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ABSTRACT

This study was carried out to determine the effect of weight on moisture content and drying rate of different species of fish, a laboratory dryer was used at a constant temperature of 60oC with four different types of fish (mackerel, sardine, croaker and cat fish) cut into 50g and 100g weights. It was observed that sardine has the least moisture content for 50g sample while croaker has the least moisture content for 100g sample after drying. Croaker has fastest drying rate both for 50g and 100g, it dried faster in 50g than 100g. The Single factor Analysis of Variance shows that the higher the weight of sample test the less significant difference in the moisture content and drying weight of different species of fish.

Keywords : Cat fish, Mackerel; Sardine; Croaker; Drying rate; Moisture content; ANOVA.

INTRODUCTION

Fish is a very important foodstuff in developing countries, in areas where cold preservation techniques are often missing. Spoilage of fish refers to the term used in change in fish's normal state, such changes can be detected by touch or sight, smell and taste. Quality losses can occur very rapidly after catch leading to spoilage due to factors such as moisture, microbial growth, oxygen and temperature (Opara et al, 2013). Fish normally spoil within 12 – 20 hours depending on the species and the methods of capture. If the fishes are not processed immediately after they are captured, certain irreversible spoilage and deterioration reactions begin to take place (Conne, 1995). Fish spoils at different rates as a result of difference in surface properties of fish. Microbial growth mainly takes place at the surface; spoilage is probably to some large extent a consequence of bacterial enzymes diffusing into the flesh and nutrient diffusing to the outside. The flesh of healthy live or new caught fish is sterile as the immune system of the fish prevents the bacterial from growing in the flesh, when the fish immune system collapse and the bacterial are allowed to proliferate freely. Most bacteria thrive in a temperature range of 65F to 100ºF, if fish is stored in a location with an ambient temperature of less than 65ºF, bacterial growth will be slowed. Bacteria growth will stop at temperature below 0ºF and hence preserving the fish from spoilage.

Fish drying means extraction of water from the fish by heating (Arason et al., 1992). Fish drying is an age long practice across the world. It is one of the methods of processing fish. Also the preservation of fish by salting and drying is achieved by lowering the water activity (a_w) of the fish flesh (Ismail and Wooton, 1992). Water activity measures the availability of water in fish flesh (Jason, 1958).

Traditional techniques for improving preservation and storage are Brinning/salting, drying or smoking, picking and spicing and canning. It has been observed that drying is the most convenient and cheapest method of preservation (Eyo, 1986). Major problems with traditional sun drying are loss of quality due to contamination resulting from infestation by animals. Fish drying methods vary from species to species based on the type of end product and its quality requirement. In some countries, the fish are boiled before being dried. Sun drying of fishes is a traditional practice followed in many parts of the world (Sachithananthan et al., 1985, N'Jai, 1985).

The effects of weight on temperature and drying of different species of fish using different processing methods have been studied. The experimental investigation on biochemical, microbial and sensory properties of mackerel (Rastrilliger kangurta) dried by solar-biomass hybrid cabinet dryer by Chavan et al (2008). The development and performance evaluation of a motorized fish smoking kiln. Was studied by Ashaolu Michael O.

(2014). Studies on Drying Characteristics of Prawn and Fish was carried out by Kamalakar et al. (2013**).** The effect of smoke-drying temperatures and time on physical and nutritional quality parameters of Tilapia (Oreochromis niloticus) was studied by Idah and Nwankwo (2013).

It has been observed that different processing and drying methods have different effects on the shell life, moisture content and drying rate of fish. The objectives of this study are to determine the effect of the weight on moisture content and drying rate of different species of fish (mackerel, cat fish, Sardine and croaker).

MATERIAL AND METHODS

The four different fish samples; mackerel, sardine, croaker and cat fish were bought from Choba market in Port Harcourt, Rivers State, Nigeria. The samples were cleaned (descaled and degutted) and was washed thoroughly with tap water to make sample free from foreign material and also to remove blood stains and slime, surface water from samples were been removed by placing on a sieve, to drain out moisture. The samples were cut into different sizes with the aid of a stainless steel knife into different masses 50g and 100g by using a triple beam balance for measuring their masses. The samples were arranged on dryer tray, before charging it into the oven dryer.

Experiment

The samples were gutted into various sizes and length. 50g and 100g of sardine, catfish, croaker, and mackerel were weighed respectively with the aid of a triple beam balance. The oven dryer was preheated for about 3minutes, and set to an ambient temperature 60ºC. The samples were arranged sequentially on the tray dryer, the first is a cat fish 50g and 100g, the second row mackerel 50g and 100g, the third row sardine 50g and 100g and lastly croaker 50g and 100g. The initial time of which the samples were charged to the dryer was recorded and at every 30 minutes the fish is brought out of the oven dryer and the loss in the weight is recorded, the experiment is carried out for a period of 3days and recorded time 420minutes throughout the experiments.

RESULTS AND DISCUSSION

The effect of weight on temperature and drying of different species of fish samples, after 420 minutes recorded time of drying, monitoring, observation and operation the following results were obtained as tabulated

Table 1: Drying rate and moisture content of cat fish.

TIME (MINUTES)	CAT FISH					
	Mean mass 50g after drying	Mean mass 100g after drying	50g mass		100g mass	
			DRYING RATE dW/dT	MOISTURE CONTENT (%)	DRYING RATE dW/dT	MOISTURE CONTENT (%)
0	50.00	100.00	0.000	100.00	0.000	100.00
30	48.00	93.30	0.067	96.00	0.223	93.30
60	42.10	91.00	0.197	84.20	0.077	91.00
90	41.00	90.00	0.037	82.00	0.033	90.00
120	39.50	85.30	0.050	79.00	0.157	85.30
150	38.00	82.00	0.050	76.00	0.110	82.00
180	37.80	81.30	0.007	75.60	0.023	81.30
210	37.50	81.10	0.010	75.00	0.007	81.10
240	36.40	74.50	0.037	72.80	0.220	74.50
270	35.20	73.50	0.040	70.40	0.033	73.50
300	33.10	73.80	0.070	66.20	-0.010	73.80
330	33.00	72.90	0.003	66.00	0.030	72.90
360	32.80	71.80	0.007	65.60	0.037	71.80
390	31.92	70.40	0.029	63.84	0.047	70.40
420	31.19	68.70	0.024	62.38	0.057	68.70

Table 2: Drying rate and moisture content of sardine fish.

TIME(MINUTES)	SARDINE					
	Mean mass 50g after drying	Mean mass 100g after drying	50g mass		100g mass	
			DRYING RATE dW/dT (g/s)	MOISTURE CONTENT (%)	DRYING RATE dW/dT (g/s)	MOISTURE CONTENT (%)
0	50.00	100.00	0.000	100.00	0.000	100.00
30	48.96	92.50	0.035	97.92	0.250	92.50
60	43.50	91.30	0.182	87.00	0.040	91.30
90	42.80	88.16	0.023	85.60	0.105	88.16
120	42.60	87.40	0.007	85.20	0.025	87.40
150	41.00	76.26	0.053	82.00	0.371	76.26
180	39.50	75.50	0.050	79.00	0.025	75.50
210	39.00	65.20	0.017	78.00	0.343	65.20
240	38.60	64.30	0.013	77.20	0.030	64.30
270	36.30	62.10	0.077	72.60	0.073	62.10
300	36.00	61.90	0.010	72.00	0.007	61.90
330	35.60	58.70	0.013	71.20	0.107	58.70
360	35.40	57.40	0.007	70.80	0.043	57.40
390	35.30	56.20	0.003	70.60	0.040	56.20
420	35.00	56.10	0.010	70.00	0.003	56.10

Table 3 : Drying rate and moisture content of croaker fish.

TIME(MINUTES)	CROAKER					
	Mean mass 50g after drying	Mean mass 100g after drying	50g mass		100g mass	
			DRYING RATE dW/dT (g/s)	MOISTURE CONTENT (%)	DRYING RATE dW/dT (g/s)	MOISTURE CONTENT (%)
0	50.00	100.00	0.000	100.00	0.000	100.00
30	43.40	96.90	0.220	86.80	0.103	96.90
60	42.60	89.00	0.027	85.20	0.263	89.00
90	40.00	88.00	0.087	80.00	0.033	88.00
120	33.00	87.50	0.233	66.00	0.017	87.50
150	32.00	85.00	0.033	64.00	0.083	85.00
180	31.60	82.40	0.013	63.20	0.087	82.40
210	28.00	81.60	0.120	56.00	0.027	81.60
240	27.50	81.30	0.017	55.00	0.010	81.30
270	27.40	81.20	0.003	54.80	0.003	81.20
300	27.20	81.00	0.007	54.40	0.007	81.00
330	27.10	80.00	0.003	54.20	0.033	80.00
360	27.00	80.00	0.003	54.00	0.000	80.00
390	27.00	80.00	0.000	54.00	0.000	80.00
420	27.00	80.00	0.000	54.00	0.000	80.00

Table 4: Drying rate and moisture content of mackerel fish.

TIME(MINUTES)	MACREAL					
	Mean mass 50g after drying	Mean mass 100g after drying	50g mass		100g mass	
			DRYING RATE dW/dT (g/s)	MOISTURE CONTENT (%)	DRYING RATE dW/dT (g/s)	MOISTURE CONTENT (%)
0	50.00	100.00	0.000	100.00	0.000	100.00
30	46.00	94.90	0.133	92.00	0.170	94.90
60	42.70	92.20	0.110	85.40	0.090	92.20
90	42.10	88.00	0.020	84.20	0.140	88.00
120	41.60	89.30	0.017	83.20	-0.043	89.30
150	38.40	80.00	0.107	76.80	0.310	80.00
180	37.30	78.50	0.037	74.60	0.050	78.50
210	36.70	77.50	0.020	73.40	0.033	77.50
240	34.50	77.30	0.073	69.00	0.007	77.30
270	34.30	75.20	0.007	68.60	0.070	75.20
300	33.90	69.10	0.013	67.80	0.203	69.10
330	32.60	68.90	0.043	65.20	0.007	68.90
360	31.80	68.30	0.027	63.60	0.020	68.30
390	31.50	67.40	0.010	63.00	0.030	67.40
420	30.00	67.00	0.050	60.00	0.013	67.00

	B	C	D	E	F	G	H
21	Anova: Single Factor		FACTOR :	MOISTURE CONTENT			
22			WEIGHT :	50g			
23	SUMMARY						
24	*Groups*	*Count*	*Sum*	*Average*	*Variance*		
25	CAT FISH	15	1135.02	75.668	126.2083		
26	SARDINE	15	1199.12	79.9413333	93.89391		
27	CROAKER	15	981.6	65.44	229.4754		
28	MACKEREL	15	1126.8	75.12	135.9703		
29							
30							
31	ANOVA						
32	*Source of Variation*	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
33	Between Groups	1689.037	3	563.012487	3.846056	0.0142108	2.769431
34	Within Groups	8197.671	56	146.38699			
35							
36	Total	9886.709	59				

Figure 1: Single Factor Analysis of Variance of the effect of 50g weight on moisture content of different species of fish.

	J	K	L	M	N	O	P
21	Anova: Single Factor		FACTOR :	MOISTURE CONTENT			
22			WEIGHT :	100g			
23	SUMMARY						
24	*Groups*	*Count*	*Sum*	*Average*	*Variance*		
25	CAT FISH	15	1209.6	80.64	91.084		
26	SARDINE	15	1093.02	72.868	235.1566		
27	CROAKER	15	1273.9	84.92667	40.01638		
28	MACKEREL	15	1193.6	79.57333	118.865		
29							
30							
31	ANOVA						
32	*Source of Variation*	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
33	Between Groups	1121.056	3	373.6855	3.081168	0.034633	2.769431
34	Within Groups	6791.707	56	121.2805			
35							
36	Total	7912.763	59				

Figure 2: Single Factor Analysis of Variance of the effect of 100g weight on moisture content of different species of fish.

	R	S	T	U	V	W	X
21	Anova: Single Factor		FACTOR :	DRYING RATE			
22			WEIGHT :	50g			
23	SUMMARY						
24	*Groups*	*Count*	*Sum*	*Average*	*Variance*		
25	CAT FISH	15	0.627	0.0418	0.00234		
26	SARDINE	15	0.5	0.033333	0.002169		
27	CROAKER	15	0.766667	0.051111	0.00628		
28	MACKEREL	15	0.666667	0.044444	0.001774		
29							
30							
31	ANOVA						
32	*Source of Variation*	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
33	Between Groups	0.002435	3	0.000812	0.258435	0.855007	2.769431
34	Within Groups	0.175877	56	0.003141			
35							
36	Total	0.178312	59				

Figure 3: Single Factor Analysis of Variance of the effect of 50g weight on drying rate of different species of fish.

	Z	AA	AB	AC	AD	AE	AF
21	Anova: Single Factor		FACTOR :	DRYING RATE			
22			WEIGHT :	100g			
23	SUMMARY						
24	*Groups*	*Count*	*Sum*	*Average*	*Variance*		
25	CAT FISH	15	1.043333	0.069556	0.005627		
26	SARDINE	15	1.463333	0.097556	0.015038		
27	CROAKER	15	0.666667	0.044444	0.004872		
28	MACKEREL	15	1.1	0.073333	0.008952		
29							
30							
31	ANOVA						
32	*Source of Variation*	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
33	Between Groups	0.021266	3	0.007089	0.822109	0.487176	2.769431
34	Within Groups	0.48286	56	0.008623			
35							
36	Total	0.504126	59				

Figure 4: Single Factor Analysis of Variance of the effect of 100g weight on drying rate of different species of fish.

DISCUSSION OF RESULT

After the experiment, the following were observed. Sardine and croaker has the least mean mass (56.10g and 27.00g respectively) after the drying of 100g and 50g weights respectively of different species of fish. Also for the moisture content, Sardine and croaker has the least percentage moisture content (56.10% and 54.00% respectively) after the drying of 100g and 50g weights respectively of different species of fish. These can be attributed to their high drying rate when compared to other species of fish.

Effect of weight on moisture of croaker, cat fish, sardine and mackerel

For 100g weight of different species of fish, after drying the moisture contents of croaker, cat fish, sardine and mackerel were 80.00%,68.70%,56.10% and 67.00% respectively while for 50g weight of different species of fish, after drying the moisture contents of croaker, cat fish, sardine and mackerel were 54.00%,62.38%, 70.00% and 60.00%. This shows that sardine has the least moisture content for 100g weights when compared to the other three species of fish while croaker has the least moisture content for 50g weights when compared to the other three species of fish. The single factor analysis of variance of 50g weight moisture content of different species with the test done at level of significance a = 0.05, the result gave a P-value of 0.014. This shows there is a significant difference between moisture content of different species of fish. Also for 100g weight moisture content of different species with the test done at level of significance a = 0.05, the result gave a P-value of 0.035. This implies there is a significant difference between moisture content of different species of fish.

Effect of weight on drying rate of croaker, cat fish, sardine and mackerel

For 100g weight of different species of fish, after drying the drying rate of croaker, cat fish, sardine and mackerel were 0.00g/s, 0.057g/s, 0.003g/s, and 0.013g/s respectively while for 50g weight of different species of fish, after drying the moisture contents of croaker, cat fish, sardine and mackerel were 0.00g/s, 0.024g/s, 0.010g/s and 0.050g/s . This shows that for 100g and 50g weights of different species of fish, croaker dried fastest which is as a result of low moisture content in it. The single factor analysis of variance of 50g weight drying rate of different species with the test done at level of significance a = 0.05, the result gave a P-value of 0.855. This shows there is no significant difference between moisture content of different species of fish. Also for 100g weight moisture content of different species with the test done at level of significance a = 0.05, the result gave a P-value of 0.487. This implies there is no significant difference between moisture content of different species of fish.

CONCLUSION

It can be concluded that weight has significant effect on moisture content and drying rate of croaker, cat fish, sardine and mackerel. Sardine has the least moisture content for 50g sample while Croaker has the least moisture content for 100g sample after drying. Croaker has fastest drying rate both for 50g and 100g, it dried faster in 50g than 100g weight which shows implies that the higher the weight of sample the higher the moisture content and drying time. The Single factor Analysis of Variance shows that the higher the weight of sample test the less significant difference in the moisture content and drying weight of different species of fish.

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