

Efficiency Level of Smoking Time and Quality of Cod Fish (*Euthynnus Affinis*) Smoke Based on The Position of Different Fish Smoking Equipment Racks



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KEY WORDS

smoking rack, corn cobs, equipment performance test, smoked fish quality

ABSTRACT

To improve the quality of smoked fish and streamline fish smoking time, fish smoking devices have been created, including cabinet type and Efhilink type. However, to further improve the quality of smoked fish products and the efficiency of smoking time, continuous trials are needed so that smoked fish products at least meet the set SNI standards. The purpose of this study is considering that this tool was produced first and some coastal areas use cabinet-type tools. The purpose of this study is to find out the comparison of the application of Efhilink type and simple cabinet type fish smoking equipment to the level of efficiency of smoking time in smoking smoking products and to the quality of smoked cod fish (*Euthynnus affinis*). Research Methods with an experimental method with treatment consisting of an efhilink fumigator and a simple cabinet fumigator each with 3 shelves. The experimental design used in this study is a Group Random Design. The results showed that different shelf positions had a real effect on the efficiency of the smoking process of cod fish, as well as the total phenol, pH, total acid and TPC contained in smoked cod fish. The treatment that has the best time efficiency is produced by the efhilink type smoking device, especially on the 1st rack, which only takes 56 minutes. In addition, different smoking devices and positions also showed a real influence on the chemical analysis carried out, namely total phenol, total acid, pH, and TPC. As for the organoleptic value, the best treatment was produced from the 2nd shelf efhilink fumigation device, which was with an appearance value of 39, an odor value of 27, a taste value of 29 and a texture value of 41.

1. INTRODUCTION

The development of smoked fish processing is growing, with regions like Tuban, Ternate, Bulukumba, and Tobelo producing notable smoked fish products. However, community-level smoking often involves basic equipment and practices, leading to issues with hygiene and quality. Traditional methods, using open-air smoking and inadequate facilities, can expose fish to contamination and foodborne diseases.

To enhance smoked fish quality and efficiency, various advanced smoking tools have been developed, such as smoking cabinets, oven model cabinets, and Efhilink-type smokers. The Efhilink Type, patented under IDP000079158, has shown promise, but further comparisons with other tools, like the cabinet type, are needed. This study aims to compare the Efhilink Type with a simple cabinet type smoker in terms of smoking efficiency and the quality of smoked cod fish (*Euthynnus affinis*). Efficiency will be measured by fuel consumption (corn husks) and



the time required to smoke the fish.

2. METHOD

This study employs an experimental method using two types of fumigators: Efhilink and simple cabinet, each with three shelves. The design is a Randomized Group Design (RAK), comparing different shelf levels of each fumigator: E1, E2, E3 for Efhilink and K1, K2, K3 for the simple cabinet.

Cod fish (*Euthynnus affinis*) averaging 500 grams are used, with a smoking capacity of 15 kg per device. Both fumigators use 30 kg of corn cobs as fuel. Efficiency is measured by smoking time, remaining fuel, smoking temperature, chamber humidity, fish moisture content, and liquid smoke volume.

Quality tests, conducted at the Chemistry Laboratory of the University of Muhammadiyah Malang, assess total acid, phenol, pH, and TPC by analyzing a third of each fish's body.

3. RESULT AND DISCUSSION

Fumigation Time

The Efhilink type fumigator on the 1st rack achieved the fastest smoking time of 56 minutes, due to its ability to generate higher temperatures by converting smoke into liquid smoke. In contrast, the simple cabinet fumigator on the 3rd rack took the longest, 325 minutes (5 hours 25 minutes), because it produces lower heat and the 3rd shelf is further from the smoke source.

Table 1 Cod Smoking Time

Treatment	Smoking time (minutes)
E1	56
E2	62
E3	98
K1	119
K2	268
K3	325

Fumigation Time

The Efhilink type fumigator on the 1st rack achieved the fastest smoking time of 56 minutes due to its higher temperature, generated by converting smoke into liquid smoke. In contrast, the simple cabinet fumigator on the 3rd rack took the longest at 325 minutes (5 hours 25 minutes) because it emits lower heat and the 3rd shelf is farther from the smoke source.

Table 2 Cod Smoking Time

Treatment	Smoking time (minutes)
E1	56
E2	62
E3	98
K1	119
K2	268
K3	325

Western Decline of Fish

Table 2 shows that the Efhilink fumigator on the 3rd shelf (E3) produced the lowest weight reduction in smoked cod fish, while the Simple cabinet fumigator on the 1st shelf (K1) resulted in the highest weight reduction. This difference is linked to the moisture content of the fish, as the smoking process reduces fat and water content due to the high temperatures of 90-120°C.

Table 2 Weight Loss of Cod Before and After Smoking

Parlakuan	Initial weight (g)	Final Weight (gr)	<i>Fish Weight Loss</i>
E1	400	204	49
E2	400	250	37.5
E3	400	260	35
K1	400	200	50
K2	400	240	40
K3	400	250	37.5

Up to Phenolate

Phenolic content significantly impacts the durability, safety, and organoleptic qualities of



smoked fish, including taste and aroma. Table 3 shows that phenolic levels vary by rack type and position, with F-count (992.36) exceeding F-table (5.64) at a 99% confidence level, indicating significant differences. The even distribution of phenols on the fish's surface enhances its typical smoked aroma and flavor.

Table 3 Phenolate Content in Smoked Cod Fish

Treatment	Phenolic content (mg/kg)			Total	Average
	Repetition				
	1	2	3		
E1	9947.15	10069.74	10008.445	30025.34	10008.45
E2	9104.74	9168.121	9136.431	27409.29	9136.431
E3	9644.837	9494.681	9569.759	28709.28	9569.759
K1	8370.882	8585.129	8478.006	25434.02	8478.006
K2	7530.402	7642.964	7586.683	22760.05	7586.683
K3	7118.249	7122.716	7120.483	21361.45	7120.483
Total	51716.26	52083.351	51899.806	155699.4	

Up to pH

Phenol content impacts the appearance, smell, and taste of smoked cod fish, with even distribution enhancing its typical smoked aroma. Statistical analysis (F-count 987 > F-table 5.64 at 99% confidence) indicates significant differences in pH levels based on rack type and position, affecting the acid content and shelf life of the smoked fish. Higher acid content correlates with longer shelf life.

Table 4 pH Levels in Smoked Cod

Treatment	Up to pH		
	Repetition		
	1	2	3
E1	6.21	6.19	6.200
E2	6.08	6.08	6.080
E3	6.13	6.11	6.120
K1	5.94	5.91	5.925
K2	5.82	5.83	5.825
K3	5.64	5.67	5.655
Total	35.82	35.79	35.805

Total Acid

Statistical analysis (F-count 210.981 > F-table 5.64 at 99% confidence) shows that rack type and position significantly impact the total acid levels in smoked cod fish. Higher acid content, correlated with phenol levels and pH, enhances the durability and shelf life of the smoked fish.

Table 5 Total Acid in Smoked Cod

Treatment	Total acid (%)			Total	Average
	Repetition				
	1	2	3		
E1	0.628	0.657	0.643	1.9275	0.6425
E2	0.689	0.688	0.689	2.0655	0.6885
E3	0.717	0.687	0.702	2.106	0.702
K1	0.805	0.777	0.791	2.373	0.791
K2	0.869	0.896	0.883	2.6475	0.8825
K3	0.9	0.898	0.899	2.697	0.899
Total	4.608	4.603	4.6055	13.8165	

TPC

Based on the calculation using the Group Random Design (RAK) in the table below, the results are obtained that F-count (2196) > F-table (5.64) are at a confidence level of 99% so that H₀ is rejected and H₁ is accepted, which means that the type of rack and the position of the smoking rack are different in this study, namely the type of ephilink rack and cabinet in the 1st, 2nd and 3rd rack positions affect the TPC level in the results of cod smoking.

Table 6 TPC Content in Smoked Cod Fish

Treatment	TPC content (col/g)		
	Repetition		
	1	2	3
E1	0.628	0.657	0.643
E2	0.689	0.688	0.689
E3	0.717	0.687	0.702
K1	0.805	0.777	0.791
K2	0.869	0.896	0.883
K3	0.9	0.898	0.899
Total	4.608	4.603	4.6055

Organoleptic Smoking Cod Fish



Organoleptic tests assessed the sensory qualities of smoked cod fish. The results showed notable variations based on the type and position of the smoking racks used.

For appearance, the 2nd rack Efhilink fumigator received the highest score of 39, indicating a superior visual appeal compared to the 1st rack Efhilink fumigator, which scored the lowest at 26. This suggests a significant impact of rack type and position on the appearance of the smoked fish.

Regarding smell, the 2nd shelf simple cabinet fumigator achieved the highest score of 33, while the 1st and 2nd racks of Efhilink fumigators both received the lowest score of 27. This indicates that there was no significant difference in the odor quality due to the type or position of the shelves.

In terms of taste, the 1st rack Efhilink fumigator scored the highest at 35, while the 3rd rack Efhilink fumigator had the lowest score of 21. This demonstrates a real effect of the type and position of the smoking racks on the flavor of the smoked fish.

For texture, the 2nd rack Efhilink fumigator received the highest score of 41, whereas the 3rd rack Efhilink fumigator was rated the lowest at 25. This shows a significant influence of rack type and position on the texture of the smoked fish.

Table 1 Organoleptic Test Using Efhilink Fumigation Device

Value	E1	E2	E3	K1	K2	K3
Appearance	26	39	33	27	31	29
Construction	27	27	31	21	33	27
Taste	35	29	21	31	33	25
Texture	29	41	25	33	27	35
Total	117	136	110	112	124	116

4. CONCLUSION

The results showed that different shelf positions had a real effect on the efficiency of the smoking process time of cod fish, total phenols, pH, total acid and TPC contained in smoked cod fish.

The treatment that has the best time efficiency is produced by the efhilink type smoking device, especially on the 1st rack, which only takes 56 minutes. In addition, different smoking devices and positions also showed a real influence on the chemical analysis carried out, namely total phenol, total acid, pH, and TPC. As for the organoleptic value, the best treatment was produced from the 2nd shelf efhilink fumigation device, which was with an appearance value of 39, an odor value of 27, a taste value of 29 and a texture value of 41.

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