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Effect of Preservation Techniques on Tilapia Introduced with Dermestes Maculatus

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The is a study of the effect of preservation techniques on Tilapia introduced with Dermestes maculatus. The techniques used were sun drying, smoking and salt drying. Several unsexed adults of Dermestes maculatus obtained from naturally infested smoked fish materials served as the source of the pests. Fresh fish were sun dried, dried salted and smoked fresh using smoking kiln. It was carried out under the following environmental factors: Temperature at 32°C, Humidity from 28% to 45%, Annual rainfall 3000mm and Photo period 12:L 12:D. Data was analysed using statistical tools, ANOVA, Kolmogorov-Smirnov and Spearman correlation. The result implied that the combined effect of smoking and dry salting results in highest weight loss in fish while the combined effect of sun drying and salt drying results in the lowest weight loss in fish. The preservation methods suggested to combat every cause are also different. By implication, the use of both sun drying and salt drying reduce the total weight losses in fish. The lowest moisture content in dry salting and sun dried fish product is attributed to its longer shelf life as microbial growth is favoured by moisture and are responsible for spoilage in fish and fishery products. The findings suggest that the most reliable, cost effective and efficient pest control method would drastically reduce post harvest loss and thereby making the business to boast.

Key words: *Tilapia, Weight loss, Preservation Techniques, Dermestes maculatus.*

Introduction

The demand for food has been increasing drastically due to growing of world population and likewise the awareness in the modern era on the benefit of consuming nutrious food stuffs. Fish is ranked at the top of highly demanded food stuffs according to the Food and Agricultural Organization (2016). From 9.9kg per capita in 1960 to 20kg in 2016, the global

seafood consumption has increased significantly. On the world scale map of exports in 2014, the export in fish products from developing countries accrued an income of $80 billion.

Also the chemical composition within the same species of fish differs depending on such factors such as migratory swimming, feed intake, sexual exchange and migratory swimming in connection with spawning. The biochemical composition of live fish differs from species to species. Despite the variation, fish has proved to be one of the most nutritious food stuffs despite these variations providing 20% of the protein intake of one third of the world's population (Bene C,M. G., and Allison, E.H., 2007).

Moreover, they are a rich source of a number of micro nutrients like, vitamin D and different minerals, and is also the source of health-friendly oils, omega-3 polyunsaturated fatty acids (PUFA) which can be found in higher quantities in aquatic animals than in mammals meat and plants (Mohanty BP, Mohanty A, Ganguly S, et al 2017).

Fish is also known for its highly perishable nature. However, the rapid deterioration of the quality of fish and other sea foods after their harvest is mainly due to the various mechanisms of spoilage and deterioration' due to endogenous enzymatic activities, microbial metabolic activities and chemical oxidation of lipids, all of which sea foods shelf life is shorten. According to Gram and Huss (1996), the major cause of their spoilage is the high composition of non-protein nitrogenous compounds and low acidity (pH>6) as these condition favour the growth of spoilage of microorganisms.

Fish consumers prefer the red morphs and because of this preference it was sold at a premium price. Selection for the red color found in the Nile in some countries has been made. A number of strain/hybrid red tilapia has developed and commercially produced high market acceptance for tilapia has eventuated (Malik et al. 2019; Moses et al. 2019; Nobrega et al. 2019; Prabu, Rajagopalsamy, Ahilan, Jeevagan, & Renuhadevi, 2019; Santos et al. 2019) low production levels in response to their lower growth in comparison with the wild tilapia (Makled, Hamdan, & El-Sayed, 2019; Opiyo, Jumbe, Ngugi, & Charo-Karisa, 2019; Sakyi et al. 2020).

In fatty fish in particular, chemical oxidation of lipids is a common spoilage pattern. For the oxidative rancidity of the polyunsaturated fatty acids of fish and fishery products, this spoilage patterns depends mainly on the presence of oxygen (Ashie INA, Smith JP, Simptom BK, 1996).

Of the cured fish pest damage can also cause fragmentation (Food and Agricultural Organization,1981), which can lead to loss of value due to quality reduction and quantitative loss of smaller fragments. Traditional methods of preservation have been developed over the

years which include salting, drying and smoking due to perishable nature of fish (Bellagha et al. 2007).

Thus, the experimental research was designed to investigate the effects of the preservation technique on tilapia introduced with *Dermestes Maculatus*. The aim was to understand the efficient and effective management measures against weight losses caused by the pest in the stored fish product.

Materials and Method

The research was carried out between April 2019 and August 2019 under a suitable temperature of (30°C and 32°C) relative humidity (28% to 45%) and photo-period of 12:12 hours, light to darkness regimen. Nile tilapia *(Oreochromis niloticus*) were raised or cultured in the laboratory of the school of Biological Science, University Sains Malaysia for the duration of four months.

Treatments were carried out simultaneously for the preservation technique. Several adults of uni-sexed *D. maculatus* were collected from already infested smoked fish products that served as the source of the insect pests. The sample bottles and the specimen Nile tilapia (*Oreochromis niloticus*) were sterilized at 70°C for an hour in autoclave to kill all the pest and other fungus that may be present.

Fish Sample Preparation and Processing

The experimental fish Nile tilapia (*Oreochromis niloticus*) were carefully washed and prepared. The prepared fish were separated into three groups of preservation techniques: sun drying, smoking and salt drying.The duration for experiments was the same for each, lasting for six weeks.

In sun drying, the already cleaned fish samples were spread over a wire mesh and allowed to be exposed to the sun for 6 weeks. In dry salting the cleaned fish were spread with diluted salt solution of 5% (sodium chloride) spread on the fish on the wire mesh and allowed to dry for the same period of six weeks. Smoking was carried out using the smoking Kiln hybrid version for 2 hours and for one week.

About 10 uni-sexed adults of the insect pest *D. maculatus were* introduced into each of the treatments collected in the sterilized glass jar containing the experimental fish (*Oreochromis niloticus*). Each treatment was weighed separately at the end of every week and weight loss recorded for the period of the duration of the experiment for six weeks.

Data analysis ANOVA was used for level of significance; Kolmogorow-Smirnov was used for the normality test, followed by Spearman's correlation.

Result

Hypothesis Testing

H1: There is no significant difference between the preservation techniques

Table 1:

Test Statistics[a]	
N	60.000
Chi-Square	37.471
df	2.000
Asymp. Sig.	0.000
a. Friedman Test	

Source: SPP Output

Table 2:

Descriptive Statistics	**N**	**Minimum**	**Maximum**	**Mean**	**Std. Deviation**
Weight Loss Through Sun Drying	60	0.070g	15.060g	1.916g	3.964g
Weight Loss Through Smoke Drying	60	0.100g	33.230g	2.331g	6.472g
Weight Loss Through Salt Drying	60	0.050g	2.050g	0.668g	0.424g

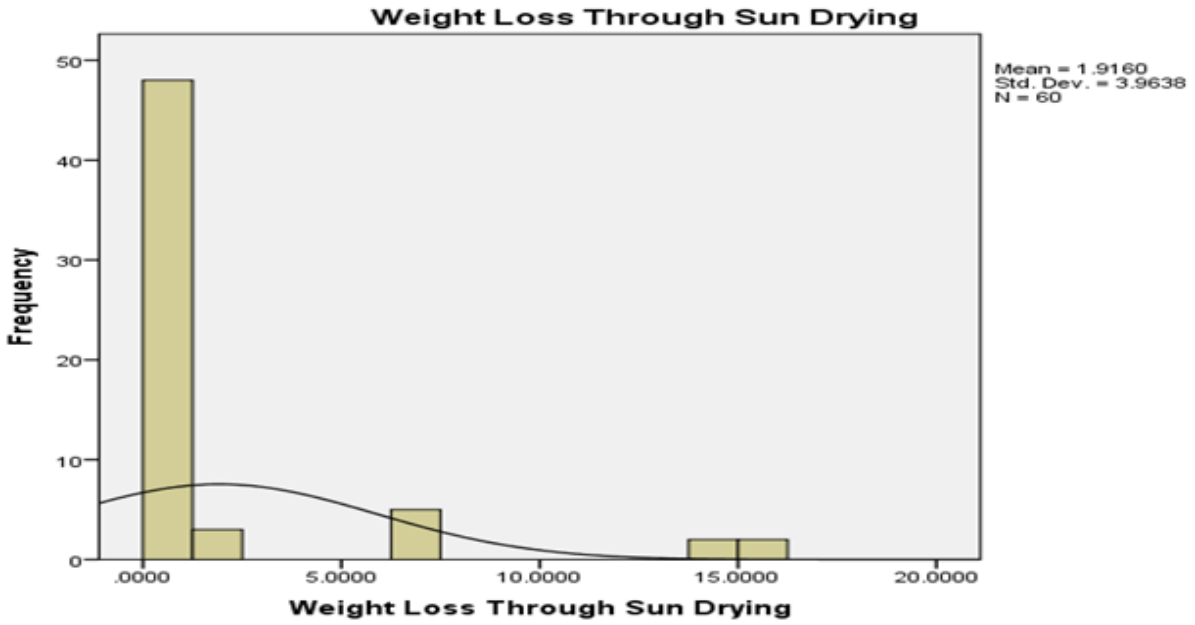
Source: SPP Output

Table 3: Mean Ranking of Preservation techniques

Preservation Techniques	Week	N	Mean Rank
Weight Loss Through Sun Drying	1	10	12.9
	2	10	23
	3	10	31.95
	4	10	33.9
	5	10	39.5
	6	10	41.75
Weight Loss Through Smoke Drying	1	10	7.05
	2	10	17.4
	3	10	25.8
	4	10	38.45
	5	10	40.75
	6	10	53.55
Weight Loss Through Salt Drying	1	10	8.85
	2	10	18.55
	3	10	27.1
	4	10	34.2
	5	10	44.55
	6	10	49.75

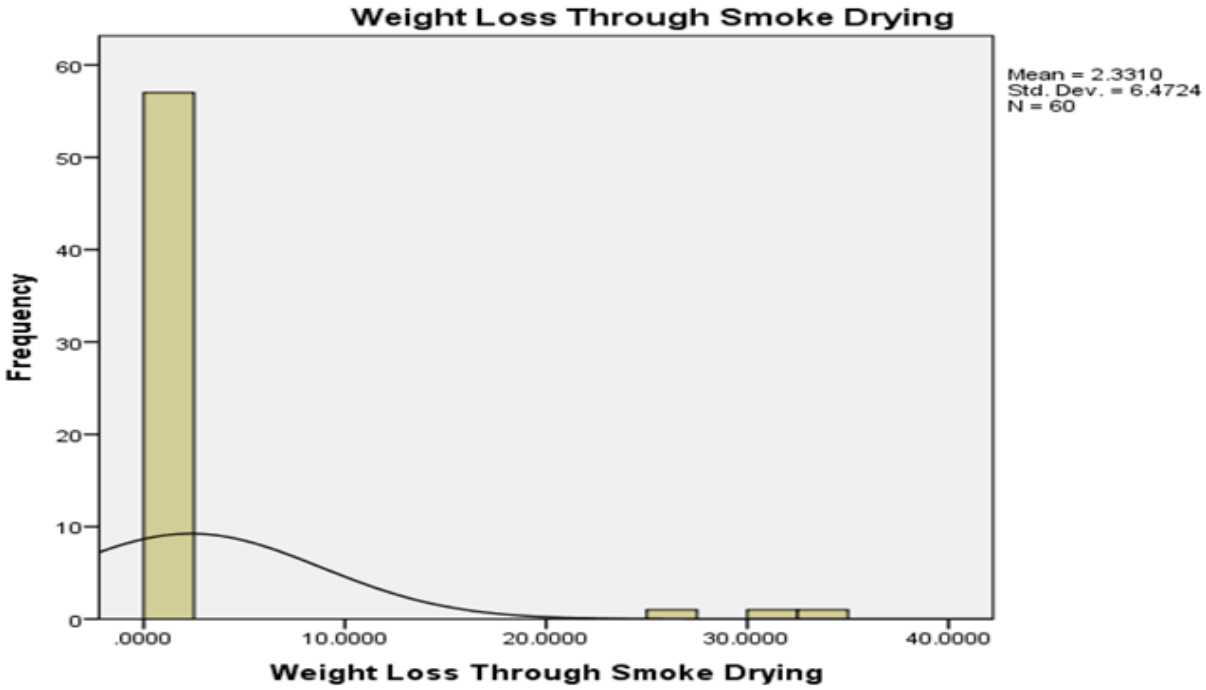
Source: SPP Output

Figure 1. Normality plot of weight loss through sundrying



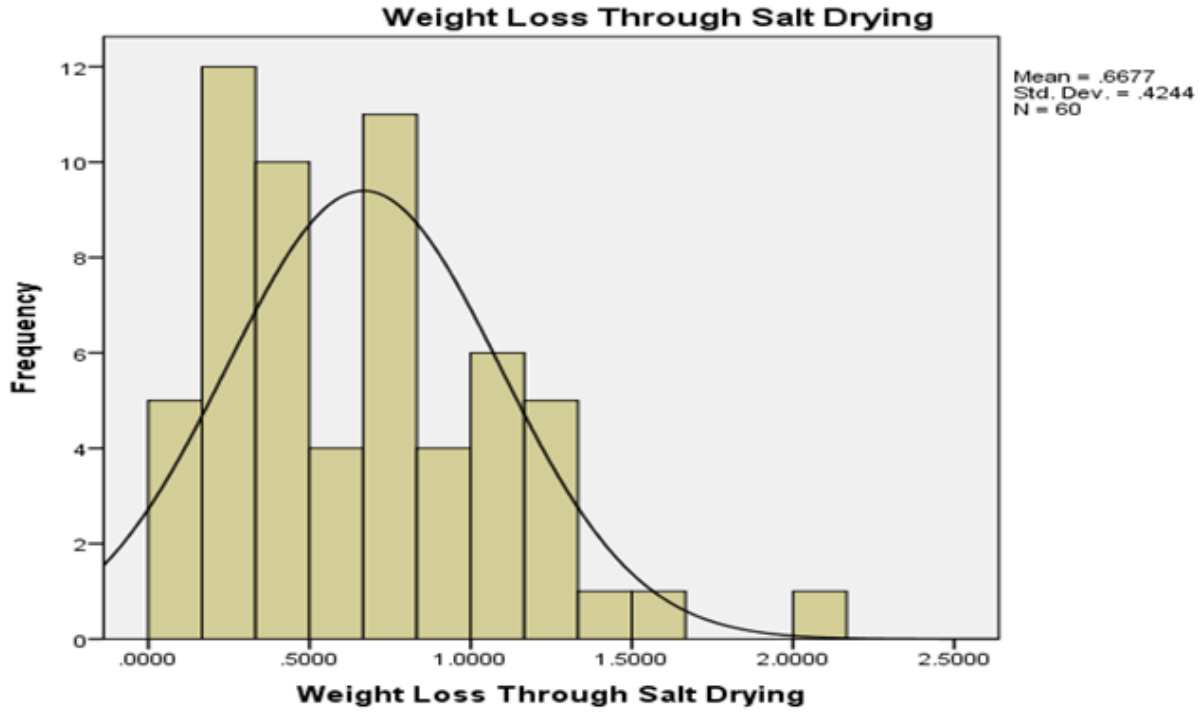
Source: SPP Output

Figure 2. Normality plot of weight loss through smoking



Source: SPP Output

Figure 3. Normality plot of weight loss through salt drying



Source: SPP Output

Table 4: Normality Test (Kolmogorov-Smirnov)

	N	Normal Parameters[a,b]		Test Statistic	Asymp. Sig. (2-tailed)
		Mean	Std. Deviation		
Weight Loss Through Sun Drying	60	1.92	3.96	0.40	.000[c]
Weight Loss Through Smoke Drying	60	2.33	6.47	0.47	.000[c]
Weight Loss Through Salt Drying	60	0.67	0.42	0.10	.174[c]

Table 5: Kruskal Wallis Test

Test Statistics[a,b]			
	Chi-Square	df	Asymp. Sig.
Weight Loss Through Sun Drying	19.259	5	0.002
Weight Loss Through Smoke Drying	47.328	5	0.000
Weight Loss Through Salt Drying	39.529	5	0.000
a. Kruskal Wallis Test			
b. Grouping Variable: Week			

Table 6: Correlation between different preservation techniques

Spearman's Rho Correlations		1	2	3
1. Weight Loss Through Sun Drying	Correlation Coefficient	1.00	.539**	.453**
	Sig. (2-tailed)		0.00	0.00
	N	60	60	60
2. Weight Loss Through Smoke Drying	Correlation Coefficient	.539**	1.00	.738**
	Sig. (2-tailed)	0.00		0.00
	N	60	60	60
3. Weight Loss Through Salt Drying	Correlation Coefficient	.453**	.738**	1.00
	Sig. (2-tailed)	0.00	0.00	
	N	60	60	60

Discussion

The objective of the research was to determined the most effective method of either of the preservation techniques such as sun drying, dry salting and smoking introduced with Dermestes maculatus.

The findings of the research revealed the combined effect of the preservation techniques on tilapia introduced with(Dermestes maculatus). Salt drying has the minimum weight loss of 0.50g, highest percentage of mortality, at 32^0C and relative humidity 25% to 45%. While the maximum weight loss was recorded through smoking with a value of 33.23g, and least percentage of mortality, at 30^0C. The result also indicates that the combined effect of sun drying and salt drying gave the minimal percentage of weight loss and it is the most effective method of fish preservation techniques with about 0.43g and lastly sun drying and smoking 0.53g weight loss. The maximum weight loss was recorded with combined effect of salt drying and smoking 0.73g. Practically this implies that the study suggested the most effective of the preservation techniques should be be adopted in order to guarantee the safety, longevity, nutritional status, and prevent any economic loss that may arise as a result of poor handling, glut, poor processing method of the fish and fisheries product. Observation and report has it that the traditional processors of fish and the literature published (FAO,1991; Y. M. et. al, 2004; Bella et. al. 2007; Berhimpon et al. 1990 and Honner, 1997) had also reported that salt application on fresh fish while drying and processing can detract or send off the beetle Dermestes maculatus. As the salt concentration increases, all the adults were dead compared to what was obtained in smoking and sun drying. Moisture content is the principal factor that determines the increase or decrease in the population of the insect pest. The result shows that Dermestes maculatus are more susceptible to both sun dried and smoked fish compared to salt dried fish. Due to the hydroscopic nature of salt, the effectiveness of the salt in protecting and preserving the fish from harm, waste or loss and infestation has been found to be highly variable (Esser, 1998 and Johson, 1997). The findings also revealed that insect heavily infested the controls which were unsalted compared to the salted fish. One of the oldest methods of preserving fish is salting process and still being used in several places around the world. As a seasoning, flavour enhancer, preservation or curing agent salt has been used for many centuries. Insect pest infestation has been assessed, the extent and value of quantitative losses caused on fish, by various authors such as Osuji (1975) and FAO (1981) depending on the length of the storage, estimated at the range from negligible up to 50% weight loss – as a result of such following factors as content, general hygienic condition, moisture content and during processing and storage.

Conclusion

In fish preservation, dry salting plays an important role in controlling insect pest infestation. The lowest moisture content in salt dried and sun dried fish also suggests the probability of producing a processed fish with longer shelf life, as moisture favours the microbial growth that are responsible for most spoilage in fresh foods.

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