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EFFECT OF DIFFERENT WASHING METHODS ON THE QUALITY CHARACTERISTICS OF MINCED CATFISH INTENDED FOR SURIMI PROCESSING

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ABSTRACT: Catfish can be used to process surimi using the traditional washing method, however, this product is currently not commercially available because it requires large amount of water to remove blood, pigments, lipids and water-soluble proteins from minced fish. Reduction of the water volume required during washing steps would lower the production cost and reduce space required during wastewater treatment. Reducing the production cost would encourage catfish processors to further invest to commercialize this product. The aim of this study was to evaluate and compare quality characteristics of washed catfish mince prepared using the traditional method (three washing steps) and modified method (one wash with 0.5% sodium bicarbonate) and to reduce the water volume required during washing steps. Washed catfish mince by both washing systems were evaluated for yield, proximate composition, quality attributes, microbiological counts, macroelements and color. The obtained results' showed that yield, pH, total volatile nitrogen (TVN), thiobarbituric acid (TBA) and microbiological counts were not greatly different. The modified washed mince was lower in fat and higher in protein and salt soluble protein than the traditional washing method, however water holding capacity (WHC) and color whiteness was lower in modified washing method.

Key words : catfish, mince, surimi, traditional washing, modified washing, yield.

INTRODUCTION

Commercial production of cultured channel catfish (locally called Karmout), as a result of the development of aquaculture methods, has increased from 654 tons in year 2000 to 656 tons in year 2001 (Puplic Organization for Aquaculture Development, Fishery Production Statics, 2001)

Channel catfish rapidly grow to harvestable size but are not easily captured by seining (Chappell, 1979).

The majority of locally caught karmout is distributed in ice and mainly sold as fresh whole. Karmout has low market value as compared to other species of fresh water fish. It has many undesirable characteristics such as rapid development of rancid off-flavor, changes in color, water holding capacity, texture and nutritive value. (Thed *et al.*, 1993). The short shelf life of frozen catfish tissue is attributed to the formation of rancid odors and flavors, which arise from the oxidation of unsaturated fatty acids (Erickson, 1993).

In surimi processing, extensive washing is employed to remove water-soluble substances, mainly sarcoplasmic proteins. The removal of sarcoplasmic proteins concentrates myofibrillar proteins responsible for the gel-forming ability of surimi (Lin and Park 1996).

Washing has significant effect in improving the color, reducing many of the oxidative changes and enhancing the frozen shelf life of minced fish. (Grantham, 1981 and Rodger *et al*, 1984).

Alkaline washing of mackerel surimi improved its gel-forming properties (Wu *et al.*, 2000).

The process to produce catfish surimi requires large volume of water to remove blood, pigments, lipids and water-soluble proteins from minced meat. Reduction of the water volume required during washing steps would lower the production cost and reduce space required for wastewater treatment as well as is ecologically important environmental to reduce the problems of pollution.

The objective of this study was designed to evaluate and compare quality characteristics of washed catfish mince prepared using the traditional method (three washing steps) and modified process (one washing with 0.5% sodium bicarbonate).

MATERIALS AND METHODS

Fresh catfish (*Clarias gariepinus*) was obtained from the production ponds that belong to Central Laboratory for Aquaculture at Abbassa, Abu Hammad District, Sharkia Governorate , Egypt.

Fish were washed thoroughly, head and gut removed, filleted and skinned. Mince was prepared from skinless fillets using a Moulinex meat mincer.

Fish were weighed before and after dressing. Weights were recorded to the nearest gram. Dressing percentage was determined according to Lovell (1981). The obtained mince was divided into 2 parts:-

The first was subjected to stepwise washing using first 0.2% NaHCO3, then distilled water and lastly 0 15% Nacl, using 3:1 (v/w) solution to mince ratio. The temperature of washing solution was 4C°. During washing the mince was stirred into the water and allowed to settle after which the water was drained from the mince.

The second one was washed only with 0.5% sodium bicarbonate (NaHCO3) solution.

Analytical methods:

Moisture, protein, fat and ash contents were determined according to the methods described by A.O.A.C. (1995). Salt soluble protein was measured according to the method recommended by Wierbicki *et al.*, (1956). The total volatile nitrogen was determined according to the method described by Mwansyemela, (1973). Thiobarbituric acid was determined according to the method mentioned by Tarladgis *et al.*, (1960). Lovibond Schofield Tinto meter apparatus was used to color estimation (Rangana, 1977). Minerals content (Ca, K, Na, Mn and P) was determined according to the method of AOAC (1995) by Atomic Absorption spectroscopy (AAS) using Perkin Elmer 2380 apparatus.

Microbiological determinations:

Total bacterial count and psychrophilic bacteria count were determined as recommended by the APHA (1992).

Total mold and yeast were counted on Oxytetracycline Glucose Yeast Extract Agar (oxoid CM545) medium as described in the Oxoid Manual, (1982). All determinations in this study were

carried out in triplicates and the average was tabulated.

RESULTS AND DISCUSSION

Effect of mincing and washing method on the yield percentage of minced catfish:

Yield varies according to the original size of the fish, the presence or absence of roe and the season, however, the yield should be determined empirically for each processing plant and the process should be adjusted in such a manner that the yield falls within the specified limits (Toyoda. *et al.*, 1992).

Table (1) showed that the yield of minced fish was 41.84% of whole fish weight . In this concern, Miyauchi and Steinberg, (1970) reported that the total yield of minced fish flesh from various fish species ranges from 37 to 60% based upon round weight.

Awad and Abdel-Aal (1994) and Abdel-Aal (2001) found that the yield of Nile Karmout fish (*Clarias Lazera*) fillet were 49.06 and 47.0%, respectively. Data in the same Table also revealed that the yield after washing with traditional method was 23.45%, whereas the yield after washing with modified method was 22.94%. There is a slight difference in yield between the two washing methods, generally the yield was decreased during washing, this decrement in yield was due to removal of water soluble, fat and small mince meat particles during washing and dewatering process. This data is in accordance with those reported by Lee *et al.* (1990); Park *et al.* (1997) and Abdel-Aal&Ibrahim (2000) found that the yield after washing and dewatering ranged between 18-33% (as whole fish weight).

Effect of washing method on chemical composition of minced catfish:

Results presented in Table (2) shows that washing methods did not markedly affect moisture content of fish flesh. Moisture content of unwashed, traditional method, and modified method were 78.07%,78.32 and 77.01%.

Fat content of unwashed minced fish was 19.69% (at dry weight basis). There was pronounced decrease in fat content as a result of washing method being 14.21% and 8.82% (at dry weight basis) for the traditional washing method and modified washing method, respectively. Separation of fat

during washing treatment was attributed to differences in density and polarity between fat and aqueous solution. The same trend was observed also in ash content where as it was slightly decreased after washing with the two methods (Table 2). Removal of these constituents was reflected in the protein content (Table 2). Protein was increased from 77.70% for unwashed fish flesh to 83.58% and 88.60% for traditional washing method and modified washing method, respectively. These results are confirmed with those stated by Lee *et al.*, (1990) and Kim *et al.*, (1996). From the same Table it could be noticed that salt soluble protein (S.S.P.) of unwashed mince was 46.23% (from the total protein) and was increased to 78.57 and 83.76% (from the total protein) for traditional washing mince and modified washing mince, respectively.

Influence of two different washing systems on quality attributes of minced catfish:

Slight changes in pH of fish flesh was noticed after washing by two methods (Table 3) which was 6.71, 6.69 and 6.72 for unwashed fish flesh, traditional washing method and modified washing method, respectively. In this respect, Haard and Warren (1986) reported that fish muscle which has a very low ultimate pH less than pH 6 can have poor kamaboko forming ability because of protein denaturation muscle has pH greater than 7 can be difficult to dewater because of the increased water retentively of the tissue at alkaline pH. The same data also shows that WHC of unwashed mince was 42% and was increased to 70% and 56% for traditional and modified washing mince, respectively.

It was observed also from the same Table that there was a general decrease in TVN and TBA after the two washing systems which were employed. In this concern Park *et al.* (1997) reached to the same results.

Influence of washing method on some macro elements content of minced catfish:

From the data in Table (4) it could be noticed that modified washing mince had higher levels of Ca, K, Na and P than that found in the traditional washing mince whereas the level of Mn was the same in the two method of washing.

Influence of two different washing systems on the microbiological counts of minced catfish:

Table (5) shows the effect of different washing methods on total bacterial count, psychrophilic bacteria, yeast and mold of minced catfish. The total bacterial counts of minced fish produced from unwashed, traditional washing and modified washing were 3 x 10^5, 2.7 x 10^5 and 2.9 x 10^5 CFU / g, respectively. These results are agreement with those reported by Elliot (1987). As for the counts of psychrophilic bacteria they were present at level 2.7 x 10^3, 2 x 10^3 and 2.4 x 10^3 CFU/g for unwashed fish, traditional washing and modified washing, respectively.

With respect to yeast counts, they were 3.1 x 10^2, 2.3 x 10^2 and 2.7x10^2 CFU/g for unwashed fish, traditional washing and modified washing, respectively. While the respective figures found for mold were <10 CFU/g. These results are in accordance with those obtained by Suvanich *et al.* (2000).

Influence of washing method on color properties of minced catfish:

Washing of the minced fish is usually carried out to produce white odorless and bland flavour surimi product. Data tabulated in Table (6) shows that the yellow, red and blue colours in raw minced catfish were7, 7 and 4, respectively and there was a general decrement in these colours after washing by two methods. These results were in agreement with El-sharnouby, (2002). However, the colour whiteness was higher in the traditional washing mince than the modified washing mince.

It could be concluded that sodium bicarbonate solution 0.5% can be used as washing medium to facilitate fat removal. This would reduce the quantity of water required for processing catfish surimi and reduce the problem of environmental pollution.

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Table (1): Changes in yield percentage of fish flesh as influenced by mincing and washing methods.

Treatment	Yield %
Whole fish	100
Minced fish	41.84
Traditional wash mince	23.45
Modified wash mince	22.94

Table (2): Effect of two different washing methods on chemical composition of minced catfish.

Components %	Unwashed (raw) minced		Traditional washing method		Modified washing method	
	Wet	Dry	Wet	Dry	Wet	Dry
Moisture	78.07	----	78.32	----	77.01	----
Fat	4.32	19.69	3.08	14.21	2.03	8.82
Protein	17.04	77.70	18.12	83.58	20.37	88.60
S.S.P.*	46.23	--------	78.57	---------	83.76	--------
Ash	0.57	2.59	0.48	2.21	0.59	2.56

SSP*: % Salt Soluble Protein from total protein

Table (3): Effect of two different washing method on quality attributes of minced catfish

Constituents	Unwashed	Traditional washing	Modified washing
PH	6.71	6.69	6.72
WHC %	42	70	66
TVN* (mg/100g)	6.43	4.92	5.81
TBA** (mg/kg)	0.43	0.29	0.41

* Total Volatile Nitrogen.
** Thiobarbituric Acid

Table (4): Effect of two washing method on some macro elements content (mg/100g.) of minced catfish .

Treatment	Ca	K	Na	Mn	P
Unwashed	55.8	810	3700	3.1	500
Traditional washing	58.8	380	2700	3.3	220
Modified washing	69.6	630	3800	3.3	350

Table (5): Effect of two washing methods on microbiological counts of minced catfish (expressed as, CFU / g)

Treatment	Unwashed	Traditional washing	Modified washing
Total bacterial Count	$3.0X10^5$	$2.7X10^5$	$2.9X10^5$
Psychrophilic bacteria count	$2.7X10^3$	$2.0X10^3$	$2.4X10^3$
Yeast count	$3.1X10^2$	$2.3X10^2$	$2.7X10^2$
Mold count	<10	<10	<10

Table (6): Effect of washing method on color properties of minced catfish.

Treatment	Yellow	Red	Blue
Unwashed	7.0	7.0	4.0
Traditional washing	4.5	4.4	2.87
Modified washing	5.0	5.1	3.1

تأثير طرق الغسيل المختلفة على خواص جودة مفروم سمك القراميط لتصنيع السوريمي

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** المعمل المركزي لبحوث الثروة السمكية بالعباسة- مركز البحوث الزراعية-الدقي- الجيزة.

تعتبر أسماك القراميط من الأسماك التى لها معدل نمو عالى ولكن قيمتها التسويقية منخفضة بالمقارنة بالأنواع الأخرى من أسماك المياه العذبة. وقد زادت إنتاجية أسماك القراميط في الآونة الأخيرة نتيجة لتطور طرق الاستزراع ولذلك يمكن تصنيعها لمنتجات من شانها زيادة القيمة التسويقية لهذه الأسماك ومن هذه المنتجات منتج السوريمى حيث يتم تصنيعه من لحوم هذه الأسماك ولكن تصنيع السوريمى بالطريقة التقليدية يحتاج لكميات كبيرة من الماء لاستخدامه في الغسيل وإزالة الدم والصبغات والدهون والبروتين الذائب في الماء وهذا يزيد من التكاليف ويجعل المنتج غير اقتصادي مما لا يشجع المنتجين على تصنيع هذا النوع وبهذا فان تقليل حجم الماء المستخدم خلال خطوات التصنيع يمكنة أن يقلل من تكاليف الإنتاج ويقلل من المساحة المستخدمة أثناء معاملة الماء المتخلف وخفض تكاليف الإنتاج يمكن أن يشجع المنتجين على إنتاجه . ولذلك فالهدف من هذه الدراسة هو تقييم ومقارنة خصائص جودة مفروم القراميط المغسول المجهز باستخدام الطريقة التقليدية (ثلاث غسلات) والطريقة المعدلة (غسله واحدة باستخدام ٠،٥ % بيكربونات صوديوم) وكذلك خفض كمية الماء المطلوبة أثناء خطوات الغسيل. وقد تم تقييم المفروم المغسول بطريقتي الغسيل المذكورة بالنسبة لنسبة التصافى والتركيب الكيماوي ومؤشرات الجودة والجودة الميكروبيولوجية وبعض العناصر المعدنية واللون. وقد أظهرت النتائج عدم وجود اختلاف كبير في كل من pH ، TVN.، TBA. ، والحمل الميكروبي في طريقتي الغسيل بينما كان المفروم المغسول بالطريقة المعدلة منخفض في نسبة الدهن وعالي في نسبة البروتين والبروتين الذائب في الملح عن المفروم المغسول بالطريقة التقليدية بينما كانت القدرة على إمساك الماء منخفضة في الطريقة المعدلة عن التقليدية وكذلك كان اللون أفتح في المفروم المغسول بالطريقة التقليدية عن الطريقة المعدلة.