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Processing and Evaluation of Hot Smoked Fillets with *Moringa* from Grass Carp Fish (*Ctenopharyngodon idella*)

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ABSTRACT

At current there a limited manufacturing use of this species of grass carp, in addition, its local fresh consumption is limited. The present paper reports the method of preparation of hot smoked fillets from grass carp fish (*Ctenopharyngodon idella*) and its customer acceptability. Weight composition, proximate analysis as well as weight loss through different operation are presented. Influence of smoking in physicochemical criteria were investigated. The proximate analysis of the muscle showed that it has protein 16.3% and 02.5 % crude fat. Protein in addition to fat content increased after smoking. Moreover, physicochemical criteria of raw grass carp fish fillets were as follows, pH value (06.5) also, TVBN (04.3 mg/100g) while TBA (0.42 mg MDA/kg), respectively. After smoking, all values increment except pH value reduce. However, weight loss (%) in brining, with *M. Oleifera* marinade 5 % (w/v) was lower brining salt only. Taste panel results display that the treatment of *Moringa* gave the results of a higher assessment than the treatment with salt only and became acceptable to the consumer, especially with the disappearance of muddy taste besides texture improved also, softens the bones. Therefore, it can be produce diversified products from low- cost fish, for export and local market having appealing characteristics to gain popularity.

Keywords: - grass carp fish, hot smoking, *Moringa oleifera*, quality, consumer acceptability.

INTRODUCTION

Fish is a highly nutritive value to man since it contains polyunsaturated fatty acids in addition to protein with all essential amino acids. Developing new foodstuffs is of utmost status, firstly to increment the range of new products, continue to attract the attention of the customers, other than second to use raw material and to follow improved methods or to use new types of raw material to meet changing tastes and food habits (El-Lahamy *et al.*, 2019).

Due to the expansion of fish aquaculture and increased production, greater attention is being directed at increasing product value through specialized processing. The result is a broad range of new seafood products entering the market place (Nunoo *et al.*, (2019)

Cyprinid species (common, bighead in addition to grass carp) are generality usually bred in aquaculture. The existence of intermuscular bones and customer attention of muddy characteristics are the vital basis for the lower favorable of the fish

Muddy characteristic because of the geosmin complex synthesised through blue-green algae other than actinomycetes (Nair *et al.*, 2018).

Smoked fish is very important to the food of people having little -income in the developing world, besides classic the process is suitable to local circumstances, as they are low-priced besides need only easy tools, (Nahid *et al.*, 2016, Chakroborty and Chakraborty 2017and Nunoo *et al.*, 2019).

Moringa oleifera (usually name drumstick) is one of that greatest main earthly plants which displayed it antifungal also, antibacterial in addition to antioxidant characteristics that affect its application in food preservation, (Chanraborty *et al.*, 2017).

M. Oleifera marinade in brine solutions keeping smoked catfish during stored from bacteriological besides fungal decomposition and preserved the ash also, fat, and the protein of smoked fish. Moreover, control commercial loss and possible health risk to customers and thus improving food protection and safety. Furthermore, retard fat deterioration, (Adeyemi *et al.*, (2013 and 2014) and Roomiani *et al*., 2019).

At current there a limited manufacturing utilization of this species of grass carp, in addition, its local fresh consumption is limited, its necessary to introduce diversified products from low- cost fish, for export and local market having appealing characteristics to gain popularity, the present paper reports the method of preparation of hot smoked fillets from grass carp fish (*Ctenopharyngodon idella*) and its customer acceptability.

MATERIALS AND METHODS

Materials:-

-Grass carp fish:-

Fresh grass carp fish (*Ctenopharyngodon idella*), of average length 40 cm, average weight 1. 80 kg, average each 0.54 cm2g specific area. Fish was obtained from the Briseq farm, Beheira Governorate, Egypt, were used for the study. fish were transported directly after catching in ice boxes to the laboratory. They were thoroughly washed. Determination of fish length parameters and fish weight composition were carried out according to zaitsev *et al.*, (1969).

***Moringa* leaves:-**

Fresh *Moringa* leaves were obtained from special farm in Wadi El Natroun, Beheira Governorate, Egypt. All wilting and visibly infected plant materials were manually removed.

Chemicals and reagents:

Solvents, chemicals, and reagents were obtained from El-Gomhouria Company, Alexandria, Egypt, and Sigma–Aldrich (Germany). All chemicals in addition to reagents used were of analytical grade.

Methods:-

Samples preparation *Moringa* leaves and brining salt:-

Samples preparation *Moringa* leaves were washed in tap water to remove dirt.

Next, leaves were soaked in 1% saline solution (Na Cl) for 5 minutes to remove microorganisms. The leaves were additionally washed with water. This step played a considerable role in the removal of dust, pathogens besides microbes present in the leave surface. The leaves were air-dried for 4 days (at room temperature in shadow 30±2°C) and ground into powder using a food blender (Moulinex), (Adeyemi *et al.*, 2013). Then the dried samples were sieved through an Aluminum sieve (2mm aperture). The sieved samples were stored in glass bottles with tight lids and labeled. *Moringa oleifera* leaves powder marinade (T2) was prepared by adding 5 % to brining solution (w/v) which prepared by 15% salt only (T1). Briefly, (T1) Brining salt only and (T2) Brining with *Moringa Oleifera* leaves powder marinade 5 % (w/v).

Fish preparation

The fish were beheaded, eviscerated and filleted (skin on). It were further washed in chilled water to remove the adhering dirt ,peritoneum membrane and others in the fillets , then were brined fish, after that, drained for about 20 min . The samples were then placed on cleaned metallic racks inside the smoking kiln. The process phases, drying phase, cooking and intensive smoking phases were taken place. This setting up the optimum time and temperature for each phase of the smoking process was called on. This was achieved by means of trial and error concept till achieving the best condition (Fig.1).

Chemical methods:-

Moisture content using hot air oven at 105 c to a constant weight, crude ether extract, crude protein (N × 6.25), total ash, and pH with spicol pH meter were determined according to the A.O.A.C., (2010) procedures. Total volatile basic nitrogen (TVB-N) by Conway micro-diffusion method and thiobarbituric acid (TBA), were determined according to the methods of (Woyewoda *et al*., (1986).

Sensory evaluation:-

Fresh fish entering the processing was evaluated according to the table given by NRI (1996) while the scheme for evaluating of cooked (fresh, not smoked) fish was evaluated according to the table given by Huss (1995). Steaming test was carried out as following: 100 g of skinned fillets which included a portion of meat removed from the anterior dorsal region were placed in individual 250 ml lidded casserole dishes, steamed in a water bath at 100°C for 30 min. (NRI, 1996) and presented in these dishes to the panelists. The organoleptic properties were then evaluated using a descriptive taste testing procedure. Colour , taste, odour , texture ,general appearance and overall acceptability of smoked fish fillets were determined using ten panelists of food science and technology department , faculty of agriculture , Alexandria university , Egypt . The acceptability was determined on a hedonic scale ranging from 1 to 9 as mentioned by Rangana (1977).

Statistical analysis

The standard deviation and significant differences ($p \leq 0.05$) were calculated using the method described by Sendecor and Cochran (1967).

RESULTS AND DISCUSSION

The results in Table (1) shows the basic data for freshly catches raw fish and smoked grass carp fish (Ctenopharyngodon idella) fillets including length measurements, weight composition, proximate analysis% and specific area (cm2 /g) for whole raw fish and smoked fillets. The average total weight (g) of fish found to be1080 g while the average total length 40 cm. The proximate analysis of the muscle showed that it has protein 16.3% and 02.5 % crude fat.

Protein besides fat content increased after smoking to 20.2% and 14.8% for (T1 brining salt only), respectively while, 23.8% and13.9% for (T2 brining with Moringa Oleifera leaves marinade 5 % (w/v)), respectively. Teye *et al*., (2013) concluded Moringa leaf meal (6g/kg meat) had enhanced protein besides nutritionally of frankfurter-type sausages.

Moreover, physicochemical criteria of raw grass carp fish fillets were as follows, pH value (06.5) also, TVBN (04.3 mg/100g) while TBA (0.42 mg MDA/kg), respectively. However, after smoking for T1 (5.9, 9.6, 0.98) and T2 (5.6, 7.8, 0.81) respectively.

Table 1. The basic data for the raw and smoked grass carp (*Ctenopharyngodon idella*).

Parameters		Value		
Length measurements		C m		
Average total length		40		
Standard length Average		32.5		
Average length of body = trunk		25		
Average length of tail		7.6		
Average length of head		7.5		
Average cross section = depth of body		10.0		
Average maximum thickness		5.2		
Weight composition		(%)		
Average total weight (g)		1080		
Fillets (skin + scales on)		43.52		
Head		25.93		
Skeleton (backbone + ribs)		16.67		
Viscera=guts		7.41		
Weight loss due to dressing		56.48		
Residues		4.62		
Tail		1.85		
Proximate analysis of muscle		Raw fillet	smoked fillet T1	T2
Moisture	(%)	77.8± 0.32	52.3± 0.54	49.7± 0.54
Crude protein (N × 6.25)	(%)	16.3 ± 0.76	20.2± 0.12	23.8± 0.78
Crude fat	(%)	02.5 ± 0.12	14.8± 0.65	13.9± 0.86
Crude ash	(%)	01.8 ± 0.46	10.9± 0.19	10.5± 0.38
Physicochemical quality				
pH value		5.6±0.1	5.9±0.8	6.5±0.41
TVB – N	(mg/100g)	4.3 ± 0.97	9.6±0.64	7.8±0.29
TBA	(mg MDA/kg)	0.42±0.51	0.98±0.49	0.81±0.23
Average specific area of whole fish (cm^2 /g)			0.54	
Average specific area of fillets (cm^2 /g)			0.52	
Average specific of smoked fillets (cm^2 /g)			0.50	
Sex			mixed	
			0.81	

Mean values represent ± Standard Deviation Values
T1 Brining salt on
T2 Brining with *Moringa Oleifera* leaves marinade 5 % (w/v)

It is noticeable that the sample T1 was higher than sample T2, this result might be owing to the result of Moringa Oleifera leaves marinade 5 % (w/v).

Similar study was agreed with (Haq *et al*., 2013. Adeyemi *et al.,* 2013 and 2014. Yu *et al*., 2017and Sun *et al*., 2017).

Though, post-mortem pH can differ from 6.0 to 7.1 be influenced by time of year, species besides further factors (Simeonidou *et al.,* 1998). Level of 30 mg TVB-N/100 g of fish is measured as the suitable limit (Connell, 1990). The concentration of TVB-N in freshly fish is characteristically among 5 and 20 mg mg/100 g, while 30–35 mg/100 g flesh are generally observed as the limit of suitability for stored fish through cold (Huss, 1988 and Connell, 1995). TBA value measuring lipid oxidation (malondialdehyde (MDA) (Goulas and Kontominas, 2007, Ojagh *et al.,* 2010).

According to Connell, (1990), TBA ideals of 1-2 mg MDA l kg of fish flesh are generally considered as the limit beyond that fish will usually develop an unpleasant odor/taste.

Results display brining with *Moringa Oleifera* leaves able to inhibit fat peroxidation.

It is clear from the previous that both samples are within the charter of acceptable.

Qwele *et al.,* (2013) showed that *M. Oleifera* leaves possible may show a character enhanced meat quality from goats as chemical composition also, colour other than, lipid stability.

Results presented M. oleifera marinade reduced-fat deterioration .This was revealed the lower Thiobarbituric acid reactive substance (TBARS) values of 5% Moringa oleifera marinade (T2 0.81 mg/MDA/kg) while the T1 (0.98 mg/MDA/kg).

Das *et al.,* (2012) detected the *M. oleiferia* leaves' extract (0.1 %) was more successful than Butylated hydroxytoluene *(*BHT), for inhibiting increment in TBARS number of prepared goat meat patties through storage at 4°C.

The sensory characteristic of wet grass carp fish entering the processing operations are showed in Table (2).Careful examination of Table (2) revealed that wet grass carp fish entering the processing operation were of very high quality, very fresh fish. This was due to the fact that the fish were transported from farmed in the early morning and then transported directly in an insulated ice-box. The external quality attributes were of similar conditions reflecting a state of a very fresh fish.

Table 2. Sensory evaluations of the raw wet whole grass carp.

I External quality attributes(whole fish)	
1 -General appearance	Uniform selvir grey bright colour, no colour bleaching and shining metallic sheen appearance = free of slime.
2- Smell	No fishy smell, free of any off odour.
3- Eyes	Convex in shape sparking black pupil, clear and translucent cornea and without any bloody spotes (no turbid)
4- Gills colour and odour	Bright- red free of discoloration ,seaweed odour , free of smell and any objectionable odour
5- Elasticity =texture (pressure test)*	(-) Elastic texture and firm (springs back quickly on pressing)
6- Scales	Adherent strong with the skin (difficult to ger removed).
7- Gut wall / abdominal coat	Strong
Peritoneum 8-	Adherent strong
II internal quality attributes (fresh flesh)	
9- Flesh colour	Uniform whit colour , free of discoloration.
10 - Flesh odour	Odourless ,free of any objectionable odour
11 - Texture	Firm and elastic, no gabbing.
12- Conclusion	Very good freshness / excellent.

This test is negative when the flesh recovers its initial position after finger pressing.*

The results of steaming test (cooked) by sensory assessment for fresh fish using in the smoking are summarized and given in Table (3). The data revealed that, fish after cooking were of a pleasant odour (free of any objectionable odour), good taste, excreted a very little amount of exudate of a pleasant taste and free of any objectionable odour. The less amount (volume) of exudate the higher quality of raw fish entering the processing operations.

Table 3. Hedonic and numerical scale of sensory evaluation of cooked fillets (skin off) of grass carp (The steaming test).

Quality attributes	Observations (Descriptive judgment)	Score(Max.9)
Odour of flesh and exudate	Like boiled egg or meat or chicken soap, free of any objectionable odour.	9±0.56
Taste	Cooked meat taste with some muddy taste were observed, free of any rancid taste, salty, sweetly, bitter and sour taste.	7.2±0.87
Colour	Homogenous off white colour	8±0.43
Exudate	1%<	

Mean values represent ± Standard Deviation Values

Fig (1) illustrates the logistic of the best processing operation for the production of hot smoked fillets from grass carp .The aim of the brining operation was to improve the taste of the final product rather than to have a preservative effect.

Fig (1), Table (4 and 5) illustrates the smoking operation and the weight loss of grass carp fish fillets, during the different operation of the smoking process. As it is shown, it include three stages: drying (30 °C for 60 min.), cooking (50°C for 60 min.) and intensive smoking operation (90°C for 90min.).Weight loss due to dressing and smoke curing was 56.48 % and 8.5% for T1 while T2 (56.48% and 5.35%), respectively. Total loss for T1 64.98% and the yield was 38.32%, while T2 (61.83% and 40.37%), respectively. The increment in weight through brining before the smoking operation is an indication of the freshness of fish meat. When the protein is denatured there is an equivalent increment in weight loss through brining. Smoking imparted a golden colour to fish fillets. The increased weight loss through smoking is an indication of the denaturation of protein (Moustafa *et al.,* 2000).This setting up the optimum time and temp. for each phase of the smoking process was called on. This was achieved by means of trial and error concept till achieving the best condition (Fig.1).

Furthermore, Table (4 and 5) showed that weight loss through the various operations of smoking (*Ctenopharyngodon idella*). It is noticeable that the yield in brining, with *M. Oleifera* marinade 5 % (w/v) was higher brining, salt only. Moreover, weight loss (%) in brining, with *M. Oleifera* marinade 5 % (w/v) was lower than brining salt only. This result might be owing to the result of used *Moringa Oleifera* leaves marinade 5 % (w/v), these results are in line with Adeyemi *et al.* (2013 and 2014).

Table 4. Weight loss (Brining salt only) through the various operations of smoking grass carp.

Operation	Weight loss (%)	Yield (%)
Dressing	56.48	43.52
Brining		3.30
smoke curing	8.5	
Total	64.98	38.32*

After subtracting a 8.5% weight loss through smoking curing*
T1 Brining salt only

Sensory evaluation

The organoleptic properties of the end product at zero time using ten panelists of food science department, were conducted to evaluate the product acceptability. Table (6). The results detected that the hot smoked fillets from grass carp had odour similarly rated product odour i.e. had the desirable smoky odour free of any objectionable odour. The

hot smoked fillets of grass carp were good in colour (8.0 and 8.8), taste (7.8 and 8.6) and overall acceptability (7.6 and 8.7) for T1and T2, respectively. Sample T2 high quality *($p<0.05$)*. This attribute was improved by using 5% *Moringa oleifera* marinade in the brining operation.

Table 5. Weight loss (Brining with *M. Oleifera* marinade 5 % (w/v)) through the various operations of smoking grass carp.

Operation	Weight loss (%)	Yield (%)
Dressing	56.48	43.52
Brining		2.20
smoke curing	5.35	
Total	61.83	40.37*

After subtracting a 5.35% weight loss through smoking curing
T2 Brining with *Moringa Oleifera* leaves marinade 5 % (w/v).

The muddy flavour was not observed in smoked fillets especially in T2 of grass carp in addition to texture improved also, softens the bones. *M. Oleifera* marinade apply to preserve the quality of characteristic smoked fillets of grass carp. Use of crude extract of *M. Oleifera* leaves (2 %) had significant antioxidant also, antimicrobial properties and enhanced the sensory quality by improving the juiciness besides tenderness in cooked meat from buffalo, Hazra *et al.*, (2012). Teye *et al.*, (2013) concluded *Moringa* leaf meal (6g/kg meat) had enhanced sensory quality, protein also,nutritionally of frankfurter-type sausages. *M. Oleifera* marinade 5 % Brine (w/v) solutions keeping smoked catfish during stored from bacteriological in addition to fungal decomposition and preserved the ash also, fat , as well as the protein content of smoked fish. Moreover, control commercial loss and possible health risk to customers and thus improving food protection and safety. Furthermore, retard fat deterioration, Adeyemi *et al.* (2013 and 2014). Generally, *M. oleifera* marinade was beneficial than salt only (Control) in keeping smoked fish against lipid peroxidation and maintain quality attributes.

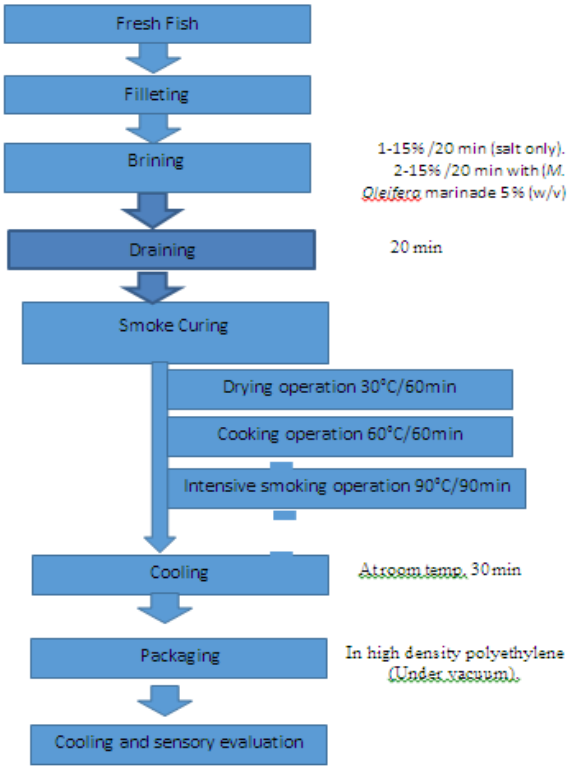

Fig. 1. the best processing operations for the production of hot smoke cured fillets from grass carp (*Ctenopharyngodon idella*).
T1 Brining salt only.
T2 Brining with *Moringa Oleifera* leaves marinade 5 % (w/v).

Table 6. Hedonic and numerical scale of sensory evaluation after hot smoked fillets of grass carp

Quality attributes	Characteristics	Score(Max.9)	
		T2	T1
Colour	Golden and free of burned area.	8.0 ± 0.82^b	8.8 ± 0.91^a
Odour	Appetizing smoky odour and free of any objectionable odours.	7.5 ± 0.67^b	8.7 ± 0.65^a
Taste	Smoked taste, free of any other objectionable taste.	7.8 ± 0.12^b	8.6 ± 0.38^a
Texture	Firm , juicy ,no residues remain in the teeth after chewing (not chewy)	7.6 ± 0.53^b	8.5 ± 0.73^a
Overall quality	Typical quality of hot smoked product.	7.6 ± 0.98^b	8.7 ± 0.15^a

Mean values represent ± Standard Deviation Values
Mean values with different superscripts within the same row are significantly different ($p\leq 0.05$)
T1 Brining salt only. T2 Brining with *Moringa Oleifera* leaves marinade 5 % (w/v).

CONCLUCION

Grass carp could be successfully used for preparation of high quality hot smoked fillets .Taste panel results that muddy flavour was not observed in smoked fillets especially in brining with *Moringa Oleifera* leaves marinade 5 % (w/v) of grass carp and texture improved also, softens the bones. But both producers were accepted by the panelists. Processing of grass carp will introduce diversified products from low- cost fish for export and local market having the appealing characteristic to gain popularity.

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تصنيع وتقييم الشرائح المدخنه علي الساخن مع المورينجا من أسماك مبروك الحشائش

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في الوقت الحالي ، هناك استخدام صناعي محدود لهذا النوع من أسماك مبروك الحشائش ، بالإضافة إلى أن استهلاكه المحلي الطازج محدود. في هذا البحث يتم تحضير شرائح اللحم المدخن الساخن من أسماك مبروك الحشائش (*Ctenopharyngodon idella*) ومدى قبوله. يتم تقديم تركيبة الوزن والتحليل التقريبي وفقدان الوزن أثناء العملية المختلفة. تم دراسة تأثير التدخين في المعايير الفيزيائية والكيميائية. وأظهر التحليل التقريبي للعضلة أنه يحتوي على نسبة البروتين الخام 16.3 ٪ و 02.5 ٪ من الدهون الخام.وكان هناك زيادة في محتوى البروتين والدهون بعد التدخين. علاوة على ذلك ، كانت المعايير الفيزيائية والكيميائية لشرائح المبروك الحشائشي على النحو التالي ، قيمة الرقم الهيدروجيني (06.5) أيضًا ، TVBN (04.3 مجم / 100 جم) بينما TBA (0.42 مجم MDA / كجم) ، على التوالي. بعد التدخين لوحظ زياده جميع القيم باستثناء قيمة الرقم الهيدروجيني. ومع ذلك ، كان فقدان الوزن (٪) في المحلول الملحي مع المورينجا 5 ٪ (وزن / حجم) أقل من الملح فقط. تظهر نتائج الذوق أن استخدام المورينجا أعطى نتائج تقييم أعلى من المعامله بالملح فقط وأصبح أكثر قبولا لدى المستهلك ، خاصة مع اختفاء الطعم الغير مرغوب فيه (الطيني) وكذلك تحسين الخواص الحسيه . لذلك ، يمكن إنتاج منتجات متنوعة من الأسماك منخفضة التكلفة ، للتصدير والسوق المحلية ذات الخصائص المرغوبه والمحبيه للمستهلكين.