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Effect of Combination Treatment of Liquid Smoke Concentration, Soaking Time, Packaging and Different Storage Time To Yield And Moisture Contentnila Fish *Fillet* (*Oreochromis niloticus*)

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Abstract : This study aims to determine the yield and moisture content *fillet* of tilapia (*Oreochromis niloticus*) were given the combination treatment pickling liquid smoke concentration, soaking time, types of packaging and storage time are different. This study was conducted in laboratory with factorial experiment in a completely randomized design (CRD) 5 x 3 x 3 x 5 with 3 replicates in order to obtain 675 experimental units. A factor consists of the concentration of liquid smoke is composed of 5 (five) levels is Control (smokeless liquid / 0%), 5% and 10%, 15% and 20%; long immersion factor B consists of 3 (three) levels is soaking time 5 minutes, 10 minutes and 15 minutes; factor C type of packaging consists of three (3) levels is without packaging (control), plastic packaging polyethylene (PE) and packaging plastic polypropylene (PP) and factor D storage time (days) consists of 5 (five) levels is 0, 3 , 6.9 and 12 days. Parameters measured were yield and moisture content. The results showed that the interaction effect of combined treatment of different concentrations of liquid smoke cinnamon soaking time to the yield ($P < 0.05$), as well as in combination treatment with different concentrations of different storage time. The combination of other treatments showed no significant effect on yield effect ($P > 0.05$). For a combination of 3 (three) and 4 (four) treatments showed no interaction. Rated highest yield obtained in the combination treatment of soaking time 15 minutes on without soaking liquid smoke (smoke concentration liquid 0%) of 73.686% was significantly different from other treatments, combination treatment concentration liquid smoke 0% (without liquid smoke) with a storage time of 9 days amounting to 71.77% significantly different from other treatments, while the combination of other treatments were not significantly different. On the water content *fillet* of tilapia, no interaction on a combination of four treatments, the difference of soaking, the concentration difference immersion, types of packaging and storage time ($P<0.05$), but the interaction on a combination of three treatment difference soaking time, the difference of concentration and storage time on water content. Interactions also occur in prolonged submersion, types of packaging and storage time while the combination of two, three other treatments did not show any interaction on water content. The results of the water content of the lowest in the *fillet* of tilapia found in the average water content *fillet* of tilapia lowest obtained in the treatment of packaging in plastic bags of polyethylene (PE) in the old submerged for 15 minutes with storage for 0 days of (11.934%), and water content results a combination of four treatments preservation on *fillet* of tilapia meet the Indonesian National Standard (SNI) 01-2725-1992 namely smoked fish a maximum moisture content of 60 percent.

Keywords : *fillet*, concentration, soaking, packaging, storage.

I. Introduction

Among the species of freshwater fish are now being developed and grown in the provinces of West Sumatra are Tilapia (*Oreochromis niloticus*). The potential of aquaculture land estimated area of 12,300 hectares [1]. This is because these fish easy life, fast breeding, the meat is white and it was quite tasty. Processing methods can be developed against the fish is a fish processing. Result *fillet* processing such as *fillet*s of fish including food very quickly decompose *(high perishable food*). As perishable foodstuffs, then the quality of the fish must be maintained as much as possible to get into the hands of consumers. For that we need a good handling. One way of handling is curing fish.

Fumigation is a technique of embedding and incorporating various chemical compounds of smoke into foodstuffs [2]. Fogging was intended to extend the shelf life of a material, but in line with the increase in public acceptance of the product smoke then that goal began to turn to the flavor, which gives aroma and distinctive taste and prevents rancidity of the meat due to the oxidation of fat. Fumigation can be performed both traditional and modern. Traditional fumigation can be done in the cold and heat by burning wood or sawdust, where the smoked fish direct contact with the smoke. While modern fumigation using liquid smoke as the public media smoke. General perform fumigation with traditional fumigation techniques. Though the technique of curing it has a lot of shortcomings, among other things take a long time, is not efficient in the use of firewood, the uniformity of the product to produce color and flavor desired difficult to control, environmental pollution, and the most dangerous is the residual tar and hydrocarbon compounds polycyclic aromatic (*Benzo(a) pyrene*) were deposited in food that can be harmful to health. Based on the above conditions, the fogging technique it is time to be replaced with modern fumigation.

One of the ways modern fumigation done with the use of liquid smoke. The advantages of using liquid smoke Award smoke flavor in fish, the use of more practical because only by spraying, dipping, soaking the fish in a solution of liquid smoke, followed by heating. The development of liquid smoke more rapidly in the preservation of foodstuffs, due to the costs required for timber and equipment manufacture more efficient smoke, harmful components can be separated or reduced before being used in food as well as the composition of the liquid smoke is more consistent for repeated use [3]. The results of the study Budaraga *et.al*., [4] to get the purification of liquid smoke cinnamon on the distillation temperature of 140^{o}C have undetectable levels of *benzo (a) pyrene*. Modern fogging is fumigation with the gas phase (gas phase smoke) or fumigation with liquid smoke (liquid smoke). Fumigation with the liquid smoke made by soaking the product in liquid smoke that has been disbursed through pyrolysis and distillation process [3]. Fumigation this way can improve the quality of products in terms of health because of carcinogenic compounds such as *benzo(a)pyren* contained in the liquid smoke can be absorbed and reduced in number, while the tar can be separated by using sedimentation and filtration [5].

Some research on the production and use of liquid smoke has been carried out include the determination of the temperature and time of pyrolysis of rubber wood to produce liquid smoke quality [6], the study of raw materials cinnamon at a temperature pyrolysis 400oC produce quality liquid smoke [7], the study wood sweet with a temperature pyrolysis of 400^{o}C at concentrations of 1500 ppm showed the highest antioxidant amounted to 35.091% [8], the determination of antibacterial properties of liquid smoke produced from several kinds of soft wood [9], the preservation of the tongue smoked with liquid smoke produced from teak [10] , Budaraga al al., [11]research results to get the dominant content of liquid smoke coconut husks, coconut shell and cinnamon contains acetic acid and phenol. Further research Budaraga *et al*., [12] to get the cytotoxic properties (the ability to kill *Artemia salina*) liquid smoke cinnamon at 400^{o}C temperature pyrolysis of 19.048%. These studies all utilize hardwood and softwood separately. Whereas softwood with low lignin content will be very effective to extend the lasting power of fish and produce flavor which is not typical [13] when combined with other wood (hardwood).

Based on the above research, the cinnamon is ideal to use as a preservative. According Budaraga *et al*., [14] to get the liquid smoke toxicity cinnamon purified by precipitation during the 3-day 83.75%. Results antioxidant liquid smoke cinnamon in a manner different purification produces antioxidants that are strong enough (<50 ppm) Budaraga *et.al*., [15]. Furthermore, the results of research Budaraga *et.al*., [16] to get the measurement results on the antibacterial properties of E. coli liquid smoke cinnamon purified by precipitation for 3 days resulted in inhibition diameter 34.129 mm / ppb. Their immersion in liquid smoke concentration right cinnamon continued with the type of packaging and different storage time will affect the yield and moisture content. The results of the study [17] showed the absence of good packaging during storage will increase the

water content of the product. The purpose of this research know the effect of combined treatment of liquid smoke concentration, soaking time, types of packaging and storage differently to yield properties, the water content of tilapia *fillet*s.

II. Materials and Methods

The materials used for the manufacture of fish is tilapia *fillet*s black bought at the market bottom of the crocodile with an average weight of 250 grams / fish, 70% alcohol, salt, water and liquid smoke cinnamon purified by distillation temperature of 140^{o}C. The tools used in this study are: a. Tool at to manufacture preservative solutions flask, glass beaker, beakers, pipettes, pip*et a*nd mixer.b. Equipment for the manufacture of fish *fillet* was basins, pans, mixers, stainless steel knives, water heating, cutting boards, work desks, spray equipment, pan drainer, freezer, and analytical scales. c. Equipment for drying of tilapia *fillet*s: briquette stove heat resistance [18], a drying oven tool length 240 x width 100 x height 80 cm equipped with a temperature gauge copper 200^{o}C [19]. d.Alat for packaging and storage: storage racks, plastic polyethylene, polypropylene plastic, paper labels, paper plates for a *fillet*. Another tool used in this study as a refrigerator for cooling, flask, oven, porcelain dish, desiccator, erlenmeyer 125 ml and 500 ml beaker.

2.1.Research methods

The experimental design used to use experimental factorial in a completely randomized design (CRD) consisting of a treatment concentration of liquid smoke fifth stage, soaking time 3 levels, types of packaging 3 levels and storage time 5 level in order to obtain 5 x 3 x 3 x 5 with 3 replications = 675 experimental units. The first factor is the concentration of liquid smoke control, 5% and 10%, 15% and 20%; The second factor is a long soaking period of immersion 5 minutes, 10 minutes and 15 minutes; The third factor is composed of a type of packaging without packaging, packaging polyethylene (PE) and polypropylene packaging (PP) and the fourth factor storage time (days) consisting of 0, 3, 6, 9 and 12 days. The data were analyzed by analysis of variance on the real level of 5%, when next significantly different by Tukey's test at 5 percent significance level [37].

2.2.Implementation Research.

2.2.1. Preparation of liquid smoke.

Before the pickling process tilapia *fillet*s prepared liquid smoke cinnamon purified by distillation temperature of 140^{o}C. The concentration of preservative liquid smoke used is smokeless liquid (control), 5%, 10%, 15% and 20%.

2.2.2. Preparation and preservation Tilapia *Fillet* with liquid smoke

The process of making *fillet*s of tilapia and preservation with liquid smoke cinnamon once packaging and storage is done with the following activities: implementation of activities begins with the preparation of materials and tools such as a desk, knives, cutting boards sterilized liquid smoke cinnamon. Prepared aqudest (control), liquid smoke 5%, 10%, 15% and 20%, Tilapia been in fresh condition refers to the SNI [20] on fresh fish and SNI specifications [21] on the raw material requirements.

As for how to manufacture *fillet*s of tilapia as follows: Selected fresh tilapia which has passed through the phase freezing (rigor mortis) and cleanliness be maintained, then washing it clean, then performed an incision behind the gill fins to the back of the head; front heads toward keekor incision along the dorsal fin using a stainless steel knife and a knife made parallel so separated from the ribs when taking *fillet*. Turn the fish, cut off the back fin gills until the head backward; The cut of the tail toward the head. Open the *fillet* by cutting towards the head with a knife close to the ribs, cutting through the bone of thorns. Furthermore *fillet* obtained immediately put to the cooler as soon as possible. To prevent a decline in quality, cleanliness *fillet* is always maintained. In this study using fish *fillet* blocks that form boneless *fillet*s. Avoid contamination which can easily infiltrate into the meat tissue and muscle meat that has been open to the whole fish. To reduce drip (water from the muscle tissue is lost in the frozen product melted) *fillet* do immersion in pure saline solution 10% for 20 seconds. Block in the form of fish, *fillet* transported easily stored and handled according to SNI [22]. Furthermore, fish blocks cut size of ± 5 x 10 cm with a thickness of ± 2 cm and be accorded treatment concentration of liquid smoke 5%, 10%, 15%, 20% and control (without liquid smoke) and combined with the soaking time 5 minutes, 10 minutes and 15 minutes. After completion of the immersion, the *fillet* is removed and drained and winds up dry *fillet* surface. *Fillet* of tilapia further arranged on the shelves of the oven so evenly, and dried at 70 °C for 6 (six) hours. After the *fillet*s of tilapia smoked dried kept cooled at room

temperature for ± 20 minutes to cool and placed on the container styre form and hygienic SNI [23], and then inserted into plastic packaging polyethylene (PE), plastic packaging polypropylene (PP) and without packaging further stored at room temperature and held observation started the day 0, 3 days, 6 days, 9 days and 12 days the yield was measured by comparing the *fillet* obtained with the initial raw material x 100 percent [24], the water content by the method Oven [25].

III. Results and Discussion

3.1. Yield (%) *fillet* of tilapia

3.1.1. Effect of soaking time and the concentration of liquid smoke to the yield.

At variance showed that the interaction effect of combined treatment of different concentrations of liquid smoke cinnamon soaking time to the yield (P <0.05), as well as in combination treatment with different concentrations of the old store. The combination of other treatments showed no significant effect on yield effect (P> 0.05). For a combination of 3 (three) and 4 (four) treatments showed no interaction. The average yield of *fillet* of tilapia were given treatment with liquid smoke concentration soaking time is presented in Table 1 below.

Table 1. Values of interaction the average recovery rate (%) *fillet* of tilapia based on the concentration of liquid smoke with different soaking time.

Factor	t concentration of liquid smoke (%) (L)					Mean	Interaction
and level	0 (L_0)	5 (L_1)	10(L_2)	15(L_3)	20(L_4)	L	(L * K)
5 minute (K_1)	69.483 ^{c}	69.276^{c}	65.201^{h}	68.261^{de}	61.792^{i}	66.80^{a}	2.67
10 minute (K_2)	69.178^{cd}	66.829^{g}	67.853^{ef}	65.245^{h}	66.556^{g}	67.13^{b}	0.96
15 minute (K_3)	73.686^{a}	66.278^{g}	66.991f^{g}	60.199^{j}	72.516^{b}	67.93^{c}	-0.44
mean (K)	70.78^{d}	67.46^{c}	66.68^{b}	64.57^{a}	66.95^{b}	67.29	
Interaction(K * L)	-0.27321	0.0333	0.0522	0.3058	-0.361		
CV = 1,92							

Description: Different superscript letters in the same row or column showed significant difference (P <0.05)

Based on Table 1 shows the interaction of soaking to produce liquid smoke concentration value of positive and negative interactions. Values of positive interaction means the concentration of liquid smoke treatment with soaking time together give a high enough response to the yield *fillet* produced than if the response given by each factor. Furthermore, in Table 1 shows the interaction of treatment without the administration of liquid smoke (control) in the long immersion for 15 minutes showed the value of the yield of fish *fillet*s highs of 73.686% and is statistically different from other treatments, while the value of the yield of the lowest on the interaction of treatment concentration of liquid smoke 20 % at 5 minutes soaking time of 61.792%. The low yield obtained allegedly caused by prolonged immersion is not so optimal as well as high concentrations of liquid smoke, so it will affect the content of the existing fish *fillet* so that the yield is low. This means that treatment with different concentrations of liquid smoke soaking time together affect yield levels in tilapia *fillet* smoked. Values interaction soaking time 5 minutes at different concentrations of liquid smoke give the highest positive interaction (2.56) than the value of the other interactions. This means that prolonged submersion tilapia *fillet*s for 5 minutes at a liquid smoke responded very well to yield. Furthermore, in contrast to the value of interaction of liquid smoke concentration of the different soaking time shows the value of positive and negative interactions is low.

According Hadiwiyoto [24] yield of fish can be defined as the weight ratio between meat and whole fish weight. The calculation of the yield used to estimate how much of the body of fish that can be used as a food ingredient. In a study conducted, used meat tilapia *fillet*s with skin. The more the frequency of washing (soaking the longer) then *fillet* yield obtained will fall. This is due at the time of the washing process, the meat component soluble in water such as blood, water soluble proteins (sarcoplasmic), dirt and grease can be dissolved together with the washing water. In addition, during the washing process, the water is in the ground beef will also reduced, leading to reduced weight of meat [26]. The elimination of water-soluble proteins, including enzymes, hemeprotein and non-protein nitrogen components other than products ranged 50-60% [27].

Increased frequency of washing will cause more and more components are dissolved together with the wash water as sarcoplasmic proteins, blood, pigment and also grease is wasted during washing [28].

3.1.2.The effect of different concentrations of the storage duration to the yield

The average value of the yield of *fillet* of tilapia in the treatment of liquid smoke concentration with different storage time is presented in Table 2.

Table 2. Value interactions average recovery rate (%) *fillet* of tilapia by different concentrations of liquid smoke with storage time

Factor and	Storage time (S) (day)					Mean	Interaction
Level	0 (S_0)	3 (S_1)	6(S2)	9(S_3)	12(S_4)	S	S x K
0 % (K_0)	71.048 [a]	70.966[a]	70.637[ab]	71.77[a]	69.491[b]	70.7824[a]	0.0753
5 %(K_1)	68.01[c]	67.816[cd]	67.523[de]	67.139[ef]	66.818[fg]	67.4612[b]	0.5504
10%(K_2)	67.61[cd]	67.183[fg]	66.561[gh]	66.26[gh]	65.794[hi]	66.6816[c]	0.7317
15%(K_3)	65.382[ij]	64.973[jk]	64.503[jk]	64.291[jk]	63.692[k]	64.5682[d]	0.6619
20%(K_4)	67.99[c]	67.129[ef]	67.149[ef]	66.589[gh]	65.918[hi]	66.955[c]	0.7583
Mean (K)	68.01[a]	67.61[ab]	67.27[b]	67.21[b]	66.34[c]		
Interaction K x S	-6.090	-6.033	-5.999	-5.976	-5.907		
CV = 1,92							

Description: Different superscript letters in columns averaging showed significant difference (P <0.05)

Table 2 shows the combined treatment of different concentrations of liquid smoke with storage time (lines) yields a value of positive interaction. Values of positive interaction means the concentration of liquid smoke treatment with storage time together give a high enough response to the yield of fish *fillet* produced than if the response given by each factor. In the combined treatment difference storage time of the different concentrations of liquid smoke (column) value negarif interaction. This means that the storage time difference factor with different concentrations of liquid smoke provides opposite response or responses given jointly lower than each of the factors. The results obtained in the highest yield without giving the interaction of liquid smoke concentration (control) on the storage time of 9 days amounted to 71.77% and is statistically significantly different from other treatments. Suharto [26] that the yield of fish varies according to the shape, age and condition before or after spawning. Fish that have elliptical yield of 60% and above, while the big-headed fish or fish that have flattened the meat yield of 30-40%.

The smallest yield results occurred in the treatment of liquid smoke concentration of 15% with a storage time of 9 days. This means that the longer the storage *fillet* of tilapia despite giving liquid smoke showed a drop in yield. A decrease in the yield figures mean any signs of damage to the nutrients contained in the *fillet* of tilapia. This result is different from the statements Anonymous [29] that the content of chemical compounds in the liquid smoke such as phenol, carbonyl, and acid has the ability to preserve and give color and flavor to foods such as fish products. In the process of curing the fish with liquid smoke, elements that play a role in improving the durability of fish is acid, phenol derivatives, and carbonyl. Chemical elements, among others, can take the role of flavor (aroma), color forming, antibacterial and antioxidant. The yield is influenced by the water content in the body of the fish, type of fish, the tools used, and handling during *fillet* fish [30]. Meat tilapia widely used for public consumption. Fish body has two types of meat is white meat and red meat. In freshwater fish rare red meat. White meat has the advantage of a high protein content and also have actin and myosin that form aktomiosin. Factors that influence the properties of the gel aktomiosin in fish is the protein concentration, pH, ionic strength, time and heating temperature [31].

3.2.Water Content.

3.2.1.The influence of the concentration of liquid smoke, long soaking and storage time at water content

From the analysis of variance moisture *fillet* of tilapia indicates that there is interaction triple combination treatment that differences soaking time, the concentration difference soaking and storage time showed a significantly different effect on water content (P <0.05), as well as the interaction of the combined treatment differences old immersion, different types of packaging and storage time while the combination of three treatments others all do not show the real effect (no interaction) on water content. The same thing happens

on a combination of four treatments showed no interaction. The average moisture content of tilapia *fillet*s on the treatment of liquid smoke concentration, soaking time and different storage time is presented in Table 3 below.

Table 3. The value of the average interaction of water content *fillet* of tilapia based treatment liquid smoke concentration, soaking time and different storage time.

Time (K)	**Conc (L)**	**Storage time (S) day**					**Mean**	**interaction**
Soaking (minute)	Liquid smoke (%)	0 (S_0)	3 (S_1)	6(S2)	9(S_3)	12(S_4)	L*S	L*S
	0 (L_0)	20.507 ^{a}	16.507 ^{b}	16.224 ^{b}	16.49 ^{b}	15.694 ^{b}	17.084	1.769
5 (K_1)	5 (L_1)	18.113 ^{ab}	16.397 ^{b}	16.218 ^{b}	16.778 ^{ab}	14.742 ^{b}	16.450	0.865
	10 (L_2)	17.507 ^{ab}	15.862 ^{b}	17.124 ^{b}	16.449 ^{b}	15.074 ^{b}	16.403	0.581
	15 (L_3)	15.687 ^{b}	16.343 ^{b}	16.533 ^{b}	16.791 ^{ab}	16.64 ^{b}	16.399	-0.501
	20 (L_4)	17.013 ^{ab}	15.872 ^{b}	16.689 ^{ab}	15.998 ^{b}	16.897 ^{ab}	16.494	0.201
Mean (K_1)		17.765	16.196	16.558	16.501	15.809	16.566	0.890
Interaction (B1*S)		-1.883	-0.265	0.249	-0.194	0.861	-0.246	
	0 (L_0)	16.218 ^{b}	18.072 ^{ab}	15.569 ^{b}	20.537 ^{a}	16.473 ^{b}	17.374	-1.408
10 (K_2)	5 (L_1)	16.211 ^{b}	17.532 ^{ab}	14.619 ^{b}	18.143 ^{ab}	16.467 ^{b}	16.594	-0.560
	10 (L_2)	17.118 ^{ab}	16.602 ^{b}	16.016 ^{b}	17.537 ^{ab}	15.98 ^{b}	16.651	-0.043
	15 (L_3)	16.527 ^{b}	17.246 ^{ab}	15.737 ^{b}	15.717 ^{b}	16.46 ^{b}	16.337	0.481
	20 (L_4)	16.682 ^{ab}	16.603 b	16.771 ^{ab}	17.043 ^{ab}	15.907 ^{b}	16.601	-0.005
Mean (K_2)		16.551	17.211	15.742	17.795	16.257	16.711	0.964
Interaction (B2*S)		-0.283	-0.500	-0.355	-0.246	-0.460	-0.369	
	0 (L_0)	14.448 ^{b}	20.517 ^{a}	16.466 ^{b}	16.468 ^{b}	16.473 ^{b}	16.874	0.001
15 (K_3)	5 (L_1)	14.609 ^{b}	18.123 ^{ab}	16.447 ^{b}	16.461 ^{b}	16.467 ^{b}	16.421	-0.410
	10 (L_2)	16.23 ^{b}	17.517 ^{ab}	15.959 ^{b}	17.368 ^{ab}	15.98 ^{b}	16.611	-0.148
	15 (L_3)	15.727 ^{b}	15.697 ^{b}	16.438 ^{b}	16.777 ^{ab}	16.46 ^{b}	16.220	-0.573
	20 (L_4)	14.539 ^{b}	17.023 ^{ab}	15.914 ^{b}	17.043 ^{ab}	15.907 ^{b}	16.085	-0.778
Mean (K_3)		15.111	-0.645	0.704	-1.883	-0.228	16.442	0.074
Interaction (B3*S)		0.260	-1.883	-0.223	0.293	-0.228	-0.356	
Mean	0 (L_0)	17.058	18.365	16.086	17.832	16.213	17.111	0.121
Konsentration	5 (L_1)	16.311	17.351	15.761	17.127	15.892	16.488	-0.035
Liquid smoke (L)	10 (L_2)	16.952	16.660	16.366	17.118	15.678	16.555	0.130
	15 (L_3)	15.980	16.429	16.236	16.428	16.520	16.319	-0.197
	20 (L_4)	16.078	16.499	16.458	16.695	16.237	16.393	-0.194
Interaction (L)		-0.458	-0.931	0.244	-0.595	0.135		
Mean								
Time soaking (K) Minute		16.476	17.061	16.182	17.040	16.108	16.573	
Interaction (B*L*S)		1.330	-0.790	0.157	-0.161	-0.224		
CV =11,86								

Description: The figure is followed by a different letter on the line or the same column indicate significant differences (P <0.05).

Based on Table 3 shows the value of the interaction of treatment concentration, soaking time and duration of storage of 3, 9, and 12 days produces a value of negative interactions, while the value of other interaction is positive. Values of positive interaction means treatment perbedan concentration, soaking time and

storage time jointly respond quite high on water content *fillet* of tilapia produced than if the response given by each factor, while the value of a negative interaction means that the response given by a third factors above are lower than the responses given by each factor. The lowest water levels (14.448%) indicated on the interaction of soaking 15 minutes, the concentration of liquid smoke 0% at 0 days storage time. Low levels of water obtained allegedly under the influence of drying is done with the oven went perfectly, then with increasing storage time will cause the water content further increased due to the binding process water from the outside environment so that the water content further rose.

Results of research conducted by Istihastuti *et all.*,[32] showed that the jerky is made from fish eel with different packaging (vacuum and non-vacuum) each containing a water content 20.33% and 20.54%. After being stored for 8 weeks each water content increased to 22.61% and 20.79%. When compared with the current study, the water content *fillet* Tilapia fish by 20.54% water content equal of the library.

3.2.2.Effect of soaking time, types of packaging and storage against moisture.

The value of the interaction of water content *fillet* of tilapia in the treatment of soaking time, types of packaging and storage of different presented in Table 4.

Table 4. The average interaction water content (%) *fillet* of tilapia by immersion duration, types of packaging and storage time is different.

Factor	Soaking	Time storage (S) (day)					Mean	Interaction
and Level	(minute) (K)	0 (S_0)	3 (S_1)	6(S2)	9(S_3)	12(S_4)	K*S	K*S
Control (whithout	5 (K_1)	17.765 ^{a}	16.219 ^{b}	18.771 ^{a}	16.325 ^{ab}	17.381 ^{a}	17.29	0.344
packaging)	10(K_2)	18.761 ^{a}	16.425 ^{a}	17.341 ^{a}	17.795 ^{a}	16.257 ^{b}	17.32	0.420
(B1)	15(K_3)	17.331 ^{a}	17.775 ^{a}	16.257 ^{b}	19.121 ^{a}	16.257 ^{b}	17.35	-0.412
Mean (B1)		17.952	16.806	17.456	17.747	16.632	17.319	0.109
Interaction (B1*L)		-0.289	1.037	-1.676	1.864	-0.759	0.035	
Packaging	5 (K_1)	17.765 ^{a}	16.167 ^{b}	15.478 ^{d}	16.589 ^{a}	16.268 ^{b}	16.45	0.450
PP (B2)	10(K_2)	15.468 ^{d}	16.923 ^{a}	15.941 ^{cd}	17.795 ^{a}	16.257 ^{b}	16.48	-0.798
	15(K_3)	16.066 ^{b}	17.775 ^{a}	16.257 ^{b}	15.895 ^{d}	16.257 ^{b}	16.45	0.372
Mean (B2)		16.433	16.955	15.892	16.760	16.261	16.460	0.348
Interaction (B2*L)		-1.133	1.072	0.519	-0.463	-0.007	-0.002	
Packaging	5 (K_1)	17.765 ^{a}	16.203 ^{b}	15.424 ^{ef}	16.589 ^{a}	13.779 ^{fg}	15.95	0.955
PE (B3)	10(K_2)	15.424 ^{ef}	18.285 ^{a}	13.944 ^{f}	17.795 ^{a}	16.257 ^{b}	16.34	-0.543
	15(K_3)	11.934 ^{g}	17.775 ^{a}	16.219 ^{b}	15.454 e	16.257 ^{b}	15.53	-1.104
Mean (B3)		15.041	17.421	15.196	16.613	15.431	15.940	0.239
Interaction (B3*L)		-3.887	1.048	0.530	-0.757	1.652	-0.283	
Mean	5 (K_1)	17.765	16.196	16.558	16.501	15.809	16.566	0.583
Timesoaking	10(K_2)	16.551	17.211	15.742	17.795	16.257	16.711	-0.307
(K)	15(K_3)	15.110	17.775	16.244	16.823	16.257	16.442	-0.382
Interaction (K)		-1.770	1.053	-0.209	0.215	0.299		
Mean (S)		16.475	17.061	16.181	17.040	16.108	16.573	
Interaction (B*L*K)		1.460	-0.307	1.130	0.567	0.600		
CV =11,86								

Description: Different superscript letters in columns averaging showed significant difference (P <0.05)

Based on Table 4 shows the combination of soaking treatment with different types of packaging on the storage of 3 days resulted in a negative interaction value, while the value of other interaction is positive. Values of positive interaction means of soaking treatment, types of packaging and storage together provide a high enough response to water content *fillet* of tilapia produced than if the response given by each factor. Furthermore, the data on average moisture content of tilapia *fillet* lowest obtained at treatment packaging in plastic bags of polyethylene (PE) in the soaking time for 15 minutes with 0 days of storage (11.934%) and was statistically different from the other treatment combinations. Low levels of water obtained allegedly due to the influence of drying are given, as well as the initial deposit so that there is no effect of the absorption of water made by *fillet*. This is in accordance with the opinion of Winarno [2] which states that the packaging of vacuum would impede the transfer or absorption of water by the product of the environment or the surrounding air. During storage 0 days, the *fillet* without soaking time is packed with 10 minutes showing the highest water content of 18.761% and is statistically demonstrated their interaction significantly ($P < 0.05$). This means that the treatment prolonged submersion with the type of packaging and storage of different influence jointly on water content of tilapia *fillet*s. Besides the packaging is not unduly influenced by outside air humidity. While on products that are not packaged in plastic bags, the water content of the product will be higher because of the absence of packaging as a barrier against humidity from outside. According to Nugroho [33] says that soaking the material in the fluid will cause the material to experience volume expansion due to moisture absorption. So the longer the soaking time will increase the water submerged. Further material is dried fish *fillet* with oven so that the water levels will decrease after a given drying. In the opinion of Esminingtyas [34] the water content in foodstuffs affects the durability of the food against microbial attack. This is one reason the food processing, water is often removed or reduced by evaporation or drying using a drying temperature is rather high. According to the Indonesian National Standard requirements 2725.1.2009 that smoked tilapia products have a maximum moisture content% mass fraction of 60%, so that research results tilapia *fillet*s into the Indonesian National Standard.

3.2.3.Effect of soaking time and duration of storage on water content

The value of the interaction of water content *fillet* of tilapia in the treatment of soaking time, types of packaging and different storage time is presented in Table 5.

Table 5. The value of interaction average water content of tilapia *fillet* based difference prolonged submersion in liquid smoke with storage time

Factor	Time storage(S) (day)					Mean	Interaction
and level	0 (S_0)	3 (S_1)	6(S_2)	9(S_3)	12(S_4)	S	S*K
5 minute (K_1)	17.765 ^{a}	16.196 ^{bcd}	16.558 ^{abc}	16.501 ^{abcd}	15.81 ^{bcd}	16.566	0.359
10 minute (K_2)	16.551 ^{abc}	17.211 ^{ab}	15.742 ^{cd}	17.795 ^{a}	16.257 ^{bcd}	16.711	-0.106
15 minute (K_3)	15.11 ^{d}	17.775 ^{a}	16.245 ^{bcd}	16.823 ^{abc}	16.257 ^{bcd}	16.442	0.250
Mean (K)	17.061	16.182	17.040	16.108	16.108	16.573	
Interaction (K*S)	0.087	-0.034	-0.030	0.059	0.000		
CV =11,86							

Description: Different superscript letters in columns averaging showed significant difference ($P < 0.05$)

Based on Table 5 shows the treatment combination of soaking the storage time is different produce value the interaction of positive and negative, value positive interaction means the treatment of soaking and storage time jointly respond quite high on water content *fillet* of tilapia produced than if the response given by each factor, while the value of negative interactions mean responses given by the two treatments is quite weak when compared to the response given by each factor. Furthermore, in Table 5 shows the interaction of soaking 15 minutes with 0 days storage time showed the lowest water content of 15.11% and is statistically different from the other treatments. Low water levels on *fillet* of tilapia at the beginning of a new storage allegedly because the initial process of storage after drying so that moisture storage space not affect the water content. Another factor is suspected that the water content in *fillet*s of tilapia is influenced by many factors. Water is an important component in food that can affect the appearance, texture, and flavor of food. In addition, water

levels also affect the durability of a material and demonstrate the stability and quality index of foodstuffs. Materials with high water content will be more easily damaged than the material at low moisture content [2]. The water content in foodstuffs in determining acceptability, freshness and durability of the material [35]. The higher the moisture content of a foodstuff, the received power, freshness and durability of food was getting low. This is one reason why the food processing, water is often removed by evaporation and drying [2]. The water is an important component in foods that can affect the texture, appearance, aroma, and flavor of food. The water content in food influence the quality and shelf life of the food. Therefore, the determination of moisture content of a food is very important for the processing and distribution got the right treatment. Determination of water content in food is done by a drying method (with a regular oven).

3.2.4.The influence of the type of packaging and storage time on water content

Furthermore, the interaction of the average water content (%) *fillet* of tilapia occurred between the type of packaging with the storage time, the following is presented in Table 6.

Table 6. The average interaction water content (%) *fillet* of tilapia based on different types of packaging with storage time

Factor	Time storage (S) (day)					Mean	Interaction
and level	0 (S_0)	3 (S_1)	6(S_2)	9(S_3)	12(S_4)	S	S*B
Control (KK) (B_1)	17.953 ^{a}	16.806 ^{abcde}	17.457 ^{abc}	17.747 ^{ab}	16.632 ^{abcde}	17.319	-0.008
Packaging PP (B_2)	16.433 ^{bcdef}	16.955 ^{abcd}	15.892 ^{def}	16.76 ^{abcde}	16.261 ^{cdef}	16.460	0.077
Packaging PE (B_3)	15.041 ^{f}	17.421 ^{abc}	15.196 ^{f}	16.613 ^{abcde}	15.431 ^{ef}	15.940	0.365
Mean (B)	16.476	17.061	16.182	17.040	16.108	16.573	
Interaction (B*S)	-0.176	0.037	-0.137	-0.069	-0.073		
CV =11,86							

Description: Different superscript letters in columns averaging showed significant difference (P <0.05)

Based on Table 6 without giving the value of the interaction of packaging on *fillet* of tilapia with different storage time shows the value of negative interactions and other types of packaging such as PP and PE packaging shows the value of positive interaction. For a long interaction value store 3 days with different soaking time give positive interaction, while the other shows the value of negative interactions. If the value of positive interaction means both treatments together to respond to water content while the value of a negative interaction means both equal treatment gives no response or the response given jointly by the two factors is lower compared to the response given by each factor. The water content of the lowest fish *fillet*s obtained on the interaction of plastic packaging polyethylene (PE) at 0 days storage time of 15.041% and is statistically different from the other treatments. Low water levels at the beginning of storage for the initial deposit has been no influence of outside air humidity in addition to the new *fillet* drying-out experience that a low water content. Other contributing factors to moisture reduction occurs because of the evaporation of water on the material. Winarno accordance with the opinion [35] that the water content in foodstuffs in determining acceptability, freshness and durability of materials. In general, data tilapia *fillet*s water content tends to further increase with the length of storage. The increase in water content with the longer storage of materials suspected of tilapia *fillet*s that have been given liquid smoke occurs binding moisture from the environment so that the moisture content increases. According Natawiria [36] the increase in water content with increasing storage time due to the effect of air humidity storage, then the absorption of moisture from the air into the flesh of tilapia filet liquid smoke so that it becomes moist and water content increases.

IV.Conclusion.

1. There was an interaction effect of combined treatment of different concentrations of liquid smoke cinnamon soaking time to the yield (P <0.05), as well as in the combination treatment of different concentrations of the storage time is different. The combination of other treatments showed no significant effect on yield effect (P> 0.05). For a combination of 3 (three) and 4 (four) treatments showed no interaction.
2. Value the highest yield obtained in the combination treatment of 15 minutes at a soaking time without soaking liquid smoke (liquid smoke concentration 0%) of 73.686% was significantly different from other treatments, combination treatment of liquid smoke concentration 0% (without liquid smoke) with storage time 9 days amounted to 71.77% significantly different from other treatments, while the combination of other treatments were not significantly different.
3. There is an interaction on a combination of four treatments, the difference of soaking, soaking concentration differences, types of packaging and storage to water content (P <0.05), but the interaction on a combination of three treatments soaking time differences, differences in the concentration and duration of storage on levels water. Interactions also occur in prolonged submersion, types of packaging and storage time while the combination of two, three other treatments did not show any interaction on water content.
4. Results of the lowest water levels in tilapia fish *fillet*s are on the average moisture content of tilapia *fillet* lowest obtained in the treatment of packaging in plastic bags of polyethylene (PE) in the soaking time for 15 minutes with 0 days of storage (11.934%), and levels of water preservation treatment results in a combination of four tilapia *fillet*s meet the Indonesian National Standard (SNI) 01-2725-1992 namely smoked fish a maximum moisture content of 60 percent

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