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Effectiveness Analysis of the Utilization Liquid Smoke Distilled from Organic Materials as an Alternative for Fish Preservation

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Abstracts

Liquid smoke is alternative preservation fish that does not cause pollution and does not damage the respiratory organs. Liquid smoke contains antibacterial and antioxidant so that it can preserve fish that have a fast rot character. This study aims to determine the characteristics and effectiveness of using liquid smoke as an alternative to preserving fish. The research method applied in preserving fish using liquid smoke is soaked; soaked and dried; and soaked and aerated. The variables in this study include the combination of bay leaves, lemongrass, and galangal; Pandan leaves; and tuna. The results showed that the characteristics of the liquid smoke of bay leaves, lemongrass and galangal and pandan leaves were almost the same clear color, the level of viscosity was like water, and the smell of smoke flavor each stung the distinctive aroma of organic matter. Based on data analysis, it was found that an effective way to use liquid smoke in replacing traditional fumigation was to soak it than dried in the sun. This is because soaking can increase antibacterial activity while drying can reduce water content in fish.

Key words: distillation; liquid smoke; bay leaves, lemongrass, and galangal; pandan leaves.

1. Introduction

Reference [1] since increase of the fish production every year, the growth rate of fisheries production in 2015 to 2017 is 3.97% per year, so the development of processed fish must continue to be optimized. Reports on fisheries production in 2015 reached 22.31 million tons consisting of 6.68 million tons of capture fisheries and 15.63 million tons of aquaculture. In 2016, fishery production increased to 23.5 million tons, namely capture fisheries by 6.831 million tons and aquaculture by 16.68 million tons. In 2017 total fishery production increased and reached 24.21 million tons. This production consists of 17.22

million tons of aquaculture and 6.99 million tons of capture fisheries.

The results of the report show that fish production always increases every year. This means that the consumption of fish in the community has begun to increase, so that processing fish into nutritional intake that is more durable and suitable for consumption has become very important to do. If the fish not processed immediately, it tend to rot quickly, fast changing color and texture. One way that can be done to preserve the texture and give smoke flavor of fish is fumigation.

Ketandan Village (Batang, Jawa Tengah) is a center for fish fuming and almost all villager are engaged in bloater (smoked fish) business. Every day smoke was seen coming out through the chimneys they had prepared. Fish fuming is a "tradition cured" inherited from the ancestors in the village. This "traditional cured" of fish preservation in the long run can endanger the respiratory organs of the workers. They will be more susceptible to lung and respiratory tract infections (ISPA: Infeksi Saluran Pernafasan) because they inhale the smoke too often. The process of condensing smoke into liquid smoke is very beneficial for the protection of air pollution caused by pyrolysis [2]. Therefore, liquid smoke can reduce the impact of lung and respiratory tract infections. This is also proven by the results of research that the products preserved by fumigation contain carcinogenic compounds Policyclye Aromatic Hydrocarbons (PAH) [3].

Liquid smoke is present as an alternative to modern fish preservation to reduce the adverse effects of smoke use. Liquid smoke uses only the simple concept of condensation, where a gas changes its form into liquid through a process of cooling or condensation. This condensation liquid is called liquid smoke which contains phenol and can be used as a fish preservative. Liquid smoke is a mixture of solutions and colloidal dispersions derived from wood smoke vapor in water obtained from wood pyrolysis processes or made from a mixture of pure compounds [4]. Liquid smoke can be used as a food preservative because it contains with antibacterial and antioxidant. Raw materials that can be used to produce liquid smoke include coconut shells, coconut fibers, organic rubbish, coffee shells, bamboo, rice husks, and rice straw [5].

Reference [6] suggested that the use of liquid smoke has many advantages compared to traditional fumigation methods that are easier to apply, faster processing, giving distinctive characteristics to the final product in the form of more attractive aroma, colors and flavors, it's not pollute the environment. The content of benzo[a]pyrene in liquid smoke is very low, this statement is supported by other research which states that the use of liquid smoke makes it possible to produce smoke products that do not contain benzo[a]pyrene and other carcinogenic [7].

In general, coconut shell liquid smoke can be used as an alternative preservative that is safe for consumption, as well as providing sensory characteristics in the form of aroma, color, and taste that are unique to food products [8]. The development of fish preservation using liquid smoke can still be renewed, considering that there are still many other organic materials which of course can be used as fish preservatives. In this study, researchers made liquid smoke through the pyrolysis of several organic materials and then compared the level of effectiveness of preservation and the longevity of liquid smoke. Organic materials to be used are pandan leaves and a combination of bay leaves, lemongrass and galangal.

2. Experiments Procedure

The independent variable in this study is the preservation method and the types of organic materials used are pandan leaves, bay leaves, lemongrass, and galangal, while the dependent variable is fish, in this study the fish used were tuna. Tuna was tested using a different method. The first method, the fish is dripped with liquid smoke and then stirred and placed in a closed container; the second method, fish soaked in liquid smoke and then dried in the sun; while the third method is fish soaked and aerated. The controlled variables in this study were the size of the tuna, the preservation temperature, and the volume of liquid smoke of each organic material.

The tools in this research are 1 kg distillation pot with conical lid, metal pipe (aluminum) length 60 cm, transparent plastic pipe length 1 m, distillation-holding glass bottles, gas stove, and distillery storage bottles. The materials used is fresh pandan leaves, bay leaves, lemongrass stems and galangal 200 grams each; water as a solvent; and fresh tuna.

The procedure in this study includes two stages, the first stage is liquid smoke production and the second stage is preservation fish. The first stage in the production of liquid smoke, a refining device that has been prepared is cleaned until it is completely dry. Clean the organic material to be distilled and cut into small pieces. Weigh the organic material to be distilled. After all the ingredients are ready, cover the pot tightly. Before turning on the stove, make sure position tip of the transparent plastic pipe enter into the glass bottle and the center of the plastic pipe is submerged by water. The procedure must be done properly so that the distilled water can flow and drip into the glass bottle. Glass bottles should not be opened, so that when smoke begins to flow through the pipe, smoke does not come out as smoke, but as a liquid. The distillation process takes about 1 to 3 hours. Wait until the water in the pot has all evaporated and the liquid smoke has been distilled.

The second stage is the process of preserving fish using three different methods. The first method is fish smeared with 1 ml of liquid smoke and kept in a closed container, then observed every 12 hours. The second method is soaking the fish in 10 ml of liquid smoke, soaking is done with a variety of different soaking times, after soaking the fish dried it in the sun. In the third method the fish are soaked with 10 ml of liquid smoke, then air-dried.

3. Result and Discussion

Liquid Smoke Production

Liquid smoke production is carried out through a distillation process, where organic material is heated to a certain temperature then cooled with a condenser to produce liquid smoke. The process of making liquid smoke from wood material can eliminate carcinogenic polyaromatic hydrocarbons, which are cancer-triggering produced by smoke [9]. Liquid smoke from wood is made purely from wood burning without any solvents, while liquid smoke from foliage is made using solvents. Liquid smoke from the distillation of foliage with the addition of water as solvent, no need to be redistilled because it does not contain tar.

In this study, the organic material distilled to produce liquid smoke is a combination of bay leaves, lemongrass and galangal; and pandan leaves. Data on the physical properties of liquid smoke are shown below in Table 1 and Table 2.

Table 1. Data on physical properties of liquid smoke from the distillation of bay leaves, lemongrass, and galangal

No	Parameter	Data
1	Color	Clear, colorless
2	Viscosity	Fluid, like water
3	Smell	Combination smell of bay leaves, lemongrass and galangal very strong

Table 2. Data on physical properties of liquid smoke from pandan leaves distillation

No	Parameter	Data
1	Color	Clear, colorless
2	Viscosity	Fluid, like water
3	Smell	Smell of pandan steam very strong

The distillation process in this study was carried out using a simple device made from a 1 kg capacity cone lid pot, aluminum pipe length 1 m, and transparent plastic pipe length 1 m. The condenser of this tool is water in a basin to soak a transparent pipe. Distillate container (distillate) uses a used syrup glass bottle. The distillation process is carried out within 3 hours using a stove over low heat, from 200 grams

material and 200 ml solvent produced 10 ml distillate.

Preservation Fish

The process of preserving fish is carried out by three methods: liquid smoke is only dripped, soaked and dried in the sun, and soaked and aerated. In the first method, fish that have been cut into liquid smoke drops with a volume of 0.5 ml and 1 ml.

Based on the results of treatment 1, it was found that fish that were only dripped with liquid smoke and stored in a closed container would cause the water content in the fish increase and the fish rot faster. Fish that have been cut, cleaned, and dried using a tissue, if even without liquid smoke will eventually come out of water. Therefore, this method is very ineffective for preserving fish. The principle in preserving fish is to reduce the water content in fish to inhibit bacterial growth. Reference [10] states that the preservation of fish products that can be applied are those that have the potential to prevent loss of moisture, reduce water and gas degradation, and improve the texture of the product or what is called the edible coating technique.

If it is reviewed further, the longer the fish are kept in a closed container, the more watery and the smell will get rotten. Physically can be seen from the change in color, odor, and texture. Chemically, this indicates that the pH of fish is increasing due to the presence of basic compounds such as ammonia, trimethylamine and other volatile compounds as a result of bacterial activity and proteolytic enzymes [11].

The second method, preservation is done by soaking the fish using 10 ml of liquid smoke for 60 minutes, then the fish are dried in the sun for 7 hours, and stored in plastic. Fish that are soaked in liquid smoke from bay leaves, lemongrass, and galangal have a distinctive odor of the material but are more pungent, while fish from liquid pandan leaves soaking have a distinctive pandan smell but are also more pungent. Observation results of fish preservation in this method can be seen in table 4.

Table 3. Physical Properties of Fish with Preservation Method 1

Organic materials: bay leaves, lemongrass, and galangal			
No	**Smoke liquid volume**	**Storage time (hour)**	**Physical Properties of Fish**
1	0,5 ml	12	Not smell rotten, slightly runny, and the scent of bay leaves, lemongrass and galangal still smelled.
		24	Somewhat smell rotten, more water content, and the scent of bay leaves, lemongrass and galangal slightly smelled.
		36	Smell rotten, the water content increases, the color of the fish is pale, and the scent of bay leaves, lemongrass and galangal reduced.
		48	Smell very rotten, very watery, and the color of the fish is very pale.
2	1 ml	12	Smell not rotten, slightly watery, and aroma of bay leaves, lemongrass and galangal smelled, smell of the fish is not dominant.
		24	Somewhat smell rotten, more watery, the color of the fish is pale, and aroma of bay leaves, lemongrass and galangal still smelled.
		36	Smell very rotten, very watery, and the color of the fish is very pale.

Table 4 shows that liquid smoke can be used to preserve fish for up to 8 days, both liquid smoke from bay leaves, lemongrass and galangal and liquid smoke from pandan leaves. The difference is clearly seen in fish that are not given any natural preservatives, on the 6th day maggots have appeared, while fish that are preserved using salt are more durable. Based on these results it was shown that fish soaked with liquid smoke from pandan leaves were infested with ants on the 2nd day, even from day 1. It can be said that, liquid smoke from pandan leaves gives a distinctive aroma to the fish, so the ants swarm over the fish and even

eat the fish. Pandan leaves are usually used as a deodorizer and natural green giver in food. The distinctive aroma of pandan leaves arises because of the presence of a phenyl alanine derivative compound, 2-acetyl-1-pyrroline [12].

Table 4. Physical Properties of Fish with Preservation Method 2

PRESERVATION RESULTS				
Days to-	**Liquid smoke of bay leaves, lemongrass and galangal**	**Liquid smoke of pandan leaves**	**Given Salt**	**No Preservation**
2	smell of bay leaves, lemongrass, galangal; slightly soft texture	pandan odor; crowded by ants; slightly soft texture	smell of salted fish; slightly soft texture	fish special odor; slightly soft texture
4	fish odor; rather hard texture	Fish odor; crowded by ants; rather hard texture	smell of salted fish; rather hard texture	fish odor; soft texture
6	fish odor; rather hard texture	fish odor; rather hard texture	smell of salted fish; rather hard texture	maggots appeared
8	fish odor; rather hard texture	fish odor; rather hard texture	smell of salted fish; rather hard texture	-

The third method is fish soaked in 10 ml of liquid smoke for 60 minutes, then aerated for 7 hours and stored in plastic. The results of observations can clearly be seen in Table 5.

Based on observations in methods 2 and 3, it was found that fish that were soaked in each type of liquid smoke after being dried in the sun still had a distinctive odor from the organic material is used. In addition, with both its two methods, the process of preserving fish is more effective than method 1. This is because in method 1, the fish is watery and increasing bacterial activity.

Table 5. Physical Properties of Fish with Preservation Method 3

PRESERVATION RESULTS				
Days to-	**Liquid smoke of bay leaves, lemongrass and galangal**	**Liquid smoke of pandan leaves**	**Given Salt**	**No Preservation**
1	smell of bay leaves, lemongrass, galangal; very soft texture	pandan odor; very soft texture	smell of salted fish; soft texture	fish odor; soft texture
2	fish odor; soft texture	fish odor; soft texture	smell of salted fish; soft texture	fish odor; soft texture
3	slightly rotten odor, soft texture	slightly rotten odor, soft texture	slightly rotten odor, soft texture	smell bad, maggots appear
4	smell bad, maggots appear	smell bad, maggots appear	smell bad, maggots appear	smell bad, maggots appear

As a whole it can be stated that method 2 is the most effective in the preservation fish. In method 3, fish can only last up to 4 days because the water content in fish is still slightly reduced so that bacterial activity is still high. The process of preservation of fish using liquid smoke with aerated will only reduce a little water content in fish, bacterial activity can be eliminated if using the edible coating method and then the fish are kept frozen [13].

It is clear that liquid smoke from bay leaves, lemongrass, and galangal; and pandan leaves can be used to preserve fish with a

distinct distinctive aroma. The main content of bay leaves and lemongrass is citral which can be used as a fish preservative as well as deodorizing fish. In addition to citral, bay leaves also contain tannins, flavonoids, and the content of nerolidol which influences the distinctive aroma of bay leaves [14]. In lemongrass besides citral there are also content of citronellal, methylheptane, n-decyl aldehyde, linalool, geraniol [15]. The role of galangal as a food preservative is inseparable from the ability of galangal which has antimicrobial activity. Reference [16] the results show of stated that galangal contains essential oils in the rhizome, containing saponins, tannins and flavonoids. Phenolic compounds and flavonoids are sources of natural antioxidants that are usually found in plants.

Fragrant of pandan leaves can also be used to preserve fish or other food products because fragrant pandan (Pandanus amaryllifolius Roxb) contains alkaloids, saponins, flavonoids [17]. The statement is also supported by other results study which states that pandan leaves contain flavonoids, alkaloids, saponins, tannins, polyphenols, and dyes which are thought to have contributed to antibacterial activity [18].

Each substance in pandan can be known to be able to play a role as free radicals or as a natural antioxidant [19]. Antioxidants can be used to repair tissue cells, enhance the immune system, enhance anti-aging effects, and can protect nerves. Besides flavonoids, there are also alkanoid substances in pandanus and have been proven to have the ability to regenerate damaged pancreatic β cells [20].

4. Conclusion

Based on the results of research that has been done, it is found that the characteristics of liquid smoke of bay leaves, lemongrass and galangal; and pandan leaves are almost the same, namely clear color, level of viscosity such as water, and the odor of vapor is very strong each other's distinctive aroma of organic matter. From the results of the analysis of the effectiveness of the use of liquid organic matter smoke in fish preservation is the most effective method of preservation of fish is the method of soaking and drying in the sun. In this method, the water content is completely gone so that bacterial activity in fish is very low.

Suggestion

To improve the results in this study, the authors suggest conducting research with the same treatment in each method. In methods 2 and 3 there are 4 different treatments namely fish given liquid smoke from bay leaves, lemongrass, galangal; given liquid smoke from pandan leaves, given salt; and without any additions. Method 1 should also be treated with 4 different treatments so that the assessment of results is more optimal.

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