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IMPROVING QUALITY PROPERTIES OF CATFISH MINCE

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ABSTRACT: Catfish (*Clarias gariepinus*) is a good and cheap source for animal protein, however it has low markting value due to less appelizing taste. So, it is necessary to improve quality properties of such fish. The present study was conducted to evaluate the effect of washing on chemical, physical, microbiological of minced catfish using three washing steps on minced catfish flesh. It was washed using $NaHCO_3$ (0.2%), followed by distilled water and lastly with NaCl (0.15%). The obtainal results revealed that most yield loss through washing steps was in the 2nd step (distilled water) and the 3rd step (NaCl) washing. As a result of washing, the percent of moisture and protein increased, but fat and ash levels decreased. Furthermore, it was found that the pH value showed a significant increase due to washing. The three washing steps improved the water holding capacity of minced fish especially at the 1st step of washing. Values of total volatile bases nitrogen (TVB-N) and trimethylamine nitrogen (TMA-N) as well as the thiobarbituric acid value decreased gradually due to washing. Stepwise washing process also caused reduction in the total bacteria count and psychrophillic bacteria count compared with the unwashed mince. It could be concluded that washing process greatly affect and improved the product quality.

Key words: Catfish, trimethylamine, total volatile bases nitrogen.

INTRODUCTION

Catfish (*Clarias gariepinus*) 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 flavour and change in colour (El-Hanafy, 2013).

Yuka and Park (2017) showed that, the washing is one of the most critical steps in surimi manufacturing. Large amounts of water are used to remove the sarcoplasmic proteins, blood, fat and other nitrogenous compounds from the minced fish flesh. Furthermore, process involves mixing minced meat with cold water (5°C) and removing water by screening and dehydrators or centrifuging to about 51% solids. This process is repeated two or three times. Before the final dewatering under a screw press, undesirable particles, such as fine bones, scales, and connective tissues, are removed by the refiner. Suvanich *et al.* (2000) found that, 84% mince was recovered after 2 wash cycles and straining. And used a larger particle sized mince, a 1 to 3 ratio of mince to water for washing, and a screw press for dewatering. Chaijan *et al.* (2004) reported that, a large amount of myoglobin was removed in the first washing cycle and only a small amount was removed in the second washing cycle. The highest removal of myoglobin was achieved when the mince was washed with 0.2% NaCl and 0.5% NaCl.

Washing process is necessary for colour improvement and gel formation of surimi. The removal of the sarcoplasmic protein is the major objective of the surimi process. The largest proportion of muscle protein is made up of the

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myofibrillar proteins: myosin, action, tropomyosin and tropinin. These proteins contribute to the texture of natural fish flesh and to the surimi-based products through their gel-forming ability when heated Chaijan *et al.* (2010). Yathavamoorthi *et al*. (2012) reported that surimi was prepared by washing the mince once with a mince to water ration of 1:4 for 10 min at 3 -5°C and the yield was 80%. The pH of the water must be maintained at approximately that of pre-rigor fish muscle tissue (6.8-7.0) to obtain higher water retention of cooked gels (Park, 2014). Tadpitchayangkoon and Yongsawatdigul (2009) showed that, lipid is normally removed from the adipose cell during the water washing process. Neutral lipids are typically presented at the top layer after washing and can be easily removed. The same trend was observed also in ash content whereas it was decreased after the first and second washing steps. However, after the third washing step, the concentration of ash and carbohydrates enhanced. Ahmed (2001) stated that the average of total bacterial counts, psychrophilic and coliform groups were: 1.2×10^3, 2.3×10^2, 2.1×10^2, 0.7×10^2 cell/g, < 10 and < 10 in unwashed mince of carp fish and after the third washing step, respectively. While in the surimi it was: 1.6×10^3, 1.1×10^2 cell/g and < 10, respectively.

The present work was carried out to study the effect of washing process on yield, chemical, physical, microbiological properties on catfish mince and improving quality properties of catfish meat for production seafood analogues.

MATERIALS AND METHODS

Materials

Sampling

Fresh catfish was transferred directly from Central Laboratory for Aquaculture Research, Abbassa, Abo-Hammad District, Sharkia Governorate, Egypt. Samples were directly transferred to the laboratory, the fish was washed, headed, eviscerated, and hand filleted. The fillets were minced using Malounix mincer, HV6 France. The fish mince was washed three times (at pH 7.0; 4ºC) for 10 min each cycle at a ratio of mince: water 1:3 (*W:V*) first washing step was undertaken by using 0.2% $NaHCO_3$ solution, second, using distilled water and the last wash contained 0.5% NaCl. The washing with each solution was carried out using mechanical stirrer for 10 min. After each stage of washing the mince was filtered and strained twice at 5ºC by manual pressing, first in cheese then in nylon cloths. Samples were kept in altra deep freezer at -20 c until further analysis.

Analytical methods

Moisture, crude protein, crude fat and ash contents were determined as described in AOAC (2005). Total carbohydrates were calculated by difference according to Egan *et al.* (1981). Total carbohydrates (%) = 100- [moisture (%) + crude protein (%) + total lipids (%) + ash (%)]. pH-value was determined according to Ozogul *et al.* (2005). Water holding capacity (WHC) was determined as described by Volvinskaya and Kelman (1960). Total volatile bases nitrogen (TVBN) and trimethylamine nitrogen (TMAN) were determined according to the method recommended by Malle and Tao (1986). Thiobarbituric acid value (TBA) was estimated according to Tarladgis *et al.* (1960). Total soluble nitrogen (TSN) and the soluble non-protein nitrogen (SNPN) were extracted by the method of Kline and Stewart (1949).

Total bacterial count (TBC) and Psychrophilic bacterial count (PsBC): were counted according to the method described by Swanson *et al.* (1992) and coliform count was counted according to American Public Health Association (APHA) (1992). Using Maconky agar medium. The bacterial counts were expressed as mean $\log_{10}$ CFU/g sample.

Statistical Analysis

Three replications of each trial were performed. Analytical procedures data were analyzed using Analysis of Variance ANOVA and means were separated by Duncan at a probability level < 0.05 (SAS, 2001).

RESULTS AND DISCUSSIONS

Yield of Catfish Mince

Results in Table 1 illustrate that, the changes in yield of unwashed and washed mince fish. The mince yield was decreased after washing process. After first washing step, the mince yield was 32.38%. The losses in mince yield during the stepwise washing process were induced by removal of the water soluble substances, fat and small mince particles during washing and de-watering processes. However, there was a slight increase in the yield after the second washing step with distilled water, which was 33.25%, this slight increment may be due to water absorbed by the mince protein. Whereas, after the third washing with (NaCL 0.15%) the yield was slightly reduced to 27.96% this may be due to removing a part of moisture with salt (added salt 0.1-0.3%) in the final washing step and this reduced the moisture content of washed mince. The aforementioned results indicated that the main losses of fish mince yield was occurred by the first washing step particularly during de-watering process. These results agree with the results reported by Iso *et al.* (1985) and Lee (1986).

Effect of Washing Process on Minced Catfish (Karmout) Characteristics

Chemical properties

Results in Table 2 indicate that the chemical composition of unwashed mince of catfish was 77.05% moisture (on wet weight basis), 79.25% crude protein, 14.56% crude fat, 4.58% ash and 1.61% carbohydrates (on dry weight basis). The results of Billard and Perchec (1983) supported the present results. Table 2 also show that, the washing process caused significant increase in moisture, protein and significant decrease in fat and ash contents, these results are in a good agreement with those reported by Lin and Park (1995) and Mahmoud (2006).

Quality Parameters

Total volatile bases nitrogen (TVB-N)

Total volatile bases nitrogen is a mixture of many volatile nitrogenous compounds, such as ammonia and other lower simple monoamines, and it is an index of the degree of protein and non-protein decomposition by the effect of microorganisms.

From the tabulated results in Table 3, it could be observed that TVB-N was 12.65 (mg, TVN/ 100 g sample) for unwashed mince and sharply decreased after washing process. TVB-N was 10.75, 9.65 and 7.55 mg/100g after first, second and third washing steps, respectively. Form these results it could be indicated that unwashed mince was fresh due to the TVB-N which was less than 20 mg/100g. Also, washed mince was considered fresh due to TVB-N less than 14.4 mg/100 g according Hsu (1990).

Results obtained are in agreement to Suvanich *et al.* (2000), Ahmed (2001) and Mahmoud (2006), they showed that washing steps progressively removed all of the non-protein nitrogen. The lower TVB-N in washed minced catfish could be due to removal of free amino acids and sarcoplasmic protein during washing.

Trimthylamine nitrogen (TMA-N)

Trimthylamine nitrogen (TMA-N) is often considered a freshness index in fish. From results in Table 3 it could notice that TMA level in unwashed mince was 4.75 mg/100 g and decreased gradually after first (3.55 mg/100g), second (2.25 mg/100 g), being 1.45 mg/100 g after the third washing step of washing the mince. These results indicated the possibly lower microbial count in fresh fish, also stepwise washing lead to removing TMA and other water-soluble components according to Ahmed (2001).

Thiobarbituric acid value (TBA)

Many investigators have taken TBA as an index of fat oxidation, the same trend also observed in TBA value was 0.85 mg malonaldehyde/ kg sample for unwashed minced fish flesh and gradually significantly decreased to reach 0.35 mg malonaldehyde/kg after third washing. These results indicated efficiency of washing process for removing of fat. These results agree with Ahmed (2001).

Results obtained are in agreement to a great extent with those reported by Lin and Park (1995) and Park and Morrissey (2000) who reported that, the washed mince had lower lipid oxidation and free fatty acid content than unwashed mince.

Table 1. Changes in yield percentage of unwashed and washed minced catfish

Treatment	Yield from whole fish (%)
Whole fish	100
Minced fish	45.61
First washing step ($NaHCO_3$ 0.2%)	32.38
Second washing step (distilled water)	33.25
Third washing step (NaCl 0.15%)	27.96

Table 2. Effect of washing steps on chemical composition of unwashed and washed minced catfish (%)

Chemical composition (%)		Unwashed mince	Washed mince		
			First	Second	Third
Moisture	**Wet basis**	77.05 ±0.33 ^{c}	79.26±0.28 ^{b}	80.85±0.14 ^{a}	80.76±0.25 ^{a}
	Dry basis	----	----	----	----
Protein	**Wet basis**	18.18 ±0.20^{a}	16.95±0.26^{b}	15.98±0.04^{c}	16.40 ±0.19^{c}
	Dry basis	79.25 ±0.23 ^{d}	81.76±0.16 c	83.45±0.38 ^{b}	85.25 ±0.13 ^{a}
Fat	**Wet basis**	3.34±0.02^{a}	2.18±0.08^{b}	1.66±0.01^{c}	1.14 ±0.03^{d}
	Dry basis	14.56±0.32 ^{a}	10.55 ±0.22 ^{b}	8.75±0.12 ^{c}	5.95 ±0.23 ^{d}
Ash	**Wet basis**	1.05 ±0.11 ^{a}	0.63 ±0.08^{b}	0.16±0.02^{c}	0.23±0.01^{c}
	Dry basis	4.58 ±0.11 ^{a}	3.05 ±0.35 ^{b}	0.83 ±0.12 ^{c}	1.23 ±0.11 ^{c}
Carbohydrate	**Wet basis**	0.38±0.16^{a}	0.97±0.14^{b}	1.34±0.13^{b}	1.46±0.11^{b}
	Dry basis	1.61±0.66 ^{c}	4.64±0.73 ^{b}	6.97±0.62 ^{ab}	7.57±0.47 ^{a}

$^{a-d}$ Means within a row with the same superscript are significantly different (P<0.05)

Table 3. Effect of washing steps on quality parameter of unwashed and washed minced catfish

Physicochemical properties	Unwashed mince	Washed mince		
		First	Second	Third
TVBN (mg/100g)	12.65±0.11 ^{a}	10.75±0.45 ^{b}	9.65±0.33 ^{b}	7.55±0.01 ^{c}
TMAN (mg/100g)	4.75±0.03 ^{a}	3.55±0.11 ^{b}	2.25±0.05 ^{c}	1.45±0.01 ^{d}
TBA (mg/kg)	0.85±0.02 ^{a}	0.75±0.03 ^{b}	0.45±0.01 ^{c}	0.35±0.01 ^{d}

$^{a-d}$ Means within a row with the same superscript are significantly different (P<0.05)

Physicochemical properties

The results presented in Table 4 show the changes in pH, WHC, TSN and SPN contents of catfish mince after washing processes. A significantly changes in pH values of catfish mince after washing processes were observed (pH= 6.45 for unwashed mince), while pH= 6.74 was recorded for washed mince after third wash step (Iso *et al*., 1985).

WHC (%) was significantly increased P<0.05 after washing process. Generally, apparent increase in WHC (77.65%) was observed after second washing step, this increase may be due to the concentration of myofibril protein which increase the ability to bind water. These results are in line with results obtained by Park *et al.* (1995) and El-Hanafy (2001).

Total soluble nitrogen (TSN)

Results in Table 4, illustrate that TSN was 4.95% for unwashed mince and significantly decreased during washing processes to 4.75; 4.55 and 4.44% for washed mince after first , second and third washing steps, respectively. This reduction of TSN may be due to unstability of fish mince protein structure due to its rapid denaturation of protein during mincing and washing cycle. These results are in agreement with Park and Morrissey (2000) and Atef *et al.* (2008).

Soluble protein nitrogen (SPN)

Results in Table 4, it could be observed that soluble protein nitrogen was 1.75 in unwashed mince, while significantly decreased during washing processes, reached to 1.65; 1.59 and 1.55 for washed mince after first, second and third washing steps, respectively. These reduction in SPN may be attributed to removal of fat, ash from fish mince. These results are in agreement with Ablett *et al.* (1991) and Atef *et al*. (2008).

Microbiological properties

For microbiological quality control, Table 5 shows that total bacterial count, psychrophilic bacteria and coliform group (Log_{10} CFU/g) in unwashed mince recorded 5.6, 5.38 and less than 1.0 (Log_{10} CFU/g), respectively. While the counts of those organisms were reduced by washing cycles and this decrease may be due to the effect of washing process (Yokoyama, 1990).

Conclusion

The aforementioned results indicated that the washing process greatly affect and improved the quality properties of surimi-based products intended for some products like fish analog.

Table 4. Effect of washing steps on physicochemical properties of unwashed and washed minced catfish

Physicochemical properties	Unwashed mince	Washed mince		
		First	Second	Third
pH	6.45±0.03 ^{b}	6.65±0.02 ^{a}	6.68±0.02 ^{a}	6.74±0.02 ^{a}
WHC (%)	69.75±0.45 ^{c}	75.25±0.33 ^{b}	77.65±0.25 ^{a}	76.85±0.55 ^{ab}
TSN (%)	4.95±0.02 ^{a}	4.75±0.05 ^{b}	4.55±0.03 ^{c}	4.44±0.04 ^{c}
SPN (%)	1.75±0.03 ^{a}	1.65±0.01 ^{b}	1.59±0.01 ^{bc}	1.55±0.03 ^{c}

$^{a-d}$ Means within a row with the same superscript are significantly different (P<0.05)

Table 5. Effect of washing steps on microbiological content on unwashed and washed minced catfish (log 10 CFU/g)

Type of bacteria	Unwashed mince	Washed mince		
		First	Second	Third
Total bacterial	5.60±0.02 ^{a}	3.50±0.03 ^{b}	3.40±0.01 ^{c}	3.14±0.02 ^{d}
Psychrophilic	5.38±0.03 ^{a}	3.25±0.01 ^{b}	3.07±0.02 ^{c}	2.60±0.01 ^{d}
Coliform group	< 1	< 1	< 1	< 1

$^{a-d}$ Means within a row with the same superscript are significantly different (P<0.05)

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تحسين خواص الجودة لمفروم أسماك القراميط

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تعتبر أسماك القراميط من المصادر الجيدة والرخيصة للبروتين الحيواني إلا أنها ذات قيمة تسويقية منخفضة لذلك، فمن الضروريُ تَحسين خواص الجودة لمثل هذه الأسماك.لذلك تم دراسة تأثير عمليات الغسيل على التركيب الكيميائي والفيزيائي والميكروبي لمفروم القراميط وذلك على ثلاث مراحل، الأولى باستخدام محلول بيكربونات الصوديوم ٠,٢% والثانية بالماء المقطر والثالثة بمحلول ملحي ٠,١٥%، أوضحت النَتائِج المتحصل عليها إلى أنّ مرحلة الغسيل لمفروم اسماك القراميط (أثناء إنتاج السوريمى) أدت إلى حدوث تغيّرُ قليل فى المحتوى من الرطوبةَ والبروتينَ، بينما لوحظ فقد كبير في الدهنِ بعد دورةِ الغسيل الأولى باستخدام محلول كربونات الصوديوم، كما حدث انخفاض معنوى ($p<0.05$) فى كل من القواعد النيتروجينية الكلية الطيارة، والنيتروجين غير البروتينى، كذلك حدث انخفاض معنوى ($p<0.05$) للبروتينات الذائبة فى الملح بعد عمليةِ الغسيل الأولى، كما أوضحت النتائج حدوث تغير طفيف لقيم حمض الثيوباربتيوريك والـ pH بعد عملية الغسيل، ومن ناحية أخرى أدت عمليةُ الغسيل لمفروم اسماك القراميط إلى انخفاض فى العدد الكلى للبكتيريا والبكتيريا المحبة للبرودة، من نتائج هذه الدراسة، يمكن الأُستَنتاجَ بأنّ عمليةِ الغسيل لمفروم اسماك القراميط (أثناء إنتاج السوريمى) تُؤثّرُ كثيراً على تحسيّنَ جودة المُنتَجَ.

المحكمون :

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