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Effect of Combination Treatment of Concentration Liquid Smoke, Immersion Duration, Packaging and Long Storage different Levels of Antioxidant Tilapia Fish Fillet (*Oreochromis niloticus*)

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Abstract : This study aims to determine of antioxidant content of fillet of tilapia (*Oreochromis niloticus*) given preservation with liquid smoke derived from a combination of liquid smoke treatment concentration, soaking time, types of packaging and storage time are different. This study was conducted experimentally using factorial experiment with a completely randomized design patterns (RAL) 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 consisting of Control (smokeless liquid / 0%), 5% and 10%, 15% and 20%; factor B consists of soaking time with liquid smoke is composed of three (3) levels ie soaking time 5 minutes, 10 minutes and 15 minutes; factor C consists of the type of packaging consists of three (3) levels ie without packaging (control), packaging polyethylene (PE) and packaging of polypropylene (PP) and factor D consists of the storage time (days) consists of 5 (five) levels ie 0 , 3,6,9 and 12 days. The parameters measured were the levels of antioxidant content. Results of research on the analysis of variance showed (1) there is an interaction of a combination of the two treatments on fillet of tilapia on levels of antioxidants ie long soaking and storage time while the two other treatment combinations that do not occur interaction. For a combination of three treatments on fillet of tilapia on levels of antioxidant interaction between soaking time, differences in the concentration and duration of storage, while for other combinations of the three treatments were no interaction. The interaction does not occur in four combination treatment of different concentrations, dipping time, storage time, and type of packaging on fillet of tilapia on levels of antioxidants. (2) the highest antioxidant levels in tilapia fillets on a combined treatment of soaking time 5 minutes, liquid smoke concentration of 20% (control / without packaging), polyethylene and polypropylene packaging and on storage 0 days at 69.836%.

Key words : fish fillet, immersion, concentration, packaging, storage, antioksidan.

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 fish. The result fillet processing such as fillets 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 good handling and preservation and processing into products ready to be eaten but durable power longer. One way of processing that has long been known to the public is the curing of 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 done traditionally or in modern [3]. 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 (steam dispersion in the fluid as a result of condensation of smoke from wood pyrolysis) as media fumigation . Generally wider communit, especially the coastal communities do 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)pyren*) deposited in food that can be harmful to health. In areas producing smoked fish, in order to meet the source of the smoke (wood) many people who cut down trees, even be protective coastal mangroves were not spared from logging target. These circumstances make alternative use of firewood has to be considered as well as fogging technique was time to be replaced with modern fumigation.

The use of liquid smoke broader application to replace the traditional way of curing. With the provision of liquid smoke aroma smoke on fish would be more practical because only by spraying or dipping 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 [4].

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 the process of pyrolysis and distillation [4]. 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 400^{o}C produce quality liquid smoke [7], the study wood sweet with a temperature pyrolysis of 400^{o}C at concentrations of 1500 ppm showed antioxidant teringgi 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 research results et al, [11] to get the dominant content of liquid smoke coconut husks, coconut shell and cinnamon contains acetic acid and phenol. Further research Budaragaet.al., [12] to get the cytotoxic properties (the ability to kill Artemiasalina) liquid smoke cinnamon at 400oC 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. The results of further research Budaraga et al, [14] to get the purification of liquid smoke cinnamon on the distillation temperature of 140^{o}C have undetectable levels of *benzo(a)pyrene*. Further research Budaraga et al, [15] 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, [16]. Furthermore, the results of research Budaragaet.al., [17] 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 cinnamon right would affect the levels of antioxidants and so far there is no information about it.

The next process followed by drying the fillets of tilapia resulting in decreased water levels expected product microbial activity is inhibited, resulting in a longer lasting power products. During this time the nature of the community is still traditional fish processing, fish fillet products in the form of beef jerky is usually not packaged properly so easily contaminated by microorganisms which will result in reduced power durable besides that do not pay intention shelf. Besides the water content of the product is still relatively high. To obtain a lower water content, then fillet products were not made in the form of a thick but in the form of thin slices. It is intended that the liquid smoke cinnamon can more rapidly penetrate into slices of fillet of tilapia, as well as the drying process faster. With the form of the product in the form of thin slices of fillet, hoped no bones were shipped, all the edible parts and form a thin more attractive for consumers. Contamination with microbes and other damage can be prevented by packing with a plastic bag. It remains no information about the type of packaging and storage right on the antioxidant content of tilapia fillet stuffed with liquid smoke. The results of the study [18] showed no packaging was good at cooking spices during storage will cause a loss of quality. The purpose of this study to determine the levels of antioxidants smoked fillet of tilapia given combined treatment of liquid smoke concentration, soaking time, types of packaging and storage time are different.

II. Result and Methods

The materials used for the manufacture of fish is tilapia fillets black bought at the market bottom of the crocodile with an average weight of 250 grams / fish, alcohol 70%, salt, water and liquid smoke cinnamon purified by distillation temperature of 140^{o}C. The tools used in this study are: a. Equipment for the manufacture of preservative solutions flask, glass beaker, beakers, pipettes, propipet and pengaduk.b. Equipment for the manufacture of fish filet 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 fillets: briquette stove heat resistance [19], a drying oven tool length 240 x width 100 x height 80 cm measurement device 200^{o}C [20]. d. Equipment for packaging and storage: storage shelves, polyethylene, polypropylene plastic, paper labels, paper plates for a fillet. Another tool used in this study such as, refrigerator coolers, freezers, flask, cup petridist, electric stove, filter paper, oven, burette, incubators, ovens, porcelain dish, desiccator, filter, thermometer, erlenmeyer 125 ml and 500 ml, beaker, filter paper, soxhlet, test tubes, micro burette, pipette, pipette volumetric flask of 250 ml.

2.1. Method Research

The experimental design used in this study using factorial pattern in a completely randomized design (CRD) is a combination of liquid smoke concentration with soaking time, types of packaging and storage in order to obtain 5 x 3 x 3 x 5 x 3 trial replications = 675 experimental units. The first factor consisted of 5 (five) level is the concentration of liquid smoke control, 5% and 10%, 15% and 20%; The second factor of soaking with liquid smoke is composed of three (3) levels ie soaking time 5 minutes, 10 minutes and 15 minutes; The third factor type of packaging consists of three (3) levels ie without packaging, packaging polyethylene (PE) and polypropylene packaging (PP) and the factor of the place of storage time (days) consists of 5 (five) levels ie 0,3,6,9 and 12 days. The observed data in the form of the protein content analyzed by analysis of variance on the real level of 5%, when next significantly different by Tukey's test at 5 percent significance level [21].

2.2. Implementaion Research.

2.2.1. Preparation liquid smoke.

Before the pickling process fillet of tilapia with liquid smoke cinnamon purified by distillation temperature of 140^{o}C first prepare liquid smoke subsequent dilution with distilled water. The concentration of preservative liquid smoke used is smokeless liquid (control), 5%, 10%, 15% and 20%.

2.2.2. Make fillet of tilapia and preservation with liquid smoke

The process of making fillets of tilapia and preservation with liquid smoke cinnamon well as packaging and storage done in this study are as follows: In the conduct of research activities begins with the preparation of materials and tools such as a desk, knives, cutting boards that have been sterilized with alcohol 70% and cinnamon liquid smoke that has been purified. Prepared aqudest (control), liquid smoke concentration of liquid smoke 5%, 10%, 15% and 20%, Tilapia been in fresh condition refers to the SNI [22] on the specifications of

fresh fish and SNI [23] on the requirements of the raw material with the characteristics -ciri raw materials are clean, free of any odor indicating decay, is free of signs of decomposition and forgery, free from other natural properties that can reduce the quality and not harmful to health. Organoleptic characteristics of the raw material has a freshness: a) appearance: intact, convex eyes, bright white cutlet; b) The smell: specific fresh fish; c) texture: Solid, compact and elastic, with a weight of 250 ± 10 grams. As for how to manufacture fillets of tilapia as follows: Cultivated using fresh fish that has passed through the phase freezing (rigor mortis) and cleanliness is always maintained by weeding the scales of a fish, discarding the entrails, feces, and lining the wall of the stomach is black, then do the washing up clean to remove any remaining dirt, blood, loose scales and slime. Already 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 into the freezer -20 ° C as soon as possible. To prevent a decline in quality, cleanliness fillet is always maintained and in working to make fillets have to really pay attention to sanitary aspects such as using gloves, head, working table knife would have been made sterile by sprayed and rinsed with alcohol before starting the job.

In this study using fish fillets in the form of block ie boneless fillets. Avoid contamination which can easily infiltrate into the meat tissue and muscle meat that has been open to the whole fish. In the process of handling for each stage of work to keep the fish stay fresh is to protect from the sun, wind, other heat source to increase the temperature of the fish and once made fillet put in the freezer. To reduce drip (water from the muscle tissue is lost in the frozen product melted) fillet do immersion in pure saline solution 15% for 20 seconds.

This fillet construction work done quickly but carefully to avoid spoilage, contamination and defects due to carelessness which may adversely affect the product and to anticipate these things put in feezer. Waste obtained from pemfilettanbe removed from the processing to avoid contamination of the product.In blocks, fillets transported easily stored and handled SNI [24]. Furthermore, fish blocks are cut in the form of stick (size of ± 5 x 10 cm with a thickness of ± 2 cm) and are given treatment liquid smoke is a concentration of 5%, 10%, 15%, 20% and control (without liquid smoke) and combined with the long immersion different ie 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 fillets of tilapia smoked dry due to heating, fillet cooled at room temperature for ± 20 minutes to cool placed in a clean container styreform and hygienic [25], and then inserted into the packaging polyethylene (PE), polypropylene (PP) and without packaging shall be retained and held at room temperature observations began days 0, 3 days, 6 days, 9 days and 12 days to levels of antioxidants with DPPH [26].

III. Results and Discussion

3.1.Uji Antioxidants(%).

In the analysis of variance showed that the interaction of a combination of the two treatments, long soaking and storage time while the two other treatment combinations that do not occur interaction. For a combination of three treatments interaction between soaking time, differences in the concentration and duration of storage of the number of antioxidants (P> 0.05), while for other combinations of the three treatments were no interaction. The interaction does not occur in four combination treatment of different concentrations, dipping time, storage time, and type of packaging. The average value of the number of antioxidants fillet of tilapia on a combination of soaking treatment, konentrasi liquid smoke, types of packaging and different storage time is presented in Table 1 and Figure 1 below.

Table 1. Average value% inhibition (antioxidant) fillet of tilapia based on differences in the concentration of liquid smoke, prolonged submersion, types of packaging and storage

Type of Packaging (B)	Time (K) soaking (minute)	Concentration (L) liquid smoke (%)	Time storage (S) (day) 0 (S_0)	3 (S_1)	6(S_2)	9(S_3)	12(S_4)	Mean (L)/(K)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
		0 (L_0)	1.35	0.9	1.173	0.676	2.669	1.35
	5 (K1)	5 (L_1)	16.478	16.554	14.163	15.471	14.88	15.51
		10 (L_2)	34.487	30.859	31.213	30.266	30.62	31.49
		15 (L_3)	55.96	55.151	55.571	54.623	55.043	55.27
		20 (L_4)	69.836	68.347	68.803	67.854	68.31	68.63
	Mean 5 minute		35.62	34.36	34.18	33.78	34.30	34.45
control		0 (L_0)	1.44	0.675	2.837	0.814	0.723	1.30
(non	10 (K2)	5 (L_1)	14.395	15.699	15.111	16.034	16.102	15.47
packaging)		10 (L_2)	31.399	30.454	30.807	34.146	30.484	31.46
(KK)		15 (L_3)	55.69	54.746	55.165	55.721	54.907	55.25
		20 (L_4)	68.887	67.941	68.396	69.676	68.174	68.61
	Mean 10 minute		34.36	33.90	34.46	35.28	34.08	34.42
		0 (L_0)	3.094	1.083	0.631	0.904	0.769	1.30
	15 (K3)	5 (L_1)	15.34	16.257	16.328	13.93	15.242	15.42
		10 (L_2)	30.994	34.317	30.672	31.027	30.077	31.42
		15 (L_3)	55.286	55.841	55.029	55.45	54.5	55.22
		20 (L_4)	68.482	69.756	68.26	68.718	67.766	68.60
	Mean 15 minute		34.64	35.45	34.18	34.01	33.67	34.39
	Mean	0 (L_0)	1.96	0.89	1.55	0.80	1.39	1.32
	consentration	5 (L_1)	15.40	16.17	15.20	15.15	15.41	15.47
	liquid smoke	10 (L_2)	32.29	31.88	30.90	31.81	30.39	31.45
		15 (L_3)	55.65	55.25	55.26	55.26	54.82	55.25
		20 (L_4)	69.07	68.68	68.49	68.75	68.08	68.61
	Mean	5 (K_1)	34.45					
	time	10(K_2)	34.42					
	soaking (minute)	15(K_3)	34.49					
	Meantime storage		34.87	34.57	34.28	34.35	34.02	34.42
	Mean packaging control (KK)		34.45					
		0 (L_0)	1.349	0.899	1.172	0.677	2.668	1.35
	5 (K1)	5 (L_1)	16.477	16.554	14.163	15.471	14.88	15.51
		10 (L_2)	34.487	30.859	31.213	30.266	30.619	31.49
		15 (L_3)	55.96	55.15	55.57	54.623	55.042	55.27
		20 (L_4)	69.836	68.346	68.803	67.853	68.31	68.63
	Mean 5 minute		35.62	34.36	34.18	33.78	34.30	34.45
Packaging		0 (L_0)	1.439	0.585	2.836	0.814	0.724	1.28
PP	10 (K2)	5 (L_1)	14.394	15.699	15.11	16.034	16.101	15.47
		10 (L_2)	31.399	30.454	30.807	34.146	30.484	31.46

		15 (L_3)	55.69	54.745	55.164	55.721	54.907	55.25
		20 (L_4)	68.887	67.94	68.396	69.675	68.174	68.61
	Mean 10 minute		34.36	33.88	34.46	35.28	34.08	34.41
		0 (L_0)	3.094	1.082	0.631	0.904	0.769	1.30
	15 (K3)	5 (L_1)	15.34	16.256	16.328	13.93	15.241	15.42
		10 (L_2)	30.994	34.316	30.672	31.026	30.077	31.42
		15 (L_3)	55.285	55.841	55.029	55.45	54.5	55.22
		20 (L_4)	68.481	69.756	68.26	68.718	67.766	68.60
	Mean 15 minute		34.64	35.45	34.18	34.01	33.67	34.39
	Mean	0 (L_0)	1.96	0.86	1.55	0.80	1.39	1.31
	consentration	5 (L_1)	15.40	16.17	15.20	15.15	15.41	15.47
	liquid smoke	10 (L_2)	32.29	31.88	30.90	31.81	30.39	31.45
		15 (L_3)	55.65	55.25	55.25	55.26	54.82	55.25
		20 (L_4)	69.07	68.68	68.49	68.75	68.08	68.61
	Mean	5 (K_1)	34.45					
	time	10(K_2)	34.41					
	soaking (minute)	15(K_3)	34.39					
	Meantime storage		34.87	34.57	34.28	34.35	34.02	34.42
	Mean packaging control (PP)		34.42					
		0 (L_0)	1.349	0.899	1.172	0.677	2.668	1.35
	5 (K1)	5 (L_1)	16.477	16.554	14.163	15.471	14.88	15.51
		10 (L_2)	34.487	30.859	31.213	30.266	30.619	31.49
		15 (L_3)	55.96	55.15	55.57	54.623	55.042	55.27
		20 (L_4)	69.836	68.346	68.803	67.853	68.31	68.63
	Mean 5 minute		35.62	34.36	34.18	33.78	34.30	34.45
Packaging		0 (L_0)	1.439	0.585	2.836	0.814	0.724	1.28
PE	10 (K2)	5 (L_1)	14.394	15.699	15.11	16.034	16.101	15.47
		10 (L_2)	23.41	95.19	62.15	20.9	80.75	56.48
		15 (L_3)	25.36	76.34	45.04	10.46	63.83	44.21
		20 (L_4)	19.06	55.73	32.73	8.18	54.61	34.06
	Mean 10 minute		16.73	48.71	31.57	11.28	43.20	30.30
		0 (L_0)	3.093	1.082	0.632	0.904	0.769	1.30
	15 (K3)	5 (L_1)	15.339	16.256	16.328	13.93	15.241	15.42
		10 (L_2)	30.994	34.316	30.672	31.026	30.077	31.42
		15 (L_3)	55.285	55.841	55.029	55.449	54.5	55.22
		20 (L_4)	68.481	69.756	68.26	68.718	67.766	68.60
	Mean 15 minute		34.64	35.45	34.18	34.01	33.67	34.39
	Mean	0 (L_0)	24.53	23.45	23.98	23.49	23.19	23.73
	consentration	5 (L_1)	21.39	10.65	10.48	9.99	10.45	12.59
	liquid smoke	10 (L_2)	29.60	43.17	30.94	17.31	36.94	31.59
		15 (L_3)	38.35	44.06	33.36	21.97	39.44	35.43
		20 (L_4)	40.81	53.35	45.09	37.08	52.13	45.69
	Mean	5 (K_1)	34.45					
	time	10(K_2)	30.30					

	soaking (minute)	15(K_3)	34.39					
	Meantime storage		29.00	28.05	21.92	15.09	25.62	23.94
	Mean packaging control (PE)		33.05					
	CV= 1,13							

Keterangan :Angka yang diikutiolehhuruf yang berbedapadabarisataukolom yang samamenunjukkanperbedaan yang nyata (P<0.05).

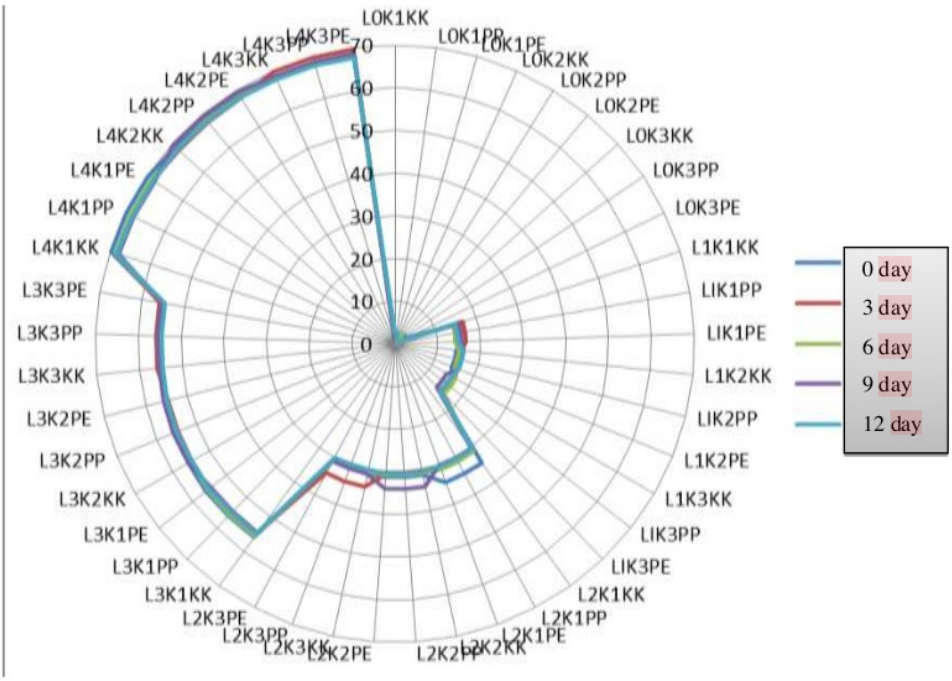

Figure 1. The average value of% inhibition (antioxidant) fillet of tilapia based on differences in the concentration of liquid smoke, prolonged submersion, types of packaging and storage

In Table 1 and Figure 1 shows the highest antioxidant levels in the combination treatment of soaking time 5 minutes, liquid smoke concentration of 20% (control / without packaging), polyethylene and polypropylene packaging and on storage 0 days amounted to 69.836%. High levels of antioxidants in the beginning of the storage at 20% concentration of liquid smoke with a soaking time 5 minutes on different types of packaging allegedly caused by the concentration of liquid smoke used is quite high, so a lot of liquid smoke are absorbed, causing high levels of antioxidants into. At the time of immersion for 5 minutes at the initial storage of liquid smoke yet many are missing so the antioxidant content becomes high. Lowest antioxidant levels in the combination treatment without following the granting of liquid smoke liquid smoke concentration of 5.10 and 15%, on a long soaking started 5,10 and 15 minutes, on different types of packaging, as well as on different storage time. The low content of antioxidants is suspected in the absence of treatment administration of liquid smoke or the provision of low concentration of liquid smoke so that the antioxidant content becomes lower. Measurement of antioxidant activity is characterized by color change from purple to yellow later in the absorbance using a wavelength of 517 nm [27]. The results of the analysis of antioxidant activity in each treatment combination in Table 1 and Figure 1 states that fillet of tilapia were given a combination of four treatments of soaking 5 minutes, the concentration of liquid smoke 20%, as well as on the type of packaging is different in storage time is different have antioxidant activity of 69 863% so it can be declared to have inhibitory activity of free radicals highest compared with the other four treatment combinations and statistically showed no significant difference. Percentage yield difference antioxidant levels is due to the difference in

treatment thus providing a different role on the antioxidant levels in tilapia fillets. According to Blois [28] that the substrate which has IC50 range of between 50 -100 ppm antioxidant classified as having strong activity.

Furthermore, the average value of the interaction of the antioxidant content of tilapia fillet based difference treatment of soaking the storage time is presented in Table 2 and Figure 2 below.

Table 2.Average value interaction antioxidant levels (%) fillet of tilapia based on the difference consentration asap liquid, long soaking and storage time.

Time (K)	Concentration (L)	Time storage (S) day					Mean	Interaction
soaking (minute)	liquid smoke (%)	0 (S^0)	3 (S^1)	6(S^2)	9(S^3)	12(S^4)	L*S	L*S
	0 (L^0)	1.349 ^{h}	0.899 ^{h}	1.172 ^{h}	0.677 ^{h}	2.669 ^{h}	1.353	-0.085
5 (K^1)	5 (L^1)	16.477 ^{g}	16.554 ^{g}	14.163 ^{g}	15.471 ^{g}	14.88 ^{g}	15.509	0.737
	10 (L^2)	34.487 ^{c}	30.859 ^{cdef}	31.213 ^{cdef}	30.266 ^{f}	30.619 ^{def}	31.489	1.736
	15 (L^3)	55.96 ^{b}	55.15 ^{b}	55.57 ^{b}	54.623 ^{b}	55.043 ^{b}	55.269	0.556
	20 (L^4)	69.836 ^{a}	68.346 ^{a}	68.803 ^{a}	67.853 ^{a}	68.31 ^{a}	68.630	0.800
Mean 5 minute		35.622	34.362	34.184	33.778	34.304	34.450	1.153
Interaction (K^1*S)		35.291	34.698	35.334	34.701	34.289	34.863	
	0 (L^0)	8.606 ^{abc}	6.822 ^{abc}	10.275 ^{abc}	6.718 ^{abc}	6.864 ^{abc}	1.286	0.228
10 (K^2)	5 (L^1)	16.126 ^{ab}	6.631 ^{abc}	10.460 ^{abc}	5.386 ^{c}	6.888 ^{abc}	15.468	-0.736
	10 (L^2)	7.412 ^{abc}	6.085 ^{bc}	7.391 ^{abc}	6.860 ^{abc}	6.091 ^{bc}	31.458	-1.105
	15 (L^3)	6.550 ^{abc}	6.200 ^{bc}	7.215 ^{abc}	7.711 ^{abc}	6.200 ^{bc}	55.246	-0.045
	20 (L^4)	7.093 ^{abc}	7.613 ^{abc}	7.587 ^{abc}	6.896 ^{abc}	7.627 ^{abc}	68.614	-0.362
Mean 10 minute		34.362	33.891	34.463	35.278	34.078	34.414	0.140
Interaction (K^2*S)		35.238	34.739	34.235	35.482	34.741	34.887	
	0 (L^0)	3.094 ^{h}	1.082 ^{h}	0.631 ^{h}	0.904 ^{h}	0.769 ^{h}	1.296	0.939
15 (K^3)	5 (L^1)	15.339 ^{g}	16.256 ^{g}	16.328 ^{g}	13.93 ^{g}	15.242 ^{g}	15.419	0.766
	10 (L^2)	30.994 ^{cdef}	34.317 ^{cd}	30.672 ^{cdef}	31.026 ^{cdef}	30.077 ^{f}	31.417	0.835
	15 (L^3)	55.285 ^{b}	55.841 ^{b}	55.029 ^{b}	55.45 ^{b}	54.5 ^{b}	55.221	0.202
	20 (L^4)	68.481 ^{a}	69.756 ^{a}	68.26 ^{a}	68.718 ^{a}	67.766 ^{a}	68.596	0.303
Mean 15 minute		34.639	35.450	34.184	34.006	33.671	34.390	-1.013
Interaction(K^3*S)		34.144	35.387	34.792	35.430	34.650	34.880	
Mean	0 (L^0)	1.961	0.865	1.546	0.798	1.387	1.312	0.361
concentration	5 (L^1)	15.404	16.170	15.200	15.145	15.408	15.465	0.256
liquid smoke	10 (L^2)	32.293	31.877	30.897	31.813	30.393	31.455	0.489

	15 (L^3)	55.645	55.246	55.254	55.265	54.817	55.245	4.238
	20 (L^4)	69.068	68.681	68.486	68.749	68.083	68.613	0.247
Interaction (L)		34.891	34.942	34.787	35.204	30.560		
Mean								
time		34.874	34.568	34.277	34.354	34.018	34.418	
soaking (minute)								
Interaction (K*L*S)		0.490	-0.544	0.000	-0.114	0.317		

Description: Figures followed by different letters in the same row or column showed significant differences (P <0.05)

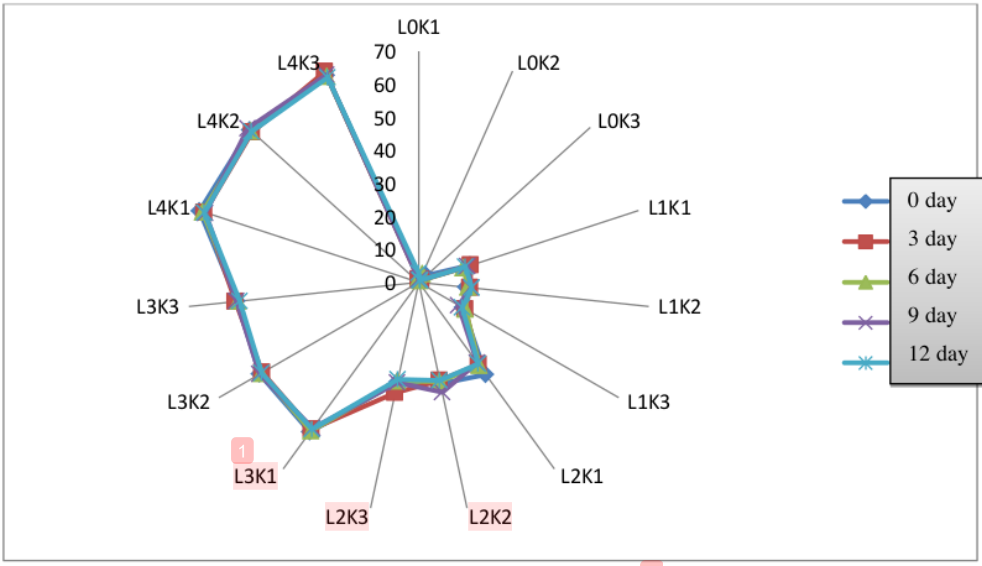

Figure 2.Average value interaction antioxidant value (%) fillet of tilapia based on differences in the concentration of liquid smoke, long soaking and storage time.

In Table and Figure 2 shows the highest antioxidant levels found in the combination treatment of soaking time 5 minutes, liquid smoke concentration of 20% at 0 days storage time of 69.863%. In the combined treatment of tilapia fillets with no treatment given liquid smoke administration shows no signs of antioxidants, then the antioxidant levels increased when their treatment increased concentration of liquid smoke from 5, 10 and 15% on a long soaking 5,10 and 15 minutes, on a different storage periods , Testing of antioxidant activity using DPPH (2,2-diphenyl-1-picrylhydrazyl). DPPH method is chosen because it is a method that is simple, easy, quick and sensitive and requires only a small sample to the evaluation of the antioxidant activity of the compounds of natural materials [26]. The principle of quantitatively measuring the antioxidant activity using DPPH method is the change in the intensity of the color purple DPPH is proportional to the concentration of the DPPH solution. DPPH free radicals that have unpaired electrons will give the color purple. The color will change to yellow when the electron pairs. Changes in the intensity of the purple color is due to the reduction of free radicals generated by DPPH molecules reacting with hydrogen atoms released by the sample molecule compounds to form compounds Diphenylpikril hydrazine and cause decay DPPH color from purple to yellow. This color change will provide a change of absorbance at a wavelength of maximum DPPH using UV-Vis spectrophotometry so they will know the value of the activity of free radicals reduction expressed by IC50 (Inhibitory Concentration) [26].

Furthermore, the average value of the interaction of antioxidants (mEq / mg) fillet of tilapia by treatment with different concentrations of liquid smoke storage time is presented in Table 3 and Figure 3, below.

Table 3. The value of the average interaction levels of antioxidants (%) fillet of tilapia based on the difference of soaking with liquid smoke with storage time.

Concentration (L)	Timesimpan (S) (day)					Mean	Interaction
(%)	0 (S^0)	3 (S^1)	6(S^2)	9(S^3)	12(S^4)	(S)	S*L
5 (L^1)	35.622 a	34.362 abcd	34.184 bcd	33.778 d	34.304 abcd	34.450	0.256
10(L^2)	34.362 abcd	33.891 cd	34.463 abcd	35.278 abc	34.078 bcd	34.414	-0.212
15(L^3)	34.639 abcd	35.45 ab	34.184 bcd	34.006 cd	33.671 d	34.390	0.740
Mean (L)	34.568	34.277	34.354	34.018	34.018	34.418	
Interaction (L*S)	-0.017	-0.094	0.017	0.077	0.025	0.001	

Description: Figures followed by different letters in the same row or column showed significant differences (P <0.05)

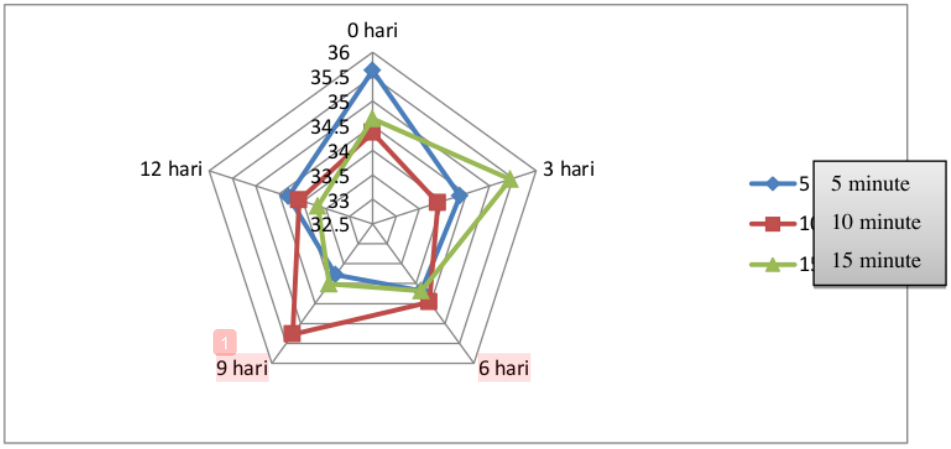

Figure 3. The value of the average interaction levels of antioxidants (%) fillet of tilapia based on the difference of soaking with liquid smoke with storage time.

Based on Table 3 shows the value of positive interaction more than the negative.Value of negative interactions as long soaking 10 minutes with different storage time means a response to the percentage of antioxidant resulting smaller when compared to the response of each factor. The results of positive interaction means that the treatment was carried out jointly between the soaking time with different storage time will give a faster response compared to each factor. The average value of the levels of antioxidants fillet of tilapia in Table 3 and Figure 3 are given the treatment prolonged submersion for 5 minutes with 0 days storage time gives a high of 35.622% and a statistically significant interaction. Results smallest antioxidant levels occur in the treatment of 15 minutes soaking time the storage time of 12 days amounted to 33.671%. This means that the storage time semakian on tilapia fillet dissertation with the longer soaking time will cause the lower levels of antioxidants. Score the lower the antioxidant allegedly for weakening the ability of antioxidants on fillet of tilapia on the oxidation of oxygen exposure. Antioxidants are substances that have a function as opposed to a substance called oxidants. Substances known as oxidants or free radicals are atoms or molecules that are very unstable (have one or more unpaired electrons), so as to obtain the electron pairs of these compounds are effective and tissue damage. Free radicals are generally only an intermediary that can be quickly converted into a substance which no longer harm the body. Large concentrations of antioxidants that are added can affect the rate of oxidation. Liquid smoke has antioxidative properties and can be classified as a natural antioxidant. Compounds that act as antioxidants are phenols, which is the main antioxidant in the liquid smoke [29]. Antioxidative role demonstrated by the high-boiling phenolic compounds, especially 2,6-dimetoksifenol; 2,6

dimethoxy-4-metilfenol and 2,6-dimethoxy-4-etilfenol which acts as a hydrogen donor against free radicals and inhibiting the chain reaction [30]. These compounds can inhibit the oxidation of fats, preventing lipid oxidation by stabilizing free radicals, and effectively prevent the loss of flavor due to oxidation of fat [31], [32].

IV. Conclusion.

1. There is an interaction of a combination of the two treatments on fillet of tilapia on levels of antioxidants ie long soaking and storage time while the two other treatment combinations that do not occur interaction. For a combination of three treatments on fillet of tilapia on levels of antioxidant interaction between soaking time, differences in the concentration and duration of storage, while for other combinations of the three treatments were no interaction. The interaction does not occur in four combination treatment of different concentrations, dipping time, storage time, and type of packaging on fillet of tilapia on levels of antioxidants.
2. The highest antioxidant levels in tilapia fillets on a combined treatment of soaking time 5 minutes, liquid smoke concentration of 20% (control / without packaging), polyethylene and polypropylene packaging and on storage 0 days at 69.836%.

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