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Effect of Salting and Drying Techniques on Treated Meat of Khashm El-Banat (*Mormyrus niloticus*) Collected from the White Nile in Sudan

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Abstract: The present study investigated effect of salting and drying techniques on nutritive values of treated meat of Khashm El-Banat (*Mormyrus niloticus* Bloch and Schneider, 1801). Twenty six kilograms of the studied fish were evaluated after dividing them into two main groups named salted fish and non-salted depending on 20% brine used. Each salted fish and non-salted fish were divided into two subgroups and then one subgroup of both salted fish and non-salted fish was exposed directly to sun rays in Open Air (OA) and the other one was exposed indirectly to sun rays in Shade (SH). Results showed that drying technique of Khashm El-Banat in OA was quicker than that in SH. Protein content showed having high significance where non-salted fish had the highest values as 63.9% in OA and 61.4% in SH. Ash content also was highly significant where salted fish had the highest content as 17.8% in OA and 17.9% in SH. Drying technique in OA was not preferable for Khashm El-Banat, because it had a relative fat content which led to accumulate dust particles on the crusted surface of the dried fish.

Key words: Fish production, drying process, ash, oil, *Mormyrus niloticus*

INTRODUCTION

In Sudan, Post-harvest Treatment (PHT) of fish showed a wide spectrum as regards the choice, consumption and ways of utilization. People consume preserved fish in the form of: salted, dried, or smoked and more recently for other purposes as feeds for other animals or fertilizer for agriculture (Abu Gideiri *et al*., 1999).

Both drying and salting techniques prolong the preservation time of fish products and make them available to be consumed far from their sources (Berkel *et al.,* 2004; Mohammed, 2007). The extent of natural drying in tropical and semi-tropical areas is estimated at 33% of the initial weight in 7 days (Makine, 1996). When salt is added to fish before drying, less water needs to be removed to achieve the same effects and a product with water content 35-45%, depending on amount of salt present (FAO, 1981). If air humidity around the salted product is high, the product can absorb it beside a hard crusted surface can be created. If it is exposed directly to sun rays, the sun rays then prohibit micro-organism such bacteria to grow and then keep protein tissue (Mohammed, 2007). Protein may not actually be lost during drying (depending on temperature); but during salting, the amount of protein lost is not significant and depends on the nature of the salting process and the length of time taken for the fish to dry. Water-soluble vitamins are also lost during salting, while fat and fat-soluble vitamins are conserved (Morris *et al.,* 2004). Regards fat, most of fish contain fairly high levels of fat or oil. Some of the fatty fish contain up to 20% or more in their flesh where as white lean fish contain very little amount of oil (1-5%) in their flesh (Vinogradov, 1953). Although, this study concentrated only on *M. niloticus* which is locally known as Khashm El-Banat though there are two other species belong to the same genus live in the Nile River system and have the same name Khashm El-Banat (Bailey, 1994). They are *Mormyrus caschive,* Linneaus 1758 and *Mormyrus kannume*, Forskal 1775. Therefore, this study of Khashm El-Banat may represent those two other fish species of the genus *Mormyrus*.

The objectives of this study were: (1) to study effect of drying and salting techniques on nutritional values of treated meat of Khashm El-Banat, (2) to study effect of exposing sun rays whether directly or indirectly on treated meat of Khashm El-Banat and (3) to study effect of fat on drying time for both salted fish and non-salted fish.

MATERIALS AND METHODS

Sample collection: Twenty six kilograms of Khashm El-Banat *(Mormyrus niloticus* Bloch and Schneider, 1801)

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were purchased from fish market in south of Khartoum state after identification according to Bailey (1994). The fish sample then were transferred to the lab of Environment and Natural Resources Research Institute, National Centre for Research in Khartoum for the study. They had standard length ranged between 28 and 39 cm.

Drying process: Drying process was done during May-June 2007 after dividing the fish samples into two main groups. One group was treated by 20% brine and named salted fish; whereas, group two was treated without 20% brine and named non-salted fish. Each group was divided into two subgroups depending on drying in Open Air (OA) and drying in shade (SH). Loss in weights of treated fish and air speed were taken daily until weight of the dried fish was being stable.

Analysis of proximate chemical composition: Chemical analysis was used for determining contents of protein, oil, moisture and ash for each subgroup according to AOAC (1980) as follows:

$$\text{Protein (\%)} = \frac{(V2-V1)\times N\times 14\times 100\times 6.25}{1000\times \text{weight of the drying sample}}$$

Where,

V1 : Volume of HCl used in the plank titration
V2 : Volume of HCl used in the test titration
14 : Conversion factor from ammonium sulphate to nitrogen
6.25 : Conversion factor from nitrogen to protein
N : Normality of HCl used in titration

$$\text{Fat (\%)} = \frac{\text{Weight of ether extracted fat}}{\text{Weight of sample}}\times 100$$

$$\text{Moisture (\%)} = \frac{\text{Initial weight-oven dried weight}}{\text{Initial weight}}\times 100$$

$$\text{Ash (\%)} = \frac{\text{Weight of ash}}{\text{Weight of sample}}\times 100$$

ANOVA test was used to determine the significant differences among nutritive values of dried salted and non-salted fish of Khashm El-Banat.

RESULTS

Loss in weights (g) and air speed (m min^{-1}): Loss in weights (g) of fish that were dried in OA was generally higher than those dried in SH. Dropping in weights of salted fish in OA ceased on the 7th day of the experiment; while, loss in weights of non-salted fish ceased on the 5th day in the same conditions. Hence, the study recorded that loss in weight of salted fish in OA with high air speed particularly was higher than that of non-salted fish in SH (Table 1).

Loss of weights of all treatments: Non-salted fishes in both OA and SH were scored higher loss in weight than salted fish in the same conditions (Table 2). Relationship between weight and time was upward and abdicable relationships and also showed no significant differences among all treatments (Table 1, 2). Moreover, both dried fish salted and non-salted showed strong correlation in SH (Table 3).

Table 1: Relation of loss in mean weights of treated meat of Khashm El-Banat (*Mormyrus niloticus*) with air speed per time in open air (OA) and Shade (SH)

	Weights of non-salted (g)		Weight of salted (g)		Air speed (m min^{-1})	
Sample time (h)	OA	SH	OA	SH	OA	SH
0.0*	1000.0±0.00	1000.0±0.00	1000.0±0.00	1000.0±0.00	1000.0±0.0	1000.0±0.0
3#	1000.0±0.00	1000.0±0.00	698.2±97.4	785.5±76.3	0.0	0.0
24	417.3±58.4	611.6±56.5	381.1±82.8	401.1±44.4	113.2	23.9
48	315.5±32.3	459.1±47.5	297.7±65.2	330.4±38.7	90.8	11.6
73	268.6±24.0	384.3±41.9	253.1±49.9	293.3±37.0	216.3	10.4
96	255.5±19.7	348.1±38.8	233.8±45.2	273.1±36.5	169.4	43.1
120	253.6±18.9	333.9±36.8	223.4±43.8	263.4±36.7	49.6	32.9
144	250.8±17.8	323.6±35.2	218.4±40.7	254.3±37.0	147.8	6.3
168	250.5±17.6	318.1±33.6	215.7±39.3	249.0±37.1	105.9	73.2
192	250.1±17.8	317.4±33.0	214.2±39.5	243.4±37.1	124.9	55.9
216	249.4±17.6	310.5±32.7	212.7±39.3	240.4±37.0	109.3	35.5
240	248.1±17.7	308.2±32.2	211.4±39.0	237.9±36.8	42.8	19.1

*Initial mean wt. (g) of fish before starting drying process at 0 h, #Total mean wt. (g) of fish after immersed in brine immediately as well as for non-salted fish

Table 2: Effect of drying technique on loss of body weight of Khashm El-Banat (*M. niloticus*) collected from the White Nile in Sudan

	Drying in OA			Drying in SH		
Weight	Initial weight (g)	Final weight (g)	Final weight %	Initial weight (g)	Final weight (g)	Final weight %
Salted	1000	210.1	21.1	1000	211.9	21.2
Non-salted	1000	248.1	24.8	1000	308.1	30.9

OA: Open air, SH: Shade

Table 3: Correlation between time (y) and weight (x) in drying technique of Khashm El-Banat (*M. niloticus*) collected from the White Nile in Sudan

Treatment	Regression	r	p
Salted in SH	Y = 601.62-45.92x	0.51	**
Salted in OA	Y = 560.29-44.05x	0.47	*
Non-salted in SH	Y = 645.59-41.19x	0.53	**
Non-salted in OA	Y = 532.38-36x	0.36	*

SH: Shade, OA: Open air, *Medium correlation, **Strong correlation

Table 4: Proximate chemical analysis of dried meat of Khashm El-Banat (*M. niloticus*) collected from the White Nile in Sudan

		Salted fish		Non-salted fish	
Parameter (%)	Fresh	OA	SH	OA	SH
Protein	21.60	48.10	51.60	63.90	61.3
Fat	0.40	28.80	31.60	30.00	32.7
Moisture	79.99	2.03	3.35	2.04	2.77
Ash	4.40	17.80	17.90	11.00	9.55

Table 5: Analysis of variance and average (mean±SD) of nutritive content of sun dried meat of Khashm El-Banat (*M. niloticus*) collected from the White Nile in Sudan

		Salted fish		Non-salted fish	
Parameter	F-value	OA	SH	OA	SH
Protein	7.95*	48.10±4.80	51.60±7.02	63.90±4.37	61.30±4.88
Fat	1.00	28.80±3.14	31.60±4.95	30.00±1.68	32.70±2.61
Ash	22.66**	17.80±2.44	17.90±2.33	11.00±1.34	09.55±0.766
Moisture	6.12*	02.03±0.413	03.35±0.643	02.04±0.622	02.77±0.289

F-value at 3.12 df, *High significant, **Highly significant

Chemical composition of dried fish: Results showed that protein content of salted fish was less than that of non-salted fish in both OA and SH; whereas, result of oil content was not significantly different. Ash content of salted fish was higher than that of non-salted fish dried in both OA and SH (Table 4). On the other side, both contents of protein and ash showed high significance; whereas, oil content was not significant (Table 5).

DISCUSSION

The higher loss in fish weights was after 24 h and then the weights were being decreased slightly until they were stable. Results of loss in weights showed that a strong correlation between high/low air speed and temperature (Table 1). This is an indicator to effects of air speed and temperature on moisture of dried meat. This result is in agreement with result of Makine (1996).

Results showed that weights of slated fish decreased clearly with nearly 300 g after 3 h of starting drying process in both OA and in SH and also showed higher decline in weights compared to non-salted fish (Table 1). This may be due to effect of salt concentration which assists to extract water from meat easily. This is in-line with result of FAO (1981). In addition, decline in weights of salted fish after 48 h were being slight till all weights were stable at the end of the drying period. This may be due to crusted surface that created by reaction of extracted oil and air humidity which led to decrease losing moisture of dried fish. These results are in harmony with those results of FAO (1981), Makine (1996) and Mohammed (2007).

Moreover, total loss of both dried salted fish in OA and SH were at around 21.1% which was fewer than that loss of both dried non-salted fish. Loss of dried non-salted fish in OA was fewer (24.8%) than that loss of dried non-salted fish in SH (30.9%). This result may be due to effect of high temperature during summer season (May-June) when the drying process was done and it is also in contradiction with result of Makine (1996).

Protein contents of treated fish showed high significance (Table 4, 5). In non-salted fish, protein content was higher than that of salted fish. Because of protein content may not actually be lost due to effect of moderate temperature during carrying out this study. This explanation agrees the previous result of Morris *et al.* (2004).

In spite of oil dropping took place of 12 days during the drying period, there was no significantly difference. Loss in oil quantity and a relative long period of 12 days for being in less in dried meats may be due to effects of temperature and physical characteristics of oil with water. This result agrees the results of Morris *et al.* (2004) and Vinogradov (1953).

Ash contents recorded the highest readings in salted fish during whole drying period. This may be due to three reasons such as: (1) types of salt used which agrees with result of FAO (1981), (2) effect of extracted oil which helps to create a crusted surface on each dried fish and then per which it can collect dust particulars which is in-line with result of Mohammed, (2007) and (3) effect of ground bones and scales in dried meat. Therefore, ash content was highly significant (Table 5).

CONCLUSION

It can be concluded that it is not preferable to dry Khashm El-Banat in both OA than SH due to oil content that causes crusted surface on dried fish and then let drying period be longer than 7 days and makes dried fish so dirty due to gathering dust. In spite of the fact that salted fish lost their weights faster than non-salted drying; drying fish in OA without salting is better than that of salted fish. This was because of the protein content of salted fish were lost with large quantity. Due of oil content, type of salt and ground bones and scales; ash content was the highest among nutritive values of dried fish especially in salted fish.

RECOMMENDATION

It is preferable to make a similar study on the other species of the genus *Mormyrus* which were mentioned above to confirm if there are differences in contents of nutritive values (protein, ash and oil) compared to the present results of *Mormyrus niloticus*.

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