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Post-harvest Loss of Farm Raised Indian and Chinese Major Carps in the Distribution Channel from Mymensingh to Rangpur of Bangladesh

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Abstract: Post-harvest loss of catla (*Catla catla*), rohu (*Labeo rohita*), mrigal (*Cirrhinus mrigala*), silver carp (*Hypophthalmichthys molitrix*), grass carp (*Ctenopharyngodon idella*) and sarpunti (*Puntius sarana*) in a single distribution chain from harvest in Mymensingh to retail sale Rangpur town were determined, in order to obtain information on quality deterioration and existing handling and icing conditions so that suggestions for improving such practices can be made. Quality defect points of the fish at different steps of distribution channels were determined using a sensory based quality assessment tool. Percent quality loss of fish at each step of distribution was calculated from the number of cases that crossed sensory quality cut-off points. Neither of the fish lost their quality when they were in the farm gate, during transportation and in wholesale markets in Rangpur but most of the fishes lost their quality at the retail fish shops. The quality loss was 8, 12, 8, 6, 10 and 14% in case of *C. catla*, *C. mrigala*, *L. rohita*, *H. molitrix*, *C. idella* and *P. sarana* respectively in the retail markets. Fishes were not properly handled, bamboo baskets wrapped with polythene sheet were used as carrying container and inadequate ice was used during transportation. Retailers were found to be more proactive in the use of ice. However, most of the fishes were deteriorated during retail sale. The losses of farmed fishes could be minimized by adopting good handling practices like using insulated container and adequate icing.

Key words: Post-harvest loss, indian major carps, quality loss, defect point

INTRODUCTION

Fish provides 60% of total protein in the diet and it creates diverse livelihood opportunities for 5.5 million people as well as earns valuable income and revenue in Bangladesh (DoF, 2012). Proper handling, processing and distribution can ensure the cost effective and efficient utilization of a highly perishable food like fish. The reduction of post-harvest loss can meet the increasing demand of fish in the country and it can also prevail the consumer satisfaction on fish quality and quantity (Nowsad, 2010).

Each and every stage of fish supply chain from harvest to retail distribution in Bangladesh suffers from severe post-harvest loss due to unawareness and negligence on proper handling and processing (Nowsad, 2004). In case of low quality fishes, improper handling and processing reduce the quality of the products and cause a great concern to food security and public health. The fish traders and processors also face serious economic loss due to this ignorance. Most of the freshwater catch is marketed by the fishermen/farmers in the vicinity of the culture sites or landing spots through a number of intermediaries such as fish vendors, (feriwala), wholesalers (paiker) or agents. Large quantities of high valued fishes are usually transported to more distant markets while small quantities of fish with little amount of high valued fish are disposed of local daily markets. During transportation, a considerable portion of the total catch loses its quality by the time it reaches the consumer. Quality loss also occurs when the fish are transported to distant markets by trucks, carrier launches and retail wagons (Coulter and Disney, 1987). Lack of proper knowledge on packing, handling during loading and unloading and method of icing and lack of suitable containers and insufficient knowledge about sanitation and hygiene are the important factors that result in quality loss (Nowsad, 2010). On the other hand, the fisheries resources should be better utilized for the promotion of domestic and export markets. The most direct and immediate contribution to increase food supplies could be made possible by reducing post harvest loss. The consumer behavior, regular launching of new product and modern and improved packaging of the value

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added products make the export market highly competitive for the processors. They all need a wide range of research support to promote export by producing safe and quality products and providing reasonable assurance that fish and fishery products from the country will be safe and of good quality to meet the standard requirements of export. Quality of raw materials needs to be assured at farm, landing, transportation, processing and factory levels (Mansur, 2005).

However, the scientific and practical knowledge on the keeping qualities of tropical or sub-tropical fishes is very limited. In recent years, the importance of storage temperature and pH for the quality of fish muscle proteins has been realized (Nowsad, 2012). Considerable information is available on the post-harvest quality changes in fish from temperate and cold waters but very little is known on the fish species of the warm waters, particularly freshwater carp which are commercially and nutritionally very important in this region. This study was carried out to investigate the post-harvest losses of catla (*C. catla*), rui (*L. rohita*), mrigel (*C. mrigala*), silver carp (*H. molitrix*), grass carp (*C. idella*) and sarpunti (*P. sarana*) in different stages of their distribution and marketing from Mymensingh to Rangpur for getting information on quality deterioration and existing handling and icing conditions so that suggestions for improving such practices can be made.

MATERIALS AND METHODS

Study area and marketing channel of fish: The quality loss of *C. catla*, *L. rohita*, *C. mrigala*, *C. idella*, *H. Molitrix* and *P. sarana* in the distribution channel from Mymensingh to Rangpur was studied in the month of July and August 2010. To identify fish quality in a single distribution chain, fishes caught from different fish farms of Trishal upazila under Mymensingh district and their distributions routes up to retail fish markets in Rangpur were investigated. The fish farms were: (1) Janani Fish Farm, Dhanikhola, Trishal, Mymensingh; (2) Momota Fish Farm, Boilor, Trishal, Mymensingh and (3) Bhai Bhai Agro Farm, Boilor, Trishal, Mymensingh. The wholesale markets in the distribution chain where auction conducted by the commission agents was Rangpur Pouro Wholesale Market and Rangpur Terminal Market. The fishes were sold to the consumers in adjacent retail markets in Rangpur town within the day. The quality of fish thus studied in five steps of their distribution channels, viz., (1) farm site (2) loaded on truck (3) mid-way of transportation from Mymensingh to Rangpur (4) auctioning in Rangpur and (5) retailing in Rangpur town.

Condition of fish during harvest and post harvest handling: Fish were caught from the farm ponds by seine net in the evening (1800 to 1900 h). Fishes were either sold to the transporters (Foria/Pikers) or transported up to Rangpur by the farm owner himself. The traders sorted the fish on the basis of size, weighed, packed in bamboo basket with ice and loaded on truck. About 180-200 kg fish were packed in one basket. For packaging, un-insulated bamboo basket wrapped with polythene sheet and raised by bamboo sticks to accommodate 200 kg fish was used. During packing ice to fish ratio was 1:3 or 1:4. Fish in bamboo baskets were transported from Farm gate in Mymensingh to Rangpur wholesale markets in open truck. After auctioning in wholesale market, fish were taken into aluminium dish/container to transport to retail markets. After harvesting, packing and loading required 2-4 h and the journey started at 2200 h. It took about eight hours to carry fish from farm gate of Mymensingh to wholesale market of Rangpur.

Fish were taken in commission agents in Rangpur, locally called '*arat*' in very early morning (06:00 h). Auctions were stared at 0700 and continued up to 09:00 h. Fish were sold on plastic and aluminium tray in the retail markets. Retailers tried to keep the fish in good condition through re-icing and frequent use of water on fish. But in most cases no ice was used. In retail markets, fishes were sold up to 2400 h of the day (18 h after harvest). Unsold fishes were kept in ice box or with ice in bamboo basket for next day sale.

Assessment of sensory quality loss in wet fish: Quality loss of wet fish in different stages of distribution channels was assessed according to the modified method of Nowsad (2010). The method was based on fish loss assessment and control tool originally developed by Torry Research Institute, U.K (Sakaguchi, 1994). At first sensory Defect Points (DPs) of the fishes at different steps of distribution channels were determined using Table 1 and the quality of fish was determined according to Table 2.

Each of the 3 fish farms sold and transported their fish to Rangpur on regular basis. For each of the farms, two research voyages were made, one in July and another in August. Thus 6 research voyages were made. In each voyage, the data collectors moved along with the fish from the origin of harvest through the distribution channels up to retailers and assessed the quality deterioration of same fish or same lot of fish. In every step of distribution, at least five lots of same fish and 5 individual measurements for each lot were assessed based

Table 1: Defect Points (DP) for assessment of quality loss of fish

Characteristics*	Defects	DP	Name of fish
Odor of broken neck	a. Natural fishy odor	1	
	b. Faint odor	3	
	c. Sour odor	5	
Odor of gills	a. Natural odor	1	
	b. Faint sour odor	2	
	c. Slight moderate sour odor	3	
	d. Moderate to strong sour odor	5	
Color of gills	a. Slight pinkish red	1	
	b. Pinkish red to brownish	2	
	c. Brown to grey	3	
	d. Bleached color	5	
Slime of gills	a. Thin colorless slime, filaments soft & separate	1	
	b. Sticky greenish slime, filaments separate	3	
	c. Yellowish slime, filaments attached	5	
Body slime	a. Clear, transparent, uniformly spread	1	
	b. Turbid, opaque	3	
	c. Thick, sticky, yellowish or greenish	5	
Eye	a. Bulging with protruding lens, transparent eye cap	1	
	b. Slight cloudy lens, sunken	2	
	c. Dull, sunken, cloudy, blood line/reddish cornea	3	
	d. Sunken eyes covered with yellow slime	5	
Consistency of flesh	a. Firm, elastic	1	
	b. Moderately soft & some loss of elasticity	2	
	c. Some softening of muscle	3	
	d. Limp or floppy	5	
General appearance	a. Full bloom, bright, shinning, iridescent	1	
	b. Slight dullness, loss of bloom	2	
	c. Definite dullness and loss of bloom	3	
	d. Reddish lateral line and causal region, dull, no bloom	5	

*Indicators modified based on Howgate *et al.* (1992) and Connell (1990)

Table 2: Quality grade of fish with defect points (DP)

Grade	DP	Grade characteristics*
A	<2	Excellent, highly acceptable
B	2-3	Good, acceptable
C	>3-<4	Deteriorating, not acceptable
D	4-5	Spoilt, rejected

*Howgate *et al.* (1992)

on Table 1. Thus the quality deteriorations of the same fish or same lot of fish were assessed during its movement from harvest to retailers.

Percent loss of fish in each step of distribution was calculated according to Nowsad (2010). After death fish undergoes biochemical and microbiological changes and these changes are accelerated with the laps of time. Each chemical and microbiological quality parameters has a quality cut-off point beyond which the fish is said to be deteriorated or not acceptable. Quality loss (%) was calculated from the number of assessed cases that crossed DP 3.3 in different investigations. The following formula (Nowsad, 2010) was used to calculate percent quality loss of fish.

$$L\ (\%) = Pi/N \times 100$$

L = Percent quality loss

N = Number of observed lots

Pi = Total number of calculated DP those crossed DP 3.3

$$Pi = P1/n1+P2/n2+P3/n3+...+Px/nx$$

where, 'p' is the number of DP crossed 3.3 in fishes in 'x' number of lots and 'n' is the number of observations in each lot.

Data analysis: All the collected information were summarized and scrutinized carefully and recorded. Finally, they were analyzed by MS-Excel and then presented in textual and tabular forms in accordance with the objectives of the study.

RESULTS AND DISCUSSION

The quality defect points of the assessed fishes in the distribution channel from Mymensingh to Rangpur have been presented in Table 3. A total of 6 voyages were made where the same fish or the same lot of fish were evaluated through its movement from farms to retail fish shops. It was found that the quality of fish was degraded with the time passed. In *C. catla*, the Defect Point (DP) was 1.0 at farm gate (Trisal, Mymensingh) at 8.00 p.m., but 2.60±0.83 at retail markets at 2.00 p.m. of the following day. The scenario was almost similar in case of other 4 species. The DP started with 1.0 but ended with 2.94±1.66, 3.04±1.02, 3.22±0.81, 3.65±1.11, 3.15±1.34 in *L. rohita, C. mrigala*, *H. molitrix*, *C. idella* and *P. sarana*, respectively. Table 2 shows that the fish having DP in the range between 3 and 4 were deteriorating and not

Table 3: Sensory defect point (DP), ambient temperature and handling situation, time spent for fish trip at different distribution channels

	Sensory defect point (DP) of fish								
Distribution steps	*C. catla*	*L. rohita*	*C. mrigala*	*H. molitrix*	*C. idellus*	*P. sarana*	Temperature (°C)	Handling situation	Time
IaC	1.0±0	1.0±0	1.0±0	1.0±0	1.0±0	1.0±0	29.0		8.00 p.m.
LoT	1.11 ±0.12	1.11±0.10	1.12±0.12	1.11±0.11	1.05±.70	1.11±0.11	29.0	Inadequate icing and washing	9.00 p.m.
MwT	1.23 ±0.24	1.18±0.72	1.23±0.11	1.18±0.07	1.23±.07	1.18±0.072	29.8	No re-icing	9.30 p.m.
WM-1	1.83±1.10	2.03±0.1	2.18±0.61	2.22±0.05	2.31±0.05	2.25±0.05	30.5	No re-icing	6.00 a.m.
WM-2	2.02±1.00	1.98±0.76	2.44±0.45	2.72±1.22	2.56±0.87	2.05±0.68	31.0	No re-icing	6.00 a.m.
RM-1	2.60 ±0.83	2.64±1.05	2.53±0.78	2.86±1.80	2.70±1.84	2.20±1.84	32.6	Little icing or no icing	2.00 p.m.
RM-2	3.30 ±0.83	3.64±1.05	3.33±1.33	3.30±1.46	3.45±1.67	3.30±0.81	34.0	Little icing	5.00 p.m.
RM-3	3.58 ±1.05	2.94±1.66	3.04±1.02	3.22±0.81	3.65±1.11	3.15±1.34	32.6	Little icing	8.30 p.m.

IaC: Immediately after catch, LoT: Loaded on truck, MwT: Mid-way transportation, WM: Wholesale market, RM: Retail market

Table 4: Container used and other conditions applied during transportation of fish

	Container and conditions				
Fish	Farm gate	Packing	Transportation	Wholesaler	Retailer
C. catla	Bamboo basket/ plastic drum; no insulation	Raised bamboo basket with polythene sheet and bamboo stick	Open truck	Open bamboo basket	Aluminium tray
L. rohita	Iron drum/bamboo basket; no insulation	Raised bamboo basket with polythene sheet, quantity: 160-180 kg	Open truck	Open bamboo basket	Aluminium tray
C. mrigala	Bamboo basket; no insulation	Bamboo basket with polythene sheet	Open truck	Open bamboo basket	Aluminium tray
H. molitrix	Bamboo basket; no insulation	Bamboo basket with polythene sheet	Placed on open truck side by side	Open bamboo basket	Aluminium tray
C. idellus	Bamboo basket; no insulation	Bamboo basket with polythene sheet	Placed on open truck side by side	Open bamboo basket	Aluminium tray
P. sarana	Bamboo basket; no insulation	Bamboo basket with polythene sheet	Open truck	Open bamboo basket	Aluminium tray

Table 5: Extent of quality loss of fish (%) in different stages of distribution channel

			Quality loss (%)				
Fish	Month of observation	Distance of consumer market (km)	Farm gate	Packing	Transportation	Wholesaler	Retailer
C. catla	July	260	-	-	-	-	8
L. rohita	July	260	-	-	-	-	8
C. cirrhosus	July	260	-	-	-	-	12
H. molitrix	July	260	-	-	-	-	6
C. idellus	July	260	-	-	-	-	10
P. sarana	July	260	-	-	-	-	14

acceptable. In other study, Nowsad (2010) determined the sensory quality breaking point of fish at DP 3.3. Based on the results, it was observed that most of the fishes lost their quality acceptance level at the retail fish shops. The fishes those were well taken care off during transportation were found in good quality. Temperature was gradually increased as the sunshine getting intense. Obviously, the rate of deterioration was accelerated by the higher ambient temperature that resulted higher oxidation. Mansur *et al*. (2002) also found similar results. The initial temperature was 29.0°C at 8.00 p.m. and reached to 32.6°C at 2.00 p.m. of the day. Initial ice to fish ratio during the start of distribution path was 1:3. Re-icing was not done during transportation or auctioning. Ice was found to be completely melted down by the time the fish reached auction center in Rangpur. There was no scope to re-ice fish during the journey. After auction, a very little amount of ice was used by the retailers. During retail sale, however, re-icing and sprinkling of cold water over fish were done.

Mainly bamboo baskets wrapped in by polythene sheet were used to transport the fish (Table 4). Ideal ice box or metallic or plastic box with insulation were not used. During packing, bamboo baskets of 30-40 kg capacity were raised by bamboo sticks and polythene sheet to about 1.5 to 2.0 feet so that the capacity of basket increased up to 180-200 kg fish. There was no opening to drain out the melted water. Open truck were used to carry fish. Baskets filled with 180-200 kg fish were kept on the truck side by side. Retailer collected the fish from wholesale market with little or no ice since most of the ice was found to be melted down. The retailers carried their fish by aluminium tray (Table 4). In most cases, retailers did not use sufficient ice to keep the fish fresh. As a result with the passing of time and increase of temperature fishes were deteriorated in different extent (Table 5).

The percent quality loss of fish was determined in different stages of distribution channel (Table 5). In determining the quality loss, quality of fish at all steps in 6 voyages was considered and the average was taken.

Neither of the fish lost their quality when they were in the farm gate, during packing and transportation and in wholesale markets. The quality loss was 8, 12, 8, 6, 10 and 14% in case of *C. catla*, *C. mrigala*, *L. rohita*, *H. molitrix*, *C. idella* and *P. sarana* respectively in the retail markets. At the farm gate, fishes were fresh and freshness in terms of average DP were in acceptable range (DP<3.3) during transportation up to the wholesalers. But in some observations, DPs of fish at wholesalers sometimes exceeded the acceptable range, as shown that the standard error (±) values were more than 1.0 in some cases (Table 1). This wide fluctuation of DPs might be due to misappropriate handling of fish and high ambient temperature in those occasions. It was observed that, *P. sarana* encountered highest loss (14%), followed by *C. mrigala* (12%) and *C. idella* (10%). The losses might be associated with landing conditions, size and oil contents encountered with high ambient temperature. Within the same lot deterioration of *C. idella* and *C. mrigala* might be due to their less firmness of the muscle compared to other species. However, the percent loss of the studied fishes transported from Mymensingh to Rangpur were slightly lower than the percent quality loss of fish (12-16%) determined from many different distribution channels of the entire country (Nowsad, 2010). Nowsad (2010) estimated the post harvest quality loss of 28 commercial freshwater and marine fishes under different seasonal and handling conditions and in different short to long distribution channels in Bangladesh. The average post harvest loss in retailers for *C. catla*, *L. rohita*, *C. mrigala*, *C. idella* and *H. molitrix* were found to be 12, 16, 11, 12 and 13%, respectively. Due to difference in handling conditions, post harvest loss was observed not only in retailers or vendors but also in wholesalers and transporters. *C. catla*, *L. rohita*, *C. mrigala*, *C. idella* and *H. molitrix* were found to be lost by 3, 4, 6, 3 and 3%, respectively in transporters. In that study fish landed from both capture and culture fisheries were studied and average value of all types of fishes in all distribution channels were taken. But, in our present study, farm-raised fishes were transported immediately after harvest through definite distribution route without lapsing time. The present distribution route was more or less smooth and comparatively better care was taken during transportation up to wholesalers of Rangpur.

Many authors also observed post-harvest fish losses at different stages of distribution chain from capture to consumption. Hossain *et al.* (2002) found huge loss of fish due to very poor or no preservation facilities in Mymensingh area. As there was inadequate handling and preservation (icing, chilling and freezing) or storage facilities for farmed Indian major carps, the retail fish traders suffered huge economic loss in terms of low price offered for quality deterioration (Hossain and Afroze, 1991; Hossain *et al.*, 2002). Hossain *et al.* (2002, 2005) and Hoq and Kohinoor (2005) identified the livelihoods of such fish traders in Kewatkhali and Shutiakhali Union of Mymensingh was highly vulnerable.

However, these losses of farmed fishes could be minimized by adopting good handling practices like using insulated container and adequate icing.

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