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Post-harvest handling and quality loss of two major carps in the distribution channel of Jashore Region, Bangladesh

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Abstract

The study was undertaken to investigate the post-harvest loss of rohu (*Labeo rohita*) and mrigal (*Cirrhinus cirrhosis*) in the different distribution channels of the different fish markets in Jashore, Bangladesh for getting information on quality deterioration and existing practices. The sensory evaluation method was adopted to gather information about quality loss and existing handling conditions. The quality loss was observed through the different stakeholder levels because of improper handling, and transportation procedures. For rui fisherman supplied fish to aratdar at 3.57% quality loss, further 5.46% and 9.4% loss was observed through retailer and consumer respectively. For mrigal fisherman supplied fish to aratdar at 3.57% quality loss, further 5.47% and 9.05% loss was observed through retailer and consumer respectively. DPs (Defect Points) were higher in June–July which indicates that temperature rise causes more quality loss of fish. The ice ratio of fish: ice was 1:1 in summer and 2:1 in winter. Fisherman used only 25% ice whereas aratdar never used ice and retailer used 62.5% ice during transportation. The more quality loss of fish the more ice was used. Fisher transporting fish by the van, pickup, nosimon, rickshaw and the percentages were 10%, 14%, 70%, 6% respectively. Bad handling practices due to transportation and in markets also caused quality deterioration. Post-harvest loss of fish is not taken under consideration. The highest defect point was 2.7 at the retailer level because of long term exposure to open air. So, the study is needed for the development of knowledge in fishing, handling and processing, selling and transporting.

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Introduction

Fish is an important source of protein in the diet and it provides the livelihood for millions of people as well as valuable income and revenue in many countries. It is a highly perishable food, requiring proper handling, processing and distribution if it is to be utilized in a cost-effective and efficient way. In Bangladesh, the fisheries sector suffers from serious post-harvest loss every year due to ignorance and negligence in handling and processing at different stages of the supply chain from the harvest to retail distribution (Nowsad, 2010). In Bangladesh, fish marketing and distribution varies from area to area. Both the marketing and distribution of fish are mostly under the private sector. About 97% of the total production of fish is marketed internally for domestic consumption while the remaining 3% is exported (DOF, 2010). The marketing system in Bangladesh is traditional, complex and less competitive, but plays a vital role in connecting the fish producers and consumers. The high temperature in tropical climate spoils fish while still in the boat, at landing, during storage and processing, on the way to the market and even while waiting to be sold (FAO, 2003). Value of the reaped fishes landed for ingesting is misplaced during harvesting and post-harvest management (Hossain *et al*., 2012) due to ignorance and/or negligence of the people during harvest, distribution, processing and trade (Nowsad, 2004), preservation methods, transportation methods, availability of ice during transportation and selling period, etc. (Hossain and Barman, 2016). Fish were fresh at the fisherman level but as the day progress along with temperature variation fish started to losing quality and most of their quality found lost at the retailer level (Chwakravorty *et al*., 2019).

The improper handling and processing reduce the quality as well (Nowsad, 2004). The study was undertaken to investigate the post-harvest losses of rui (*Labeo rohita*) and mrigel (*Cirrhinus cirrhosus*) in different stages of their distribution and marketing in the Jashore district for getting information on quality deterioration and existing handling and icing conditions.

Materials and methods

Study area and duration

The study was conducted in two markets of Jashore district namely boro bazar and churamankati bazar. The study area was shown by (Fig. 1). The quality loss of *Cirrhinus cirrhosis* and *Labeo rohita* in the different distribution channels of Jashore was observed from June to November 2019.

Data collection and stakeholder selection

The main survey areas in respect of adjacent landing sites, local fish markets were taken under investigation. The questionnaires were administered on the primary, secondary and final consumer markets. Primary data were mainly collected from the fishermen, fish harvester, fish handler and fish traders based on questionnaire interview. The data were collected over four months. Secondary data were collected from various research projects, annual reports and kinds of literature from different websites.

Experimented fish species

For sampling *Labeo rohita and Cirrhinous cirrhosus* were tested for the sensory evaluation. These fishes were collected from the different fish markets in Jashore.

Method of evaluation

The method of assessment of fish quality was followed according to the modified method (Nowsad, 2010) which was based on fish loss assessment and control tool originally developed by Torry Research Institute, U.K. (Sakaguchi, 1990). Sensory defect points (DPs) of fishes were determined at different distribution channels using Table 1 for assessment of fish quality.

The method was based on Fish Loss Assessment and Control Tool originally developed by Torry Research Institute, U.K. (Sakaguchi, 1990). To assess the quality of harvested at different stages of fish in the distribution channel, at the first sensory defect point with numerical scores employed in a sensory analysis was done by using (Table 1). General grading of fish

obtained through the analysis of defect points (DP) was presented in (Table 2).

A quality loss index (QLI) model was followed to estimate the percent quality loss of fish at any state of distribution channel. The following equation was used for the quality loss index:

$$QLI\ (\%) = \frac{Pi}{N} \times 100$$

QLI = Quality loss index

N = Number of observations

Pi = Number of calculated DP crossed quality breaking point (QBP)

$$Pi = \frac{P1+P2+Pn}{n}$$

Where, 'P' is the number of DP (Defect points) crossed QBP point in different lots (up to n numbers) of same species under different distribution channel in different fishery regions (Nowsad, 2010).

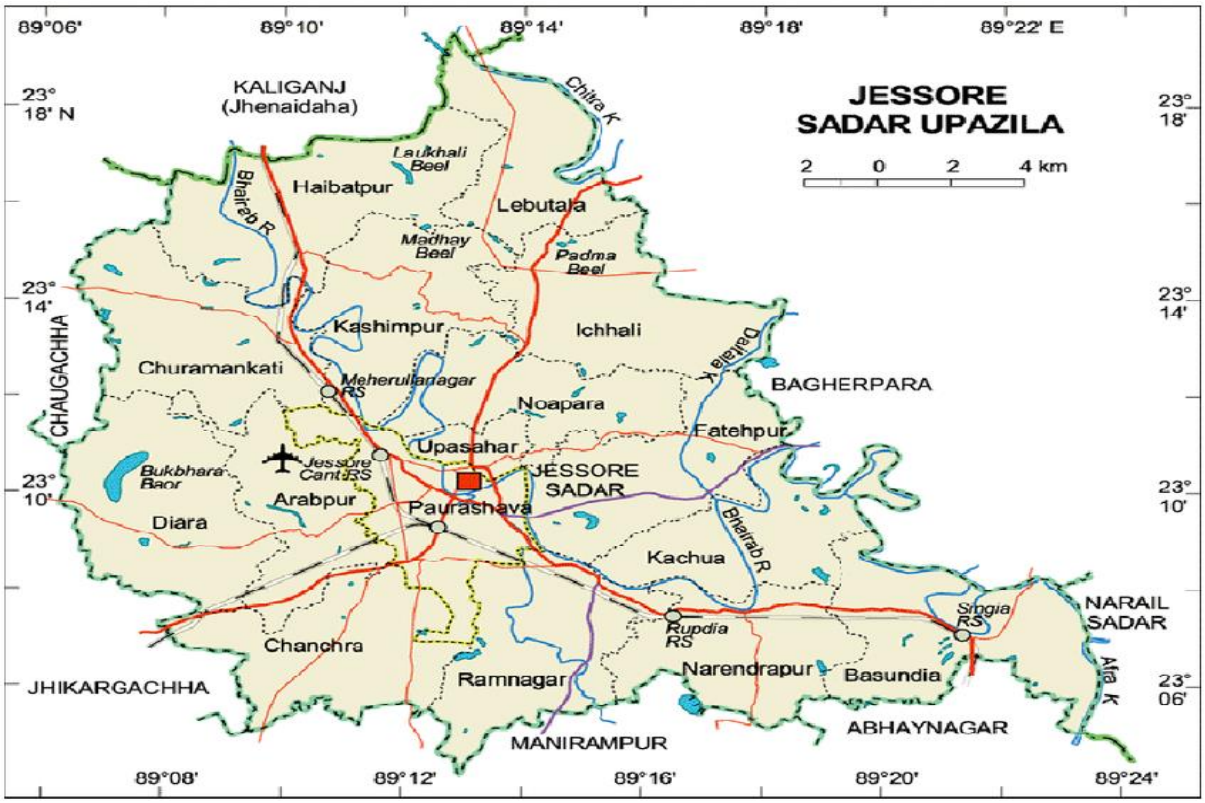

Fig. 1. Map of Jashore district indicating study area, ▲ indicates Churamankati bazar, ▲ indicates Borobazar of Jashore district.

Pi = Number of calculated defect point

Data analysis

MS Excel and Graph Pad Prism 7 were used to store all the data. Data analysis was done by using the SPSS software (Statistical Package for Social Science) version 16 to determine the mean and standard deviation of all the data.

Results

Fish Quality Loss through the Marketing Channel

Quality loss of fish was observed through the different stakeholder levels because of improper handling, and transportation procedures. For rohu fisherman supplied fish to aratdar at 3.57% quality loss, further 5.46% and 9.4% loss was observed through retailer and consumer respectively (Fig. 2). For mrigal fisherman supplied fish to aratdar at 3.57% quality loss, further 5.47% and 9.05% loss was observed through retailer and consumer respectively (Fig. 2).

Utilization of Ice

Aratdar brought fishes from monirampur and supplied fish to the retailer. Fishermen used only 25%

ice during transportation because fish remained fresh at this level. Whereas aratdar never used ice because fish sold by auctioning and remained short period. The retailer used 62.5% ice (Table 3).

Utensils used in fish transportation

Various utensils were used by fisher during transporting to the nearest market such as plastic baskets, plastic drum whose carrying capacity were 15-20 kg and 30 kg. Live fish were transported by plastic drums with water.

Utensils used in fish handling

Bamboo baskets, plastic baskets, plastic drums, aluminum trays were used for handling purposes in the market. Banana leaves or cork sheets were used with some baskets.

Vehicles used

Fisher who had a small portion of fish was seen transporting fish by the van, pickup, nosimon, rickshaw and the percentages were 10%, 14%, 70%, 6% respectively (Fig. 3). When there were remote distance and much supply of fish by large scale farm, the pickup was used.

Time of harvesting

The time of catching of fish varied from midnight to early morning. 30% of fish were caught at 3 am, 50% at 4 am, 10% at 5 am and 10% at 6 am (Fig. 4).

Table 1. Attributes and defect points for quality assessment of fish.

Attributes	Defect	Defect points	Grade
1. Odor of neck when broken	a) Natural odor	1	Acceptable
	b) Faint or sour odor	5	Reject
2. Odor of gills	a) Natural odor	1	Excellent
	b) Faint sour odor	2	Good
	c) Slight moderate sour odor	3	Acceptable
	d) Moderate to strong sour odor	5	Reject
3. Color of gills	a) Slight pinkish red	1	Excellent
	b) Pinkish red to brownish	2	Good
	c) Brown or grey	3	Acceptable
	d) Bleached color, thick yellow slime	5	Reject
4. General appearance	a) Full bloom, bright, shining, iridescent	1	Excellent
	b) Slight dullness and loss of bloom	2	Good
	c) Definite dullness and loss of bloom	3	Acceptable
	d) Reddish lateral line, dull, no bloom	5	Reject
5. Slime	a) Usually clear, transparent and uniformly spread	1	Excellent
	b) Becoming turbid, opaque and milky	2	Good
	c) Thick sticky, yellowish or green color	5	Reject
6. Eye	a) Bulging with protruding lens, transparent eye cap	1	Excellent
	b) Slight cloudy of lens and sunken	2	Good
	c) Dull, sunken, cloudy	3	Acceptable
	d) Sunken eyes covered with yellow slime	5	Reject
7. Consistency of flesh	a) Firm and elastic	1	Excellent
	b) Moderately soft and some loss of elasticity	2	Good
	c) Some softening	3	Acceptable
	d) Limp and flabby	5	Reject

Elements used when transporting fish

In the very early morning, distant areas live fishes were transported to the local market by plastic drums with water at the rate of 30%. In this way, live fish could survive for 1 hour. Fishes that were dead due to harvesting or lost bloom were seen transported with icing at the rate of 50%. 20% fisher used nothing for the transportation to near market (Fig. 5).

Re-icing

About 70% of fish sellers adopted re-icing for unsold fishes and 30% used no ice (Fig. 6). Normally retailers have no unsold fish, in the case of unsold fish, they preserve them in the ice.

Table 2. Grading of fish on the basis of the defect points.

Grade	Average DP	Comments
A	< 2	Excellent/Highly acceptable
B	2 to < 3	Good/Acceptable
C	3 to < 4	Deteriorating/Not acceptable
D	4 to 5	Spoiled/Rejected

Table 3. The ice ratio used by different stakeholder level.

Stakeholder level	Ice used		Ice ratio (Fish : Ice)		Source of ice	Water source of ice
	Yes	No	Winter	Summer		
Fishermen	25%	75%	2:1	1:1	Nearby ice factory	Deep tube well
Aratdar		100%	-	-	-	-
Retailer	62.5%	37.5%	2:1	1:1	Nearby ice factory	Deep tube well

Post-harvest loss assessment

Post-harvest loss assessment of Labeo rohita

At fisherman, average DPs level was 1.00 ± 0.00 in June-July & 1.00 ± 0.00 in October-November. At aratdar DP increased from fisherman level. DP level 1.60 ± 0.07 in June-July and 1.46 ± 0.09 in October-November. The variation noticed at the retailer level where 2.7 ± 0.20 in June-July & 2.55 ± 0.09 in October-November (Fig. 7).

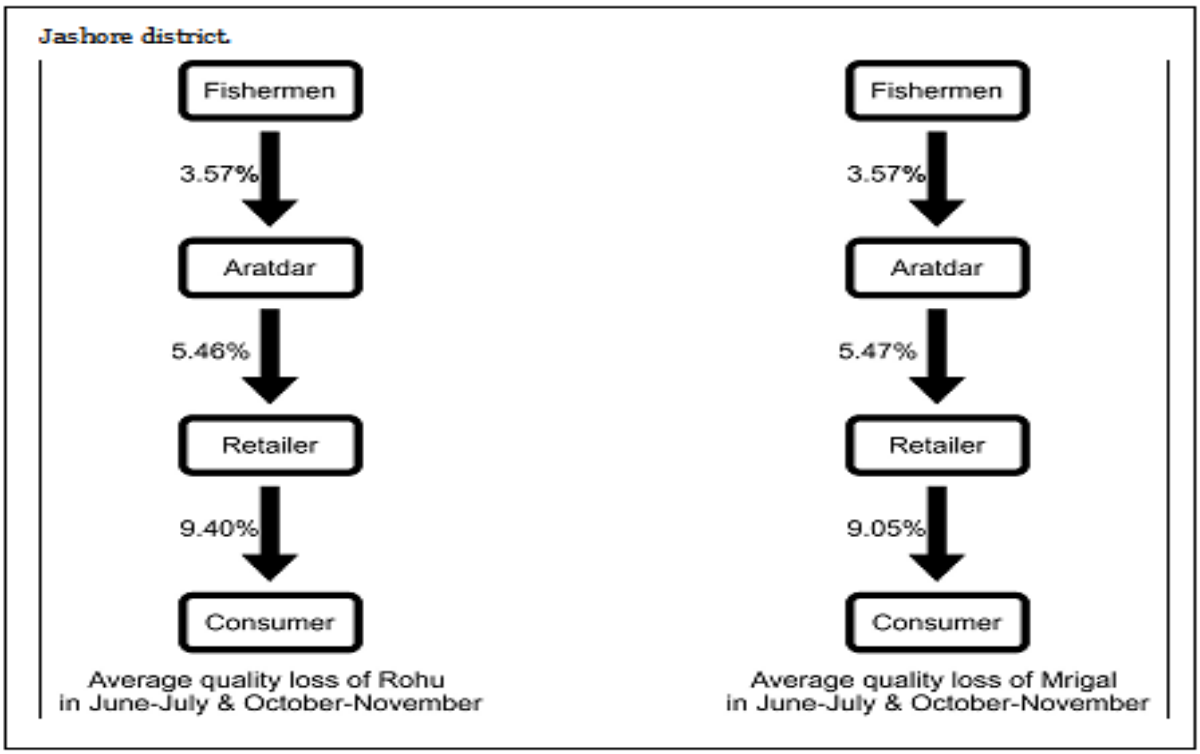

Fig. 2. Average quality loss of Rohu & Mrigal in June-July & October-November.

Post-harvest loss assessment of Cirrhinus cirrhosus

At fisherman, average DPs level was 1.00 ± 0.00 in June-July & 1.00 ± 0.00 in October-November. At aratdar DP increased from fisherman level. DP level 1.56 ± 0.11 in June-July and 1.5 ± 0.08 in October-November. The variation was noticed at the retailer level where DPs level was 2.55 ± 0.09 in June-July & 2.51 ± 0.10 in October- November (Fig. 8).

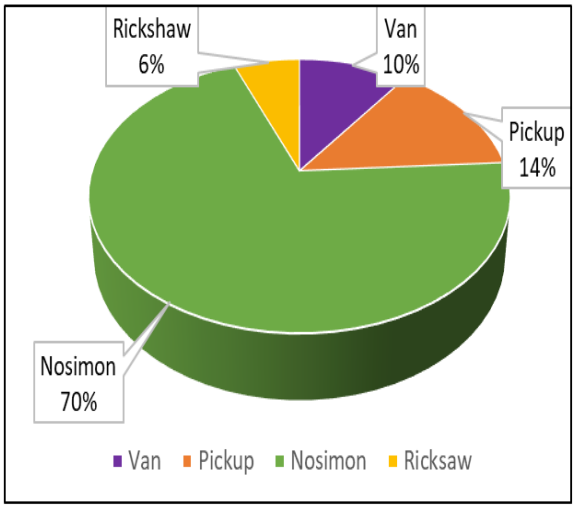

Fig. 3. Vehicles used for transportation of fish.

Discussion

Post-harvest loss of Indian major carps (*Labeo rohita* and *Cirrhinus cirrhosus)* at boro bazar and churamankati bazar estimated that fisherman supplied rui to aratdar at 3.57% quality loss, further 5.46%, 9.4% loss was observed through aratdar to retailer and retailer to consumer respectively. Similarly, fisherman supplied mrigal to aratdar at 3.57% quality loss and 5.47%, 9.05% loss was observed in aratdar to retailer and retailer to consumer respectively.

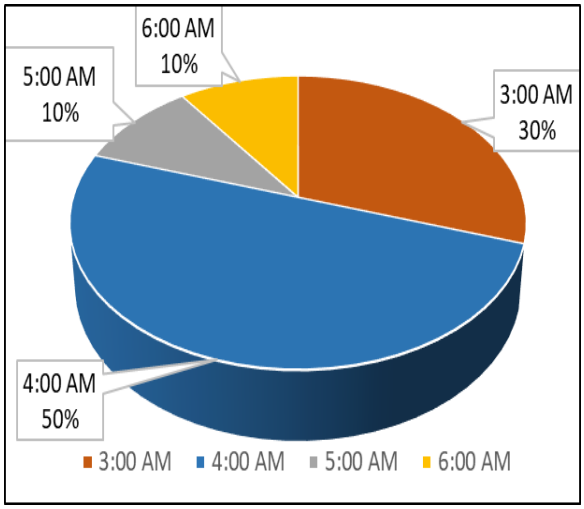

Fig. 4. Time of fish harvesting.

A similar marketing channel was shown by the study of Tilapia marketing system in the greater Jashore region, Bangladesh. (Rahaman *et al.*, 2015) and Fish fermentation in Lalpur, Brahmanbaria district: ecological implication and value chain analysis. (Hossain *et al.*, 2017). Fishes found good qualities that were taken care of during transportation. The loss was due to bad handling practice during transportation, unhygienic condition of landings and markets, long time exposure of fish during selling to consumer, improper icing, etc. which is more or less similar to the study of (Islam *et al.*, 2017) and (Vaumik *et al.*, 2017).

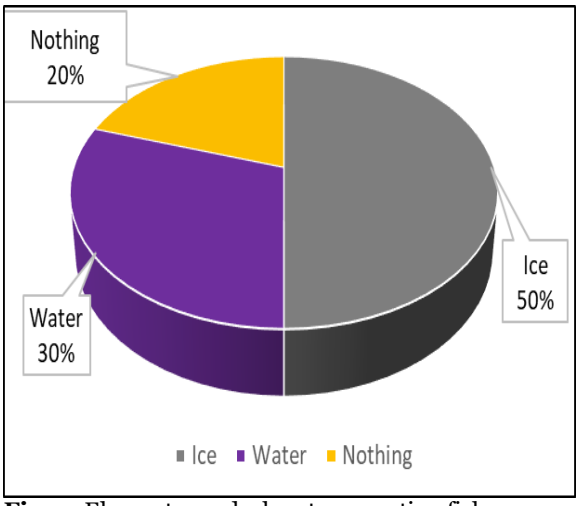

Fig. 5. Elements used when transporting fish.

Post-harvest loss assessment of *Labeo rohita*, average DPs level was 1.00 ± 0.00 in June-July and 1.00 ± 0.00 in October-November at the fisherman. At aratdar DP level increased 1.60 ± 0.07 in June-July and 1.46 ± 0.09 in October-November and retailer level where DP level was 2.7 ± 0.20 in June-July and 2.55 ± 0.09 in October-November. On the other hand, in the Post-harvest loss assessment of *Cirrhinus cirrhosus*, average DPs level was 1.00 ± 0.00 in June-July and 1.00 ± 0.00 in October-November at the fisherman. At aratdar DP increased 1.56 ± 0.11 in June-July and 1.5 ± 0.08 in October-November.

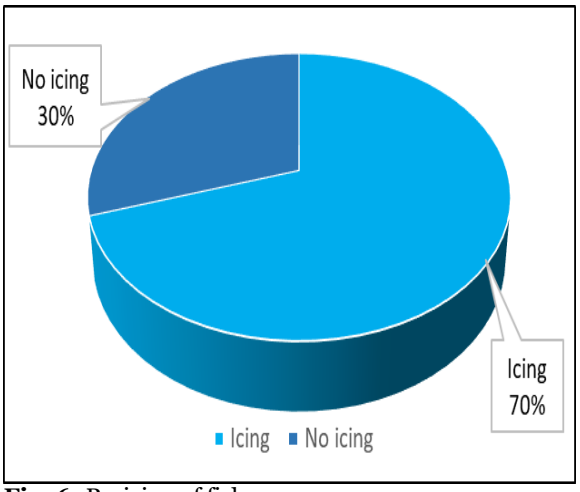

Fig. 6. Re-icing of fish.

The variation was noticed at the retailer level where DPs level was 2.55 ± 0.09 in June-July and 2.51 ± 0.10 in October- November. Whereas, Hossain *et al.*, 2012 and Nowsad, 2010 support the present study. In the present study, it was noticed that fish remained fresh at the very beginning of the day but as the day progress, various organoleptic changes were observed at different fishes of major carp. The majority portion of fish quality found good quality at the fisherman level but when these were at retailer level observed deteriorating quality due to organoleptic changes and found them almost lose their bloom or freshness.

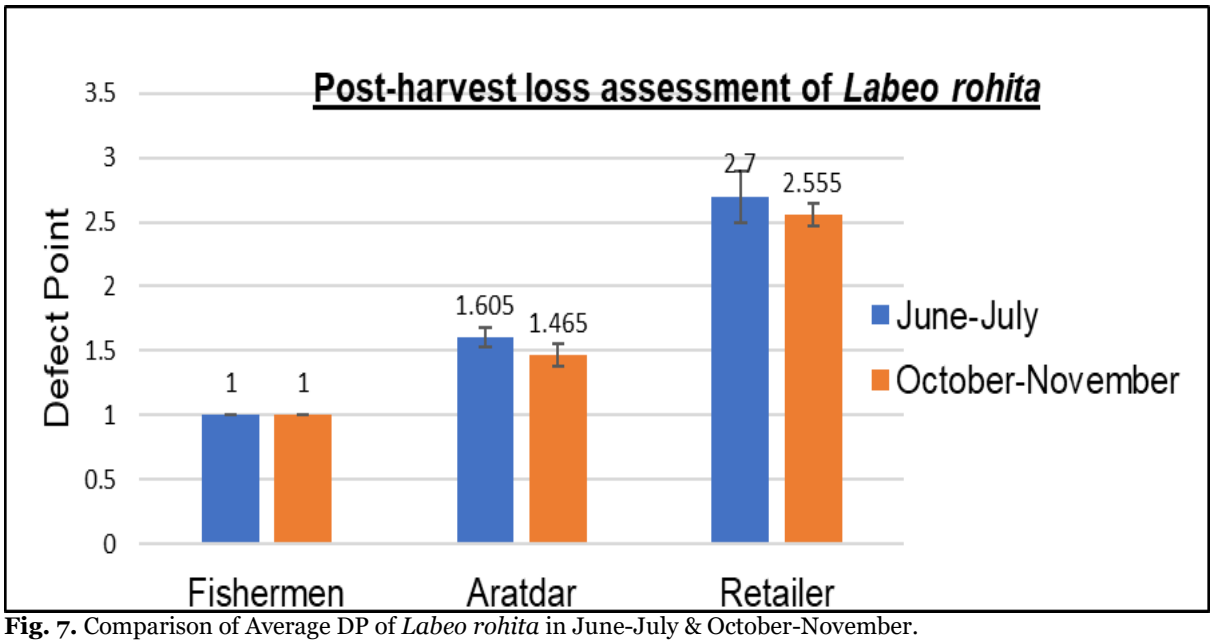

Fig. 7. Comparison of Average DP of *Labeo rohita* in June-July & October-November.

In the very early morning, distant areas fishes were transported to the local market in plastic drums or gallon with water (Ray *et al.,* 2015). The temperature gradually increased as the sunshine became intense. The rate of deterioration was accelerated by the higher ambient temperature that resulted in higher oxidation. Fisherman used ice 25%, where aratdar used no ice, the retailer used 62.5% ice. (Mansur *et al.*, 2002) also found similar results that are more or less similarly support the present study.

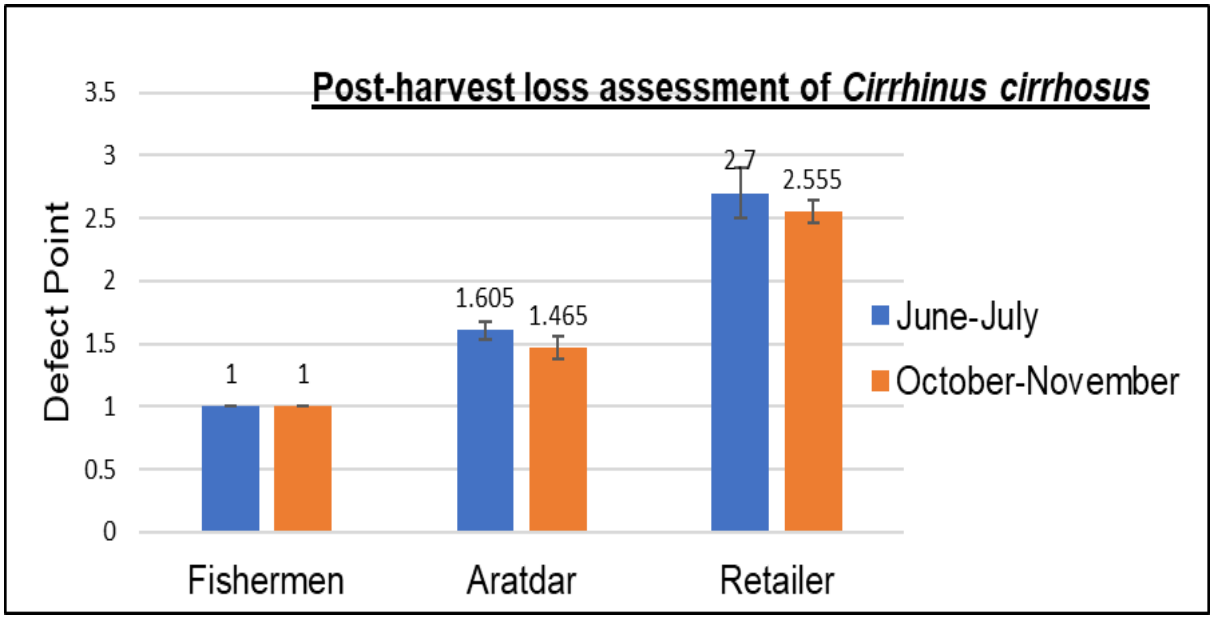

Fig. 8. Comparison of Average DP of *Cirrhinus cirrhosus* in June-July & October-November.

Bamboo baskets, plastic baskets, plastic drums, aluminum trays were used for handling purposes in the Jashore market. Recently plastic made baskets are also used. Due to the use of bamboo made baskets physical damage of fish as well as bacterial contamination also occurred. No ice was used during the transportation of fish. Bamboos made baskets were mainly arranged one by other vertically with full of fishes. (Hossain *et al*., 2012) also reported that these were not properly washed after using and were kept in a contaminated place (Lewis *et. al*., 1996) reported that *Labeo rohita* fry is relatively sensitive to the stress of transport; as a result, there is high mortality among transported fry.

Many authors also observed post-harvest fish losses at different stages of the distribution chain from capture to consumption that is similar to the present study. (Hossain *et al*., 2002) found huge loss of fish due to poor or no preservation facilities in the Mymensingh area. As there were inadequate handling and preservation (icing, chilling and freezing) or storage facilities for farmed Indian major carp, the retail fish traders suffered huge economic loss in terms of the low price offered for quality deterioration. (Hossain and Afroze, 1991; Hossain *et al*., 2002).

Conclusion

Fishermen and stakeholders have a very low level of knowledge on post-harvest handling and quality loss of fish. As a result, the huge amount of losses occurs for this reason which may cause a greater negative impact on the fisheries sector.

The result of the present study found that the highest defect point was 2.7 at retailer level and it is the acceptable range and also observe that post-harvest losses in different distribution channel which are not so high. So, the study is needed for the development of knowledge in fishing, handling and processing, selling and transporting.

As a result, awareness increase among the peoples that may ultimately minimize the post-harvest loss.

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