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HANDLING PRACTICES, CONSUMER PERCEPTION, AND QUALITY EVALUATION OF FRESH CARITE (*SCOMBEROMORUS BRASILIENSIS*) IN TRINIDAD, WEST INDIES

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ABSTRACT: This investigation provided an overview of the handling practices by individuals involved in the fish trade, consumer perception and quality of fresh carite offered for sale. Landing sites, wholesale and retail markets were visited and face-to-face interviews were conducted with fishermen, wholesalers, retailers and consumers. Microbiological and sensory analyses were performed on whole and gutted fish. All the facilities for handling and trading of fish were grossly under-equipped and in poor hygienic condition. Most consumers viewed whole fish as being 'fresh' and of superior quality compared to eviscerated fish. Fish was of best sensory quality when landed and of worse quality at the retail vendors' stalls. Several recommendations were provided for improvement of quality.

INTRODUCTION

The marine fisheries of Trinidad and Tobago, West Indies (W.I.) are characterised by high diversity in fish species, variety of harvested gear types and fishing fleet. The fishing industry has traditionally been inshore and artisanal. Major pelagic species harvested are carite, kingfish, cavalli, shark, and tuna as well as demersal stocks (Henry, 1997). Carite and king fish are of highest demand for export market and it is estimated that 70% of all carite landings are from the South and Southwestern coast of Trinidad, W.I. namely Moruga and Guayaguayare (Clarke, 1992). Locally, most fish are sold at major landing sites, local markets, roadside stalls or via bicycles and vans (Simon, 1993).

According to Adam (1989), most literature and research on Caribbean fisheries deal with the production and supply of fish, the potential marine resources and their fishing technology. Appropriate methodologies for identifying and addressing post-harvest losses in fisheries have been recognised as a key research priority (Dillon *et al.*, 1997). Freshness is one of the important parameters of quality of fish in most markets and fresh products often achieve a higher price, with the attitude among consumers that 'fresh fish is better' (Sorensen *et al.*, 1997). Assuming that safety is assured, consumers expect fish to be wholesome, and of good overall quality. This study identified the handling practices employed for fresh carite throughout the entire food chain from the fishing vessels, through onshore handling by fishermen, to distribution of fresh fish to the consumers. Consumers' perceptions and quality of fish offered were assessed at sale points.

METHODS

Study area: The landing site studied was at Grand Chemin Beach, Moruga (Southern coast of Trinidad, West Indies). It was estimated that 60% of carite and 30% of kingfish are harvested at this site in Trinidad, W.I. (Amarali, 2000). The site was visited many times at 5.30 a.m (boats return on shore) during the period of September 1999 to March 2000. The biggest wholesale market for retailers was visited at Sea lots, Port-of-Spain (North) at 5.00 a.m. (the market operates between a 2.00-6.00 a.m.). Interviews were conducted with retail vendors who were identified by the wholesalers. An observational approach was taken as to the infrastructure, general organisation of the fishing industry and handling practices at landing sites and vendors' stalls along highways (most of these stalls were located 2-3 metres along the major highways of (Churchill Roosevelt and Uriah Butler).

Data collection. Data were collected directly from fishermen at landing sites, wholesalers, vendors and consumers through face-to-face structured interviews by questionnaire and by informal

interviews with several persons in the fishing trade of Trinidad and Tobago. There were 60 operational pirogue owners at the Gran Chemin landing site and 50% (30) were randomly interviewed. All the wholesalers' (6) as identified by the fishermen were interviewed. Ten (10) vendors who were identified by wholesalers as having purchased all their fish (100%) at this landing site were randomly chosen and interviewed at their roadside stalls. A convenience sampling was done for consumers at the vendor's stalls and the first 10 consumers at each vendor (100 consumers) were interviewed, using a questionnaire.

Participants were asked what they looked for when purchasing fresh fish and what features they took into consideration.

Analyses

Samples of Spanish mackerel or carite (*Scomberomorus brasiliensis*) of the family *Scombridae* were taken just behind the gill, transverse in the lateral body of each fish The treatment groups were (1) whole (non-gutted; NG) fish which were allowed to undergo all the normal practices employed until they arrived on shore; (2) eviscerated (gutted; G) carite as soon as they were harvested and brought on shore and (3) or carite obtained from vendor (vendor; V), which had been tagged (a red string attached to the tail) as soon as they arrived on shore and allowed to go through the normal handling procedures until they arrived at the vendor's stall. These tagged samples were purchased on the morning and the vendors were instructed to fillet the fish. The same representative portions (400-500 g) were taken as for other treatments (NG and G) and immediately iced and microbial analyses were performed within 1 hr of purchase. Fish were cleaned, filleted and wrapped in polyethylene wrap and aluminum foil and stored in a freezer at 0-4^{0}C for compositional analyses.

Total volatile bases: This test determined the extent of proteolytic degradation and formation of other nitrogenous compounds such as trimethylamines. Tests were conducted using the macro-distillation method as reported by Pearson (1976).

Microbial evaluation

Microorganisms were enumerated according to the method outlined by Dawood *et al.*, (1986). From each fish, 10 g sample was taken and serial dilutions prepared with Ringer's solution using the pour plate method with Plate Count Agar (PCA) and incubated at 20^{0}C for 72 hrs and 37^{0}C for 48hrs and the results reported as cfu $^{-g}$.

Sensory quality

Using a modified quality –rating scheme as described by Dawood *et al.*, (1986), six trained judges were asked to evaluate the fish treatments (NG; G; V) on characteristics of appearance of eyes and gills, odours, flesh colour and texture according to Table 1. These judges were a wholesaler vendor, a retail vendor, a boat captain, a boat owner, and two trained panelists (members who are accustomed evaluating the quality of fish in the fishing industry). At the retailer's stall, 100 consumers were interviewed at three sites. Twenty (20) consumers were interviewed at landing sites at Sea Lots and Moruga, 20 consumers at large retail markets of Port-of-Spain and Orange Valley and 60 consumers at roadside stalls at Valsayn, San Juan, Sangre Grande, Diego Martin, and Arima. These consumers purchased fish on a regular basis. The effects of treatments (NG, G and V) on the sensory scores for appearance of eyes and gills, odor, flesh color and texture. The means were separated by Duncan's Multiple Range test at the 5% level of significance.

RESULTS AND DISCUSSION

Observational approach at sites: The infrastructure at the landing site consisted of a concrete building containing cubicles for storage of gas and fishing tackle and an open area for the repair of boats

and nets. There were no toilet and bathroom facilities, nor provision of water. The open-decked boats were 9m pirogues would only accommodate one fish box. This box was made of insulated fibre-glass coated plastic with a drainage hole and had a capacity to hold 228 kg of fish. The fish was then transported from boxes into smaller bins (50 kg capacity), then weighed and transferred into the fish boxes on the wholesalers vehicles. These vehicles which were either three ton open tray trucks or pickup (open tray) vans. Cool or cold storage facilities at ports were not available. Sorting of the fish was done on the bare ground.

Wholesale market. At Sea Lots, Port-of-Spain, the fish were separated by species and placed on the tables or in bins without ice. Inside the covered market building, fish were placed on stainless steel tables without ice. The vendors would manually transfer fish individually or as bulk transfer into boxes to be transported in their vehicles (not refrigerated), often in an unhygienic and haphazard manner. Some vendors brought ice in their boxes whilst others would use the melted ice from wholesalers' boxes to keep the fish cool. Some vendors brought large crocus feed bags for storage of fish. Often these bags were packed tightly with whole fish, without ice and stored on the floor. Faucets supplied water and a long hose facilitated washing. In all cases, retail vendors did not wear protective clothing, nor gloves except for rubber boots. Bulk of the fish was stored in bins at the back open-tray vehicles.

Responses from fishermen at landing sites: All fishermen interviewed at landing sites reported that they would fish for a 12-hr period, either during the day or night. Pirogues were designed to accommodate 250 kg icebox, but they generally transport between 25-38 kg of block ice. Ice would be crushed and mixed with water to produce a slurry. The quantity of ice applied to fish, varied according to the different species. Generally, there was the poor practice of overfilling fish in boxes.

The fishermen (50%) who used the gill netting method, 50% would allow their nets to drift in the water for 4 hrs while other reported a time period of 6 hrs. Fishermen stated it was difficult to state a specific period as the estimated time was dependent on the force of the sea current and weather condition. For fishermen who practiced live bait fishing, they kill the fish by stunning with a blow to the head of the fish, often resulting in open gashes. Some fishermen (33%) indicated that they place the fish immediately on capture in ice- boxes. The rest (67%) of the fish was left on the floor of the vessel until they had undergone rigor mortis which were then placed into ice boxes. It was a regular practice by all fishermen to store the excess fish which, could not have been accommodated in ice-boxes on the floor of the vessel. On shore, the fish were removed manually from ice boxes stored on board and transferred to open bins without ice to obtain weights. The fish were sold to exporters, wholesalers for retail trade or consumers on the landing sites. It was a routine practice for all fishermen to wash their fishing vessels and ice boxes with seawater (no disinfectant or sanitiser) within 1-2 hrs on arrival at shore. When the fishermen were asked for their opinions in respect to handling of fish, all responded that they were satisfied and indicated of no need for improvement.

Responses from wholesalers: On purchase of fish, the wholesalers (5 out of 6 interviewed) layered the fish with crushed ice, which were stored in fish boxes and loaded into vans. Only one wholesaler had large freezers for storage of fish. All wholesalers reported that they sold the fish at the wholesale market at Sea Lots, Port-of-Spain (North Trinidad, W.I.) because of better facilities and more competitive prices as compared to the wholesale market located in San Fernando (South Trinidad, W.I.). If all the fish were not sold at wholesale sites, they were stored and later sold at a cheaper price. Fish were weighed, and then displayed on tables (without ice) for purchase by retailers. The time from arrival of the fish at the port to being displayed on for wholesale vending was estimated to be 6-8 hrs.

Responses from retail vendors: Retail vendors usually purchase fish at the wholesale markets between 3.00-5.00 a.m. Iceboxes were transported in vehicles to store the fish. The length of time for this activity was between 4-6 hrs. Two (10%) of the vendors interviewed reported that the use old deep freezers as substitute iceboxes. None of the retail vendors bought ice ahead of purchase of fish as they were unable to anticipate the quantity of the catch that would be landed (often ice was inadequate) and found it risky economically. They all admitted to the reuse of melted ice from the wholesalers' boxes to keep the fish cool. Retail vendors (70 %) stored different species of fish separately while 30% did not. Most retailers began selling of fish to consumers between 9.00-10.00 a.m. At retail stalls, at Beetham and

Orange Valley, there were potable running water and toilet facilities were available. All roadside vendors brought supply of water in containers, often in limited supply. There was no provision of toilets for roadside vendors. Generally, fish were displayed uncovered and without ice on tables. Only whole fish were displayed until a customer requested the service to de-gut. All retail vendors mentioned that consumers preferred whole fish, as they would relate the presence of blood on the flesh to freshness. All retailers perceived that their handling of fish was satisfactory, having received no complaints from customers and therefore felt no need for improvement in their handling practice. It was a common practice to wrap the fish (whole, slice of fillet) in newsprint and then packaged in polyethylene bags to be sold to customers.

Responses from consumers: At landing sites, consumers (80%) would purchase fish as often as they could, generally twice per week. Even though some consumers (50%) had to travel a considerable distance to the landing sites, they viewed fish sold at this point, as being cheaper, superior in quality, and fishermen were more honest compared to fishermen at other retail outlets. However, most respondents (60%) relied on specific trusted retailers to judge the quality of the fish purchased. All buyers at Sea Lots landing site requested services from fishermen of gutting, cleaning, scaling and sometimes slicing or filleting from the retail fishermen whereas all consumers at the Moruga Fishing Centre perform these tasks at home. At the Moruga Fishing Centre, there was no supply of water for cleaning and dressingof the fish to be supplied to consumers. All consumers would purchase whole, ungutted fish but requested the removal of entrails on purchase. Consumers (40%) reported that they consume the fish on the same day of purchase, while the others refrigerated the fish for not more than 2 days.

At large retail markets. All consumers (20) who were interviewed at two of the largest retail markets at Port-of-Spain and Orange Valley preferred to purchase fish at these locations because of close proximity to their homes, place of employment or were not satisfied with the level of sanitation at roadside retail vendor stalls. Consumers (50%) stated that even though the fish were presented in the same manner as in roadside retail vendor stalls, at least there was a supply of running water and that the fish were not subjected to the direct rays of the sun, dust and exhaust fumes from vehicular traffic as in roadside stalls. As at other retail sites, consumers (90%) preferred to purchase whole fish and then requested services such as gutting, scaling, cleaning or filleting of the fish. In selection of fish, consumers (70 %) indicated that they would examine the gills, eyes and texture and smell for offensive odour. Consumers (85%) consumed fish on the same day of purchase while others consume within two days. Of those who stored fish, it was customary practice to wash, eviscerate, and store in polyethylene bags in freezers.

At roadside vendor stalls. Of the 60 consumers who were interviewed, 80% stated that the purchase fish at roadside stalls, mainly due to convenience, lack of time, limited or no choice and lower prices as compared to the supermarkets. Consumers (75%) expressed dissatisfaction with the presentation and quality of fish offered for sale at vendors stalls. Some recommendations provided by consumers, were that: the fish should be sold in an enclosed building rather than in open stalls; should be stored in ice and displayed in chillers; a supply of running water should be provided, and vendors should wear gloves in the handling of fish. As with other retail outlets, consumers usually ask for whole fish and then ask for the dressing services. Most customers reported having been sold spoilt fish and fooled into purchase of particular species of fish for another species. All individuals were of the view that eviscerated fish was synonymous with 'fresh' fish. Only thirty percent (30%) of the consumers requested to purchase fish stored in ice boxes rather than those displayed on tables without ice. Most participants (80%) reported of no awareness of the effect of temperature on the length of storage. Most consumers were familiar with the basic characteristics of fresh fish quality by examination of the skin, eyes and gills, however 55% of the consumers indicated that they did judge turgidity of the fish by touching. Consumers (50%) use the fish on the same day, 40% within two days of purchase and 10% within four days of purchase. At homes, the general practice was to wash the fish and then freeze in polyethylene bags. All consumers expressed satisfaction as to the quality of the fish and recommended no improvement in the handling practices by retailers.

Sensory evaluation: Table 2 shows the sensory scores assigned to carite for skin appearance, odour, flesh colour and texture. The gutted carite samples (G) scored the highest and thus had the best quality rating when compared to the other samples, G and V. Quality of fish was reduced ($P< 0.05$) at the retail vendor stalls.

Analyses: The total number of mesophilic aerobic microorganisms (CFU/g) was highest in carite samples sold by retail vendors (V; $3.7 \times 10^5 - 7.80 \times 10^5$), followed by the gutted sample (G; $3.8\text{-}13.0 \times 10^4$), with least microbial load for whole non-gutted carite sample (NG; $2.6\text{-}4.2 \times 10^4$), which did not relate to chill spoilage. The higher total bacterial viable load in the gutted fish (77 %; G) as compared to non-gutted sample (NG) was evident of poor evisceration. Microbiological testing of fish is often concerned with poor freshness quality rather than health hazards (Horner and Dillon, 1997). According to the International Commission on Microbiological Specifications for Foods (ICMSF, 1974) has indicated the lower limits (M) for acceptable fresh fish using these criteria at 25 °C was 1.0×10^6 cfu $^{-g}$. All the fish samples were within acceptable microbial limits.

Trimethylamine and total volatile bases have been used in the fish industry as indicators of spoilage for fish and fish products (Olafsdottir *et al.*, 1997). As reported by Pearson (1976), the fish is considered fresh, if the total volatile bases (TVB) is less than 20 mg N $100g^{-1}$ and stale if the values exceed 30 mg N $100g^{-1}$ (Pearson, 1976). The total volatile bases values for fish samples analysed after 24 hrs and 96 hrs of storage revealed that the gutted fish sample (G) had the lowest TVB values (27.8 mg N $100g^{-1}$ and 33.6 mg N $100g^{-1}$ respectively) as compared to samples NG and V (36.4 mg N $100g^{-}$ and 39.2 mg N $100g^{-1}$). All values except sample G stored at 24 hrs were higher than the limit of 30 mg N $100g^{-1}$.

Recommendations. The term 'fresh' fish as used in this investigation was fish that had not undergone any particular process of preservation after the death of the animal, except where practicable, chilling is used to reduce its temperature to near that of melting ice. Consumers reported that freshness was used as a criterion and indicator of quality Results from sensory, microbial and total volatile bases implied deterioration in the quality of fish sold by retail vendors (V) as compared to NG (fish not subjected to normal handling practices). An integrated quality assurance system is needed where the unit operations in handling and holding and distribution of fish are linked together so that process control is possible. In Trinidad, W.I., the ownership of fish can change several times between harvest by fishermen to delivery to wholesalers and retailers and finally the consumer. The operations were not closely coordinated thus resulting in delays between 5-8 hrs.

To be assured of good quality, the catch should be handled quickly and carefully and must be stored at slightly below 0°C at all stages of catchment to distribution so as to minimise loss in quality.

We recommend the use of boxes with holes in the bottom to allow melting water to run through so as to ensure effective chilling of the catch, and stable storage temperature.

There was lack of adequate physical infrastructure for the efficient fish handling system. Fish exports from Trinidad and Tobago have been banned from entering the European Union, because of landing sites, marketing facilities, processing and packaging facilities do not meet approved international standards (Ministry of Agriculture, Land and Marine Resources, 2000).

There should be a mandatory seafood inspection program such as a Hazard Analysis Critical Control System (HACCP) as an effective system to control public safety hazards in food is through the use of HACCP programs. In order to be effective, the HACCP system should be established throughout the production line, from catch to retail sale. In the case of fresh fish, the situation is most often that the fish change owner at the time of landing. Hence the new owner (exporter, wholesaler, processor, retailer, consumer) must also apply the HACCP principles.

All consumers reported that they do not purchase gutted fish, which is a contrary practice to the principles of good fish handling. Fish must be gutted, bled and washed quickly and carefully. The knowledgeable consumers judged the quality of fish by looking at the eyes, gills and turgidity of the flesh, however most consumers relied mainly on visual appearance. Many interviewees remarked that the fish

was desirable quality, if the skin glistens. However, it was a usual practice for retailers to periodically throw water on the fish thus giving an illusion of 'freshness' with resultant deception. Consumers were not aware of the possible hazards, mal-practices and mistakes that can arise from poor handling of fresh fish. Most (90%) consumer viewed fish as being nutritious and tasty and judged freshness on purchase In a study of the consumer motives for buying fresh or frozen plaice in Denmark, the health factor was a greater determinant for the more experienced consumers as compared to less experienced consumers (Nielsen *et al.,* 1997).

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Table 1. Quality Rating Scheme for Carite

Sensory Attributes	Score
Appearance	
Eyes fresh, black pupil, bright red gills	5
Eyes flat, very slight greyness in pupil, slight loss of colour of gills	4
Eyes slightly sunken, greyed pupil, some discolouration of gills	3
Eyes sunken, milky white pupil	2
Eyes completely sunken, gills showing bleaching, covered with bacterial mucus	0
Odours	
Fresh seaweedy odours	5
Loss of fresh seaweediness	4
Lack of odours or neutral odours	3
Slight off odours, slight rancidity odours present	2
Definite off odours and rancid	0
Flesh appearance and colour	
No loss of fresh flesh colour, no reddening along backbone	5
Slight loss of fresh colour, no reddening along backbone	3
Some opacity, reddening along backbone	2
Opaque flesh, brown discolouration along backbone	1
Texture	
Rigid	5
Firm, elastic to the finger touch	4
Softening of the flesh	3
Softer flesh, dried appearance	2
Flesh soft and flabby, retains finger indentations	1

Table 2. Sensory Scores for Fish Quality.

Samples	Skin	Odour	Flesh Appearance	Texture
NG	4.71±0.18a	3.57±0.48b	3.58±0.37b	3.71± 0.18b
G	4.71±0.18a	4.71±0.18a	4.43±0.37a	4.29±0.18a
V	4.04±0.17b	1.88±0.26c	2.65±0.14c	3.11±0.08c

Means ± SE, followed by different letters are different ($P<0.05$)
NG-not gutted; G-gutted; V-sample from retail vendors
See quality rating scheme (Table 1).