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Effect of Combination Treatment of Concentration Liquid Smoke, Immersion Duration. Packaging and Old Type Storage different Levels of Fat Fish Tilapia Fillet (*Oreochromis niloticus*)

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Abstract : This study aims to determine the fat content 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 fat level. Results of research on the analysis of variance showed a). Combination treatment of soaking, the storage time shows the interaction of the fat content of tilapia fillets to the combination of two treatments while others show the influences that were not significantly different. b). Combination three (3) treatments, namely the concentration difference, long soaking and storage time shows the interaction of the fat content of tilapia fillets, while the combination of the third and four other treatments showed no interaction.
Key words : fish fillet, immersion, concentration, packaging, storage, fat.

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 it easily lived, rapidly proliferating, white meat and it was quite tasty. Processing methods can be developed against the fish is a fish fillet processing. Results fishery 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.

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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 community, 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 high 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 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 Budaraga et.al.,[12] to get the cytotoxic properties (the ability to kill Artemiasalina) 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. 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 Budaraga*et.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 observe 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 fat content of tilapia fillet smoked given combined treatment of liquid smoke concentration, soaking time, types of packaging and storage time are different.

II. Raw 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. Metode 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 fiber and ash 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.Action Research.

2.2.1.Preparation liquid smoke.

Before the pickling process fillet of tilapia with liquid smoke cinnamon purified by distillation temperature of 140oC 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.Making 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 filletbe 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 against the fat content [26].

3. Results and Discussion

3.1.Contentfat

At variance showed that the combined treatment of soaking time, the storage time shows the interaction of the fat content of tilapia fillets to the combination of two treatments while others show the influences that were not significantly different. For a combination of three (3) treatments, namely the concentration difference, long soaking and storage time shows the interaction of the fat content of tilapia fillets, while the combination of the third and four other treatments showed no interaction. The average value of the fat content of tilapia fillets on the treatment of soaking, liquid smoke concentration, types of packaging and different storage time is presented in Table 1 and Figure 1 below.

Table 1. Average fat content (%) of tilapia fillets soaking time difference effect of treatment, liquid smoke concentration, type of packaging with storage time.

Type	Time (K)	Concentration (L)	Time storage (S) (day)					Mean (L)/(K)
Pcakaging (B)	soaking (minute)	liquid smoke(%)	0 (S_0)	3 (S_1)	6(S_2)	9(S_3)	12(S_4)	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
		0 (L_0)	15,275	16,028	16,851	16,013	15,044	15,842
	5 (K1)	5 (L_1)	17,783	16,039	16,852	16,024	15,045	16,349
		10 (L_2)	16,684	13,752	12,486	13,759	12,261	13,788
		15 (L_3)	16,672	14,989	14,084	14,845	14,248	14,968
		20 (L_4)	14,612	19,496	14,486	19,494	15,325	16,683
	Mean 5 minute		16,205	16,061	14,952	16,027	14,385	15,526
Control		0 (L_0)	16,854	16,014	15,045	15,268	16,029	15,842
(non	10 (K2)	5 (L_1)	16,855	16,025	15,046	17,776	16,024	16,345
packaging)		10 (L_2)	12,489	13,760	12,262	16,677	13,744	13,786
(KK) (B1)		15 (L_3)	14,087	14,846	14,249	16,665	14,845	14,938
		20 (L_4)	14,489	19,495	15,326	14,605	19,489	16,681
	Mean 10 minute		14,955	16,028	14,386	16,198	16,026	15,519
		0 (L_0)	15,046	15,272	16,032	16,847	16,012	15,842
	15 (K3)	5 (L_1)	15,047	17,780	16,023	16,848	16,023	16,344
		10 (L_2)	12,263	16,681	13,741	12,482	13,758	13,785
		15 (L_3)	14,250	16,669	14,843	14,080	14,844	14,937
		20 (L_4)	15,327	14,609	19,470	14,482	19,493	16,676
	Mean 15 minute		14,387	16,202	16,022	14,948	16,026	15,517
	Mean	0 (L_0)	15,725	15,771	15,976	16,043	15,695	15,842
	concentration	5 (L_1)	16,562	16,615	15,974	16,883	15,697	16,346
	liquid smoke	10 (L_2)	13,812	14,731	12,830	14,306	13,254	13,787
		15 (L_3)	15,003	15,501	14,392	15,197	14,646	14,948
		20 (L_4)	14,809	17,867	16,427	16,194	18,102	16,680
	Mean	5 (K_1)	15,526					
	time	10(K_2)	15,519					
	soaking (minute)	15(K_3)	15,517					
	Meantimestorage		15,182	16,097	15,120	15,724	15,479	15,520
	Meanpcakaging control (KK)		15,521					
		0 (L_0)	15,275	16,049	20,251	16,046	10,484	15,621
	5 (K1)	5 (L_1)	17,783	16,097	20,253	16,017	10,485	16,127
		10 (L_2)	16,684	13,826	12,290	13,744	14,770	14,263
		15 (L_3)	16,672	14,942	11,876	14,834	14,805	14,626
		20 (L_4)	14,612	19,502	14,081	19,504	13,612	16,262
	Mean 5 minute		16,205	16,083	15,750	16,029	12,831	15,380
Pcakaging		0 (L_0)	20,253	16,047	10,485	15,268	16,047	15,620
PP (B2)	10 (K2)	5 (L_1)	20,255	16,018	10,486	17,776	16,095	16,126
		10 (L_2)	12,292	13,745	14,771	16,677	13,824	14,262
		15 (L_3)	11,878	14,835	14,806	16,665	14,940	14,625
		20 (L_4)	14,083	19,505	13,613	14,605	19,500	16,261
	Mean 10 minute		15,752	16,030	12,832	16,198	16,081	15,379
		0 (L_0)	10,486	15,272	16,048	20,250	16,045	15,620
	15 (K3)	5 (L_1)	10,487	17,780	16,096	20,252	16,016	16,126
		10 (L_2)	14,772	16,681	13,825	12,289	13,742	14,262
		15 (L_3)	14,807	16,669	14,941	11,875	14,833	14,625
		20 (L_4)	13,614	14,609	19,501	14,080	19,503	16,261
	Mean 15 minute		12,833	16,202	16,082	15,749	16,028	15,379
	Mean	0 (L_0)	15,338	15,789	15,595	17,188	14,192	15,620
	concentration	5 (L_1)	16,175	16,632	15,612	18,015	14,199	16,126
	liquid smoke	10 (L_2)	14,583	14,751	13,629	14,237	14,112	14,262
		15 (L_3)	14,452	15,482	13,874	14,458	14,859	14,625

		20 (L_4)	14,103	17,872	15,732	16,063	17,538	16,262
	Mean	5 (K_1)	15,380					
	time	10(K_2)	15,379					
	soaking (minute)	15(K_3)	16,262					
	Meantimestorage		14,930	16,105	14,888	15,992	14,980	15,379
	Meanpcakagingkontrol (PP)		15,674					
		0 (L_0)	15,275	16,024	14,732	15,978	15,294	15,461
	5 (K1)	5 (L_1)	17,783	16,025	14,734	16,010	15,295	15,969
		10 (L_2)	16,684	13,749	16,512	13,737	16,350	15,406
		15 (L_3)	16,672	14,844	14,688	14,798	15,011	15,203
		20 (L_4)	14,612	19,461	12,014	19,483	9,908	15,096
	Mean 5 minute		16,205	16,021	14,536	16,001	14,372	15,427
Packaging		0 (L_0)	14,734	15,979	15,295	15,268	16,049	15,465
PE (B3)	10 (K2)	5 (L_1)	14,736	16,011	15,296	17,776	16,050	15,974
		10 (L_2)	16,514	13,738	16,351	16,677	13,764	15,409
		15 (L_3)	14,690	14,799	15,012	16,665	14,946	15,222
		20 (L_4)	12,016	19,485	9,909	14,605	19,508	15,105
	Mean 10 minute		14,538	16,002	14,373	16,198	16,063	15,435
		0 (L_0)	15,296	15,272	16,022	14,730	15,977	15,459
	15 (K3)	5 (L_1)	15,297	17,780	16,023	14,732	16,009	15,968
		10 (L_2)	16,352	16,681	13,741	16,510	13,735	15,404
		15 (L_3)	15,013	16,669	14,843	14,686	14,797	15,202
		20 (L_4)	9,910	14,609	19,470	12,012	19,482	15,097
	Mean 15 minute		14,374	16,202	16,020	14,534	16,000	15,426
	Mean	0 (L_0)	14,711	16,374	15,683	15,354	16,521	15,729
	concentration	5 (L_1)	15,138	11,264	10,440	10,836	10,686	11,673
	liquid smoke	10 (L_2)	16,082	10,140	10,031	11,062	9,166	11,296
		15 (L_3)	15,322	10,489	9,952	10,450	9,914	11,225
		20 (L_4)	12,285	16,733	14,756	14,203	17,990	15,193
	Mean	5 (K_1)	15,427					
	time	10(K_2)	15,435					
	soaking (minute)	15(K_3)	15,426					
	Meantime storage		15,039	10,735	10,131	10,244	10,688	11,367
	Meanpackagingkontrol (PE)		15,429					
	CV = 22,18							

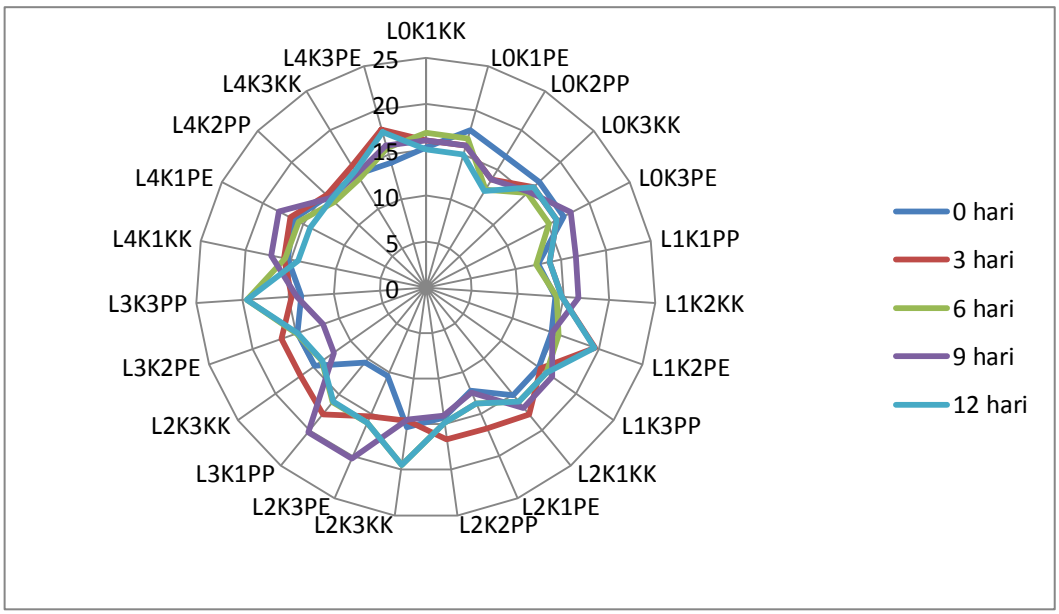

Figure 1. The average fat content (%) of tilapia fillets soaking time difference effect of treatment, liquid smoke concentration, type of packaging with storage time.

The average value of tilapia fillet fat content such as Table 1 and Figure 1 are given 5 minutes of soaking treatment at storage time 0 days, 3 days and 9 days provide the highest value and statistically showed an interaction. Results smallest fat levels occurred in the treatment of soaking time 10 minutes and 15 minutes on the storage of 0, 3 and 9 days. This means that the long immersion in liquid smoke with a soaking time did not show changes in fat content means. According Muchtadi[27] said fat is a food substance which is very important, because fat will produce high energy more effective than carbohydrates and protein, maintaining immunity, and human health. But fat can also cause damage to the food during processing and storage due to the possible oxidation.

The average value of fat fillet of tilapia in Table 1 are given the treatment of soaking 5 minutes at storage time 0 days, 3 days, and 9 days provide the highest value and statistically showed interactions. Results smallest fat levels occurred in the treatment of soaking time 10 minutes and 15 minutes on the storage of 0, 3, and 9 days. This means that the long immersion in liquid smoke with a soaking time did not show changes in fat content means. Tamaela[28] using liquid smoke to inhibit oxidation of tuna steak. The use of liquid smoke on dilution of 2.5 times can inhibit the oxidation of fat better on a tuna steak over the use of liquid smoke on dilution 5 times.

The average value of fat fillet of tilapia on a combination of soaking treatment with different concentrations of liquid smoke and different storage time is presented in Table 2 and Figure 2 below.

Table 2. Average value interaction fat content (%) of tilapia fillets treatment effect different concentrations of liquid smoke, 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
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	0 (L_0)	15.275 [a]	16.033 [a]	17.278 [a]	16.012 [a]	13.607 [a]	15.641	0.190
5 (K1)	5 (L_1)	17.783 [a]	16.054 [a]	17.280 [a]	16.017 [a]	13.609 [a]	16.149	1.195
	10 (L_2)	16.684 [a]	13.775 [a]	13.763 [a]	13.746 [a]	14.460 [a]	14.486	1.038
	15 (L_3)	16.672 [a]	14.925 [a]	13.549 [a]	14.826 [a]	14.688 [a]	14.932	0.786
	20 (L_4)	14.612 [a]	19.486 [a]	13.527 [a]	19.494 [a]	12.948 [a]	16.013	-0.645
Mean 5 minute		16.205	16.055	15.079	16.019	13.862	15.444	0.967
Interaction (K1*L)		-0.487	1.155	-2.247	1.155	-0.048	-0.094	
	0 (L_0)	17.280 [b]	16.013 [b]	13.608 [a]	15.268 [a]	16.041 [a]	15.642	0.799
10 (K2)	5 (L_1)	17.282 [b]	16.018 [b]	13.610 [a]	17.776 [b]	16.057 [a]	16.149	-0.205
	10 (L_2)	13.765 [a]	13.748 [a]	14.461 [a]	16.677 [a]	13.778 [a]	14.486	-1.171
	15 (L_3)	13.552 [a]	14.827 [a]	14.689 [a]	16.665 [a]	14.910 [a]	14.929	-1.262
	20 (L_4)	13.529 [a]	19.495 [a]	12.949 [a]	14.605 [a]	19.499 [a]	16.015	-0.431
Mean 10 minute		15.082	16.020	13.863	16.198	16.057	15.444	0.962
Interaction (K2*L)		-2.246	1.155	-0.048	-0.487	1.154	-0.095	
	0 (L_0)	13.609 [a]	15.272 [a]	16.034 [a]	17.276 [a]	16.011 [a]	15.640	-1.615
15 (K3)	5 (L_1)	13.611 [a]	17.780 [a]	16.048 [a]	17.277 [a]	16.016 [a]	16.146	-1.114
	10 (L_2)	14.462 [a]	16.681 [a]	13.769 [a]	13.760 [a]	13.760 [a]	14.486	0.865
	15 (L_3)	14.690 [a]	16.669 [a]	14.876 [a]	13.547 [a]	14.824 [a]	14.921	0.826
	20 (L_4)	12.950 [a]	14.609 [a]	19.480 [a]	13.524 [a]	19.493 [a]	16.011	-1.206
Mean 15 minute		13.864	16.202	16.041	15.077	16.021	15.441	-0.005
Interaction (K3*L)		-0.048	-0.487	1.144	-2.247	1.154	-0.097	
Mean	0 (L0)	15.388	15.773	15.640	16.185	15.220	15.641	-0.208
concentration	5 (L1)	16.225	16.617	15.646	17.023	15.227	16.148	-0.041
liquid smoke	10 (L2)	14.970	14.735	13.998	14.728	13.999	14.486	0.244
	15 (L3)	14.971	15.474	14.371	15.013	14.807	14.927	0.117

	20 (L4)	13.697	17.863	15.319	15.874	17.313	16.013	-0.761
Interaction (L)		-0.927	0.607	-0.383	-0.526	0.753		
Mean lama								
soaking (minute)		15.050	16.092	14.994	15.765	15.313	15.443	
Interaction (K*L*S)		1.170	-0.074	-0.481	0.471	-1.080		

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

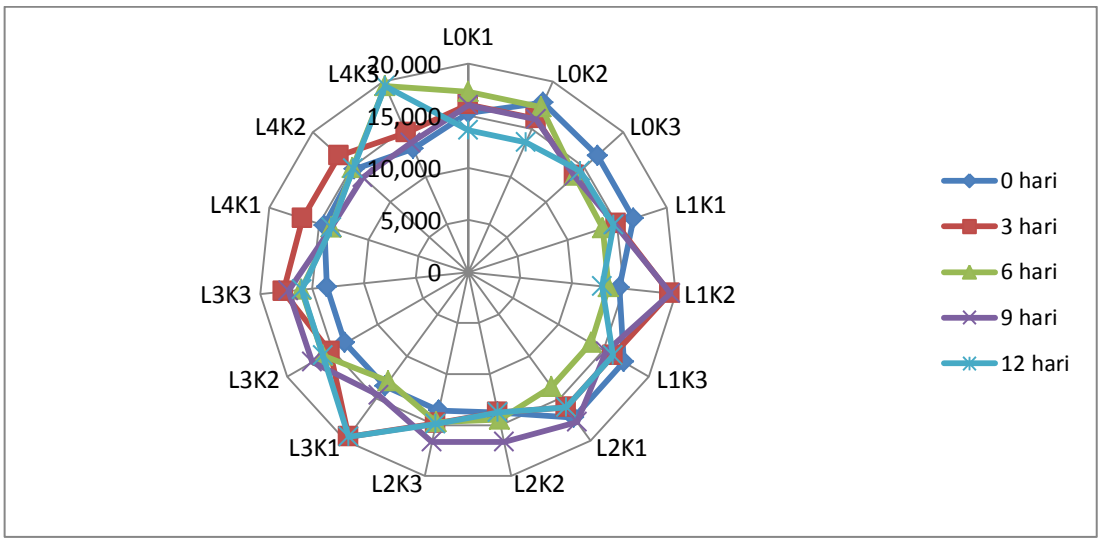

Figure 2. Average value interaction fat content (%) of tilapia fillets treatment effect different concentrations of liquid smoke, long soaking and storage time

Based on Table 2 above that treatment with different concentrations of soaking and storage time showed highly significant effect on levels of fat fillet of tilapia. Treatment differences in concentration, soaking time denngan storage time showed no interaction of the fat content. This means treatment with different concentrations of soaking and storage time together affect fat fillet of tilapia. In the treatment L4K2 (concentration of liquid smoke 20% on a long soaking 10 minutes) with a storage time of 12 days give the highest content of 19.499%, while the lowest value in the treatment L4K3 (concentration of liquid smoke 20%, soaking time 15 minutes on storage 0 days amounting to 12.95%.

Difference between levels of these fats allegedly due to more fat storage time will cause damage, and as if the fat content increase is actually not the case. Furthermore, the average value of fat fillet of tilapia on the concentration of liquid smoke and different storage time is presented in Table 3 and Figure 3, below.

Table 3. The value of the average interaction fat content (%) of tilapia fillets soaking time difference effect of treatment and storage of liquid smoke

Soaking time	**Time storage (S) (day)**					**Mean**	**Interaction**
(minute) (K)	**0 (S_0)**	**3 (S_1)**	**6(S_2)**	**9(S_3)**	**12(S_4)**	**(S)**	**S*K**
5 (K_1)	16.205 [a]	16.055 [a]	15.079 [a]	16.019 [a]	13.863 [a]	15.444	0.782
10(K_2)	15.082 [a]	16.020 [a]	13.864 [a]	16.198 [a]	16.057 [a]	15.444	-0.639
15(K_3)	13.865 [a]	16.202 [a]	16.041 [a]	15.077 [a]	16.018 [a]	15.441	0.036
Mean (K)	16.092	14.995	15.765	15.313	15.313	15.443	
Interaction (K*S)	0.074	-0.011	-0.132	0.068	0.002		

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

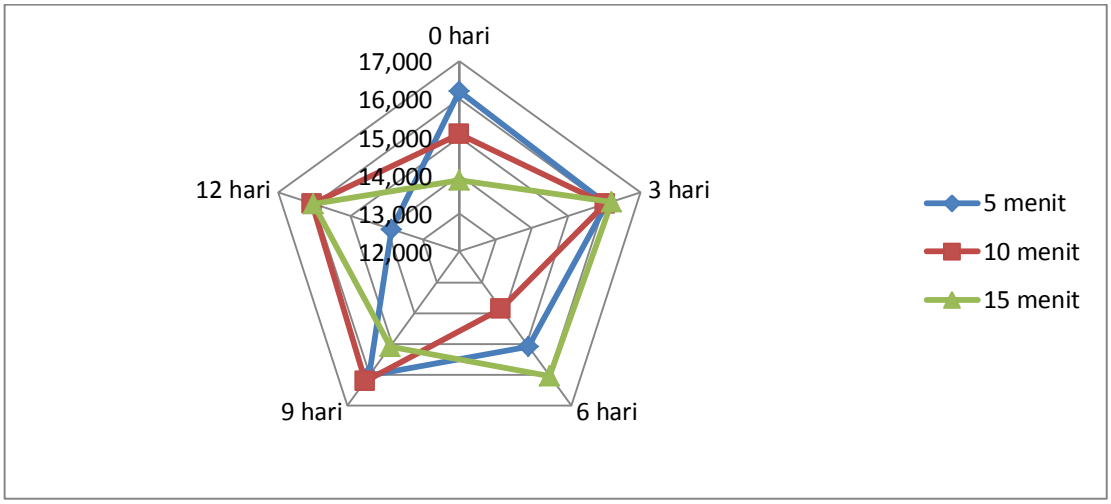

Figure 3. The value of the average interaction fat content (%) of tilapia fillets soaking time difference effect of treatment and storage of liquid smoke

In Table 3 (row) indicates the value of negative interactions in the treatment of soaking 10 minutes with different storage time of the protein tilapia fillet while the value of positive interaction going on a long soaking 5 and 15 minutes. In the column shows the positive interaction between old soaking with storage time 0 days, 9 days and 12 days, while the value of negative interactions on a long storage of 3 days and 6 days. Values of positive interaction means both treatment factors together provide a response to the protein content. While the value of a negative interaction means that both factors are not the same response.

4. Conclusion

1. Combination treatment of soaking, the storage time shows the interaction of the fat content of tilapia fillets to the combination of two treatments while others show the influences that were not significantly different.
2. Combination three (3) treatments, namely the concentration difference, long soaking and storage time shows the interaction of the fat content of tilapia fillets, while the combination of the third and four other treatments showed no interaction.

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