Effect of Evisceration on Quality of the Marine Fish (*Plectropomus areolatus*) During Ice Preservation

Hala Gindeel Abu Bakr Ahmadoon
Fisheries Research Centre, Red Sea Fisheries Research Station, Port Sudan, Sudan
Corresponding author: halagindeel@yahoo.com

ملخص البحث

أُجريت هذه الدراسة لمعرفة تأثير نزع الأحشاء فى جودة الأسماك البحرية المبردة أثناء فترة الحفظ. أختيرت سمكة الناجل لهذه الدراسة .حفظت العينات (بنسبة تثليج 1سمك:2ثلج) فى صناديق ثلج مصنوعة من ألياف زجاجية الى حين ظهور علامات التلف. أجريت التحاليل الكيميائية والمكروبيلوجية والحسية للأسماك الكاملة والمنزوعة الأحشاء فى الأيام 0 ، 7، 14، 21 و 28 من الحفظ. أوضحت الدراسة أن فترة الحفظ قد أنقصت كل المكونات الكيميائية ماعدا الرطوبة والأس الهيدروجيني اللذان زادت قيمتهما فى الأسماك المنزوعة الأحشاء والكاملة وكان هنالك تأثير معنوي لنزع الأحشاء فى نهاية فترة الحفظ فى كل من الحموضة والبروتين. التغير كان أكبر فى الأسماك الكاملة. أوضحت الدراسة خلو كل العينات من بكتريا السالمونية والضمة والمكورة العنقودية قبل وبعد الحفظ بالثلج ، ولكن كان هنالك ظهور للإيشريشية القولونية فى الأسماك منزوعة الأحشاء قبل ظهورها فى الأسماك الكاملة. أوضحت الدراسة أن هنالك فروق معنوية فى كل من المعالم الحسية أثناء فترة الحفظ بين الأسماك المنزوعة الأحشاء والأسماك الكاملة ماعدا الرائحة وتماسك اللحم ،وكانت الأسماك المنزوعة الأحشاء ذات تصنيف أفضل بالنسبة للغرين على الطبقة الخارجية والجلد وتماسك اللحم أثناء فترة الحفظ. ولكن مع نهاية الفترة لم يوجد أى فرق معنوى بين كل المعالم الحسية وأصبحت غير سارة فى الأسماك منزوعة الأحشاء والكاملة.

Summary

This work was meant to determine the effect of evisceration on the quality of chilled marine fish during preservation period. The species used in this study was *Plectropomus areolatus*. Samples were kept in a ratio of one fish: two ice in fiberglass ice boxes until the appearance of spoilage signs. Chemicals composition, bacteriological test and sensory evaluation of gutted and whole fish at days; 0, 7, 14, 21 and 28 were done. Chemical contents were decreased with progress of preservation period except moisture and pH, which increased in gutted and whole fish. A significant effect was produced from gutting at the end of preservation on acidity and protein; the change was more in whole fish. The gutted and whole fish samples, before and after chilling with ice, were free from *Salmonella* spp, *Staphylococcus* spp and *Vibrio* spp. However, *E. coli* appeared in gutted fish before whole fish. The study showed that, there were significant difference in all sensory parameters except for smell and firmness of flesh. The gutted fish show best assessment in slime, skin and firmness of flesh. At the end of preservation there was no significant difference in all sensory parameters between gutted and whole fish, and the assessment became unpleasant.

Introduction

With the increasing population, fisheries will play an important role in providing highly nutritive food (Reed, 1964). Fish harvest increased rapidly as a result of improved gear technology and expanded fishing grounds (El awad, 2009). The post harvest facility was upgraded, though handling, packaging, marketing, transportation and preservation of fish need to be improved. One of the serious problems that reduce the benefit from fish resource is the perishable characteristic of fish. In the Sudanese red sea coast fish handling and marketing standards differ from one area to another according to the distance from the main marketing centre at Port Sudan (Mishrigi *et al*, 1993). Chilling by ice is the most important preserving method of caught fish (Khalid *et al*, 2000). This study was carried out to determine the effect of evisceration on the quality of chilled marine fish during preservation period.

Materials and Methods

Samples (n=120) were collected from Port Sudan. The species used in this study, was *Plectropomus areolatus*. Freshly caught fish were kept in ice boxes and transported immediately to the Red Sea Fisheries Research Station. All samples were washed with tap water, blotted up, treated as whole fish and gutted fish, weighed, chilled in crushed ice in a ratio of 1 fish to 2 ice and kept in fibreglass (reinforced plastic) boxes. Chemical parameters, microbial tests and sensory evaluation were performed at day 0, 7, 14, 21 and 28.

Chemical parameters studied were pH, acidity, moisture, protein, fat and ash. Protein, fat, ash and moisture were determined according to AOAC (1990); pH was measured using a pH metres and acidity were measured by titration against NaOH according to Ronald (1990).

Microbiological tests were used for detection of *Salmonella* spp, *E. coli, Staphylococcus* spp and *Vibrio* spp; total bacterial counts were also doned (FAO, 1992). Sensory evaluation tests were performed according to Likert (1932) (cited by Anan and Bahy, 2005) and quality evaluation method was applied following Huss *et al* (1974). A score of five to seven indicates a high quality of sensory freshness; a score of three to one indicates low quality of sensory freshness and four indicates a middling quality.

Statistical analysis was performed using SPSS to determine the effects of preservation period on chemical parameters as well as sensory characteristics.

Results

Chemical parameters

Chemical composition tests revealed that pH and moisture were increased while other parameters were decreased during preserving gutted and whole fish in ice. Statistical analysis of the effect of preservation intervals on chemical parameters of chilled gutted and whole fish has showed significant difference ($P< 0.05$) in acidity and protein. Fat and ash also showed significant difference in the first week of preservation, while pH and moister remained unchanged (Table 1).

Sensory evaluation

After seven days of ice preservation, gutted and whole fish were of high quality, but at day 14 there were changes in all sensory parameters and they gained low quality. In day 21, there was significant change ($P< 0.05$) in all sensory parameters except for smell and firmness. However, at the end of preservation period there were no significant differences in all sensory parameters (Table 2).

Microbiological tests

Microbiological analyses showed that no *Staphylococcus* spp, *Salmonella* spp and *Vibrio* spp were present in both whole and gutted samples; but *E. coli* was present in gutted samples from day 14. Total bacterial count increased with the advancement of preservation period in both whole and gutted samples. The contamination was more in gutted, but at the end of the preservation period whole fish samples were also contaminated (Table 3).

Discussion

The present study addresses the effect of chilling on the quality of gutted fish during the preservation period. The spoilage can occur at all stages of processing starting from the time of capture and depending on the temperature, water activity of the fish flesh and presence or absence of the various spoilage microorganisms (FAO, 1981). The results show that, in gutted and whole fish, chilling preservation has a transient effect on chemical parameters. This may be attributed to autolysis which provides predigested nutrients for the spoilage microflora (Simeonido *et al,* 1998).

Table 1: Chemical composition (mean±SE) of gutted and whole fish during ice preservation period

	Gutted					Whole				
	Days of preservation					Days of preservation				
Parameter	**0**	**7**	**14**	**21**	**28**	**0**	**7**	**14**	**21**	**28**
pH	6.69±0.01	6.80±0.10	7.12±0.39	7.01±0.69	7.20±0.11	6.70±0.01	6.74±0.04	6.77±0.28	7.25±.07	7.34±0.19
Acidity*	1.15±0.07	1.27±0.25	1.00±0.35	0.69±0.29	0.56±0.00*	1.15±0.07	1.17±0.12	0.77±0.77	0.82±0.09	0.60±0.07*
Moisture	76.23±1.7	77.51±0.98	78.71±0.11	80.30±0.28*	81.9±0.02*	75.77±1.08	76.72±0.49	78.99±0.47	79.39±0.02*	79.25±1.03*
Protein*	16.67±0.38	14.95±0.9	12.80±0.14	8.90±0.07	7.50±0.1	16.37±0.03	13.95±0.28	12.45±0.07	6.60±00.12	6.30±0.01
Fat	4.10±0.14	3.90±0.06*	3.65±0.07	3.29±0.26	3.10±0.01	4.12±0.11	3.60±0.01*	3.65±0.01	3.40±0.07	3.20±0.38
Ash	5.10±0.56*	5.10±0.01	4.00±0.49	3.20±0.35	3.65±0.01	5.05±0.03*	4.35±0.21	4.100±0.14	4.04±0.07	3.24±0.34

*=P<0.05

Table 2: Sensory evaluation (mean±SE) of chilled gutted and whole fish during preservation period in ice

	Gutted					Whole				
	Days of preservation					Days of preservation				
Parameter	**0**	**7**	**14**	**21**	**28**	**0**	**7**	**14**	**21**	**28**
Slime	7±0.01	6±0.01	6±0.01	4±0.01*	3±0.01	7±0.01	5.5±0.71	4.5±0.12	2.5±0.70*	2±0.10
Smell	6.5±0.71	6±0.10	6±0.10	4±0.01	3±0.10	7±0.01	6.0±0.14	6±0.10	5±1.40	3±0.10
Eye	7±0.01	6±0.01	3±0.01	2±0.01*	1±0.01	7±0.01	3.5±0.70	4.5±1.40	3±0.01*	1±0.10
Skin	6.5±0.70	6±0.01	6±0.01	4±0.10*	2±0.10	7±0.01	4±0.10	4±0.10	3±0.10*	2.5±0.10
Finger press	6.5±0.71	5±0.01	4±1.10	3±0.10*	3±0.10	7±0.01	4±0.41	5±0.10	5±0.10*	3±0.10
Flesh firmness	6.5±0.71	5±0.01	5±0.01	5±0.01	5±0.01	7±0.01	5±0.01	4±1.40	4.5±0.70	4.5±0.70

*=P<0.05

Table 3: Total bacterial count of chilled gutted and whole fish during ice preservation period

Preservation period (in days)	Total bacterial count	
	Gutted	**Whole**
0	$3x10^3$	$2.3x10^3$
7	$1.2\ x10^4$	$2.5x10^3$
14	$9\ x10^{3+}$	$2.6\ x10^3$
21	$2.2\ x10^4$	$1.2x10^4$
28	$1.5\ x10^{4+}$	$2.5\ x10^{4+}$

+ Detected *E.coli*

Decrease in chemical parameters during chilling period is attributable to enzymatic activities and bacterial growth (FAO, 1975). The decrease was more in protein than in fat and ash; this may be due to the gut proteolytic enzymes (Hermes, 2006). The increase in acidity in day seven could be related to the change in glycolysis by the tissue enzymes and production of lactic acid. At the end of the preservation period, the acidity decreased due to the high contamination of gutted fish. The observed significant difference in fat and ash between gutted and whole fish is also probably due to the gut enzymes which continue their activities of attacking the surrounding flesh, causing it to become soft and liable to spoilage by microorganisms (Hermes, 2006).

The sensory evaluation shows that chilled gutted and whole fish remain characteristically as fresh fishes until day seven, then slight change in the quality started to appear at day 14. The whole fish score the best assessment in smell, eye and finger press; a finding which agrees with Røra *et al* (2001) who mentioned that, during gutting the belly area is exposed to air, which makes it more liable to oxidation. By day 28, gutted and whole fish became rejects, due to bacterial and enzymatic activities that break down constituents of complex structure (Connell, 1995). Johnson *et al* (1994) have mentioned that the self–digestion by enzymes, which remain active after death, affects the flavour, appearance of the fish, texture and stiffening of the muscle.

The microbial flora isolated from sea foods differs considerably from one study to another, depending on the species of fish, their environment, the mode of capture, the type of fish product as well as the climatic and storage conditions (Gram and Dalgaard, 2002). In this study, the total bacterial count increases with the increase in the preservation period, and it was higher in gutted than in whole samples. This finding agrees with that of Huss *et al* (1974) who reported that gutting of

fish exposes the belly area and the cut surfaces to the air, thereby rendering them more prone to contamination, oxidation and discolourations. At the end of preservation period the contamination was high in whole fish samples; this agrees with that of Røger *et al* (2006) who have mentioned that fish eviscerated immediately upon landing, maintain quality more days longer than uneviscerated iced fish. Both samples showed no infection with *Salmonella* spp, *Staphylococcus* spp and *Vibrio* spp; *E. coli,* however, appeared from day 14 in gutted samples, this may be attributed to contamination during gutting treatment.

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