Indonesia foods are benzoate acid, propionic acid, sorbic acid, sulfur dioxide, methyl phydroxy benzoate, potassium benzoate, potassium bisulfite, potassium metabisulfite, potassium nitrate, potassium nitrite, potassium propionate, potassium sorbate, potassium sulfite, calcium benzoic, calcium propionate, calcium sorbate, sodium benzoate, methyl-phydroxy benzoic, sodium bisulfite, sodium metabisulfite, sodium nitrate, sodium nitrite, sodium propionate, sodium sulphites, nisin and propyl-p-hydroxy-benzoic.

The use of food additives as food preservatives was regulated by BPOM under supervision of Ministry of Health. Actually, the maximum limit of preservatives amount used in Indonesian food industry is much more stringent than Europe, America, and Australia (Anon., 2010b). However, somehow small scale industries tried to obey by adding it in large amount of food preservatives over the maximum standard. On the contrary, Europe, America, and Australia, they use less amount even though they have the chance to use more due to consumers in those countries tend to avoid foods that contain preservative.

Food preservatives commonly used in Indonesia is sulfite, nitrite, and benzoate. Nitrite has been used as a preservative to maintain the color, especially in meat and fish. In term of Indonesian people, nitrite was known as sendawa salt. Benzoic acid is widely used in instant noodle industries while sulfites are used in fruit juices, sausages, and pickles industries (Anggrahini, 2008).

However, even Indonesia already has regulation on the use of food preservatives, the use of them somehow does not accordance with the regulation. Small scale industries tend to use illegal food preservatives in their products. They usually concern only on food appearance through bright color, good textures, and long shelf life but not the safety of food itself. Moreover, food street vendors which have spread out at the dense population settlements and also schools allegedly use prohibited food additives or exceeding the amount allowed. Some of prohibited food additives that they usually use are rhodamine B which its function is to improve color, borax to improve texture, even formalin to extend the shelf life.

Maskar (2004) has interviewed the owner of some food street vendors in East Jakarta. He found that they even did not know what the food additives are, how dangerous they are or they are legal or ilegal. They only know that these additives are cheap and could improve the appearance and shelf life of products. Government is trying to fix this problem by introducing the legal food additives as a preservatives to them. But some inspections showed that the use of illegal food additives was found in traditional market and food street vendor (Anon., 2012a; Anon., 2012b).

SUMMARY

In summary, the use of antimicrobial agents as a preservation has been considered in fishery industries to assure quality, shelf life, and safety of the products. Their ability to inhibit pathogen is influenced by several factors such as concentration of antimicrobial, kind of foods, the properties of food such as pH and water activity (a_w), psychochemical of food and storage condition.

Some antimicrobial agents have different inhibitor ability to particular microorganism. One of antimicrobial agents commonly used is chemical preservative. There are several chemical preservative such as organic acid, nitrite, and sulfur dioxide which has been proven successfully in inhibiting the growth of microorganisms. Consideration to their characteristic of inhibition and the targeted microorganism will give good effects in food preservation. The use of proper antimicrobial will give a maximum inhibitory to unwanted microorganisms.

In term of technique, spray acid and dip method would be developed to hinder the use of illegal substances such as anti-mosquito spray or other insecticides in dried salted fish. Therefore, introduction to artisan fishermen who process dried salted fish about this method will turn them against the use the illegal substances.

The use of chemical preservatives in food industries will steadily increase due to low cost, ease of incorporation into products, and relatively low toxicity when it is used in appropriate dose. This advantages subsequently caused chemical preservatives become widely used worldwide. In the future, the application of preservatives in food industry will be a combination of more than one preservative at once to give best preservative effect for products.

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