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STATUS OF *Penaeus monodon* FARMS, DEPOTS AND PROCESSING INDUSTRIES OF SOME SELECTED AREAS OF BANGLADESH

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ABSTRACT

A survey was carried out to evaluate the overall condition, infrastructure facilities, handling and quality management system, condition of raw materials of shrimp, *Bagda* (*Penaeus monodon*) farms and depots of some selected shrimp producing areas of Cox's Bazar (Chokoria and Teknaf), Khulna (Paikgacha and Koira), Bagerhat (Rampal and Mongla) and Satkhira (Munshiganj and Ashashuni) through direct observation and interview with cross section of people engaged in farms, depots and processing industries. The survey results revealed that the production of shrimp was not satisfactory. The post-harvest quantitative and qualitative losses in the farms were due to longer duration of harvesting, exposure of shrimp at high ambient temperature for a long time (delayed icing), contamination from dirty floor and lack of general hygiene and sanitation. On the other hand, major quality loss in depots were due to delayed icing, use of inadequate ice, rough handling and peeling, presence of foreign materials, packed under pressure in the bamboo basket, contamination, body crushing, use of dirty utensils and lack or poor personal hygiene of depot workers.

Key words : *Penaeus monodon*, Farms, Depots, Industries

INTRODUCTION

The overall shrimp quality management system of our country is not satisfactory. Shrimp are usually subjected to the contamination and spoilage due to improper handling, unhygienic care, inadequate facilities of transportation, processing, refrigeration, storage and distribution. Shrimp are more perishable food items than any other foodstuffs and there quality is dependent on a number of factors including harvest condition, handling and storage time and temperature. In the country, most of the shrimp farmers, and handlers are not conscious about the post-harvest handling. Processing industries purchase most of their raw materials through a number of channels and post-harvest losses occur at different stages of handling and transportation. It normally takes 24-48 hr to transport the raw materials from farm to the processing plants. The effect of delayed post-harvest handling exerts serious threat on quality of *P. monodon* and *M. rosenbergii* (Reilly *et. al*., 1985; Rahman *et. al*., 2001a, 2001b, 2001c) which clearly indicate that exposure of raw material at high temperature for a longer period in tropical climate drastically reduce the shelf life of shrimp and prawn.

Exportable shrimp requires special care to keep its original physical appearance, odor and organoleptic characteristics as much as possible. It must be free from dirt, filth, pathogenic organisms, uncertified chemicals and any antibiotics even in the minutest quantity. The importing countries particularly, the EU countries, USA and Japan are highly conscious about food hygiene and safety.

The present status of quality management system of shrimp at farms, and depots lead to losses of shrimp both in quality and quantity, which in turn lead to substantial economic loss. However, any loss of this very valuable exportable resource is most undesirable. Reliable information to quantify such losses at various points of shrimp handling is lacking. At this point of time when the nation is struggling to enhance export, it is very important that the quantitative and qualitative losses of shrimp in its value chain from farm to factory be quickly assessed, measures to avert the losses be prescribed, policy to salvage the resource be formulated and the recommended measures be enforced for the sake of national interest.

MATERIALS AND METHODS

Information on the infrastructure facilities and qualitative and quantitative losses of shrimp at various stages of handling and transportation were collected from the farms, depots and processing industries of four prominent *Bagda* producing districts Cox,s Bazar, Satkhira, Khulna and Bagerhat through direct observation and interview with cross section of people using prescribed questionnaires. The questionnaires were developed jointly by Department of Fisheries Technology, Bangladesh Agricultural University, Mymensingh and Bangladesh Shrimp Foundation, Dhaka. From each district two upazila were selected and from each upazila two farmers and two depot owners were randomly selected for sampling. Thus, 16 farmers and 16 depot owners were selected from 8 upazila of 4 districts to collect the information (table 1).

Table 1. Nomber of farmers and depot owners from four districts of Bangladesh

Districts	Upazila	No. of farmers	No. of depot owners
Cox's Bazar	Teknaf	2	2
	Chakoria	2	2
Satkhira	Munshiganj	2	2
	Kaliganj	2	2
Khulna	Koira	2	2
	Paikgacha	2	2
Bagerhat	Mongla	2	2
	Rampal	2	2

Information was also collected from four processing industries of two districts. Kuliarchar Fish Processing Industry and Conception Seafood Processing Industry of Cox's Bazar and Rupsha Fish and Allied Indusry and Fresh Seafood Industry of Khulna.

RESULTS AND DISCUSSION

Condition of Bagda farms of Bangladesh

To assess the condition of *Bagda* farms, some important aspects were taken into consideration such as sources of water and drainage system, latrine on the farms, removal of pond scum, water quality parameters (pH, depth, secchidisc reading, mortality) etc.

Table 2. General condition of *Bagda* farms of Bangladesh

Major aspects	Present status
Water received from or drain out to another farms	60% farms receive from or drain out to another farms
Latrine on the farms	No
Removal of pond scum	No
Water source	Use tidal water
Water quality monitoring	
- pH	- Not monitored
- Depth	- 3-4ft
- Secchidisc reading	- No
- Mortality	- 10-20% due to disease

About 60% farms were found to receive water from other ponds and drain out water to yet other ponds in all survey areas. There was a little or no evidence of using cowdung or chicken manure in *Bagda* farms. No make-shift or permanent latrines constructed on the *Bagda* farms. Pond scum are not removed in any *Bagda* farms. The main water source for *Bagda* farms was tidal water during high tide. The average depth of *Bagda* farms in all study areas were in the range of 3-4 ft. Mortality of shrimp due to white spot and other diseases is common in all *Bagda* farms. The farmers reported that 10-20% shrimp are lost due to diseases. The *Bagda* farmers do not monitor water quality of their farms (Table 2).

Infrastructure facilities of Bagda farms

The major infrastructure facilities considered in the study were shade for keeping the harvested shrimp, temporary holding containers, basket type, ice storage facilities, ice crushing box etc. Only 12% farms have been found built shade for keeping the harvested shrimp. Bamboo basket, plastic sheet, plastic drum and cemented floor were used for temporary holding of *Bagda*. The shrimp holding baskets used in the farms were 90% bamboo made and 10% plastic containers. There was no ice storage facility and ice-crushing box in *Bagda* farms (Table 3).

Production, post-harvest care and transportation and in *Bagda* farms *Bagda* were harvested at night during high tide of the lunar cycle by using both cast net and traps. The duration between the start of harvesting to marketing of *Bagda* was about 5-8 hrs. The

production of shrimp and finfish from *Bagda* farms were 370-620 kg/ha for *Bagda*, 75-500 kg/ha for *Horina* and 125-370 kg/ha for finfish.

Table 3. Infrastructure facilities of *Bagda* farms

Major aspects	Present status
Shade for keeping the harvested shrimp	Only 12% farms have shade
Temporary holding of shrimp	78% use bamboo basket, 12% plastic sheet, 10% cemented floor
Basket type	90% bamboo made, 10% plastic drums
Ice storage facilities	No
Ice crushing box	No

Table 4. Production, post-harvest care and transportation and in *Bagda* farms

Major aspects	Present status
Harvesting time	100% at night during high tide (lunar cycle)
Harvesting method	60% cast net, 40% traps
Duration between start of harvesting to marketing	5-8hrs
Farm production (kg/ha)	Bagda-370-620, Horina-75-500, Fin fish-125-370
Initial washing after harvest	80% with pond water, 20% tube well water
Sorting and grading	No sorting and grading
Shrimp head removal	No
Ice used	No
Basket washing	100% washed regularly
Mat washing	100% washed regularly
Detergent used	No
Distance from farm to depot (km)	1-4
Transportation container	60% use bamboo basket and 40% plastic
Transportation from farm to depot	60% manually, 30% rickshaw, 10%van

The post-harvest care of *Bagda* considered in this study area were initial washing after harvesting, sorting, grading, beheading and icing of *Bagda* and overall cleanliness and sanitation of equipment and utensils used in farms. About 80% farmers used pond water for initial washing of shrimp after harvest. The farmers usually do not practice sorting and grading of *Bagda* before transporting to the depots and industry.

The farmers did not practice beheading and icing at farm level. Basket and mat washing were done regularly at farm levels but they did not use any type of detergent for washing. The farmers supplied shrimp to the depots after harvesting and the distance

from farm to depot was 1-4 km. About 60% farmers used bamboo basket and 40% farmers used plastic drum for transportation of shrimp. About 60% *Bagda* were transported by the farmers manually, 30% by rickshaw and 10% by van (Table 4).

Infrastructure facilities of Bagda depots

The considered infrastructure facilities in the *Bagda* depots of Cox`s Bazar, Satkhira, Khulna and Bagerhat regions included were- roof, ceiling, walls, floors, windows, doors, stainless steel table, animal control fencing, ice plant, ice storage, sanitary latrine, drainage, electricity, water source and foot dip. The roofs of the 76% depots were made of tin, 16% were of concrete and the rest were made of straw and leaf. Some depots (8%) in Teknaf region also used straw as roof of the depots. About 80% of the *Bagda* depots had the walls constructed with bricks and 20% with tin. The floors of the 99% depots were constructed with cement and in 1% depot's floor was of mosaic. About 96% *Bagda* depots had no fly net in their doors and windows. About 85% depots had stainless steel table for sorting of raw materials but in most cases not in good condition. All the *Bagda* depots had animal control fencing. There was no ice plant but ice storage facilities were available in the study areas. About 90% depots had sanitary latrine. There was a drainage system in all depots but the condition was very poor. Electricity and tube well water were available in all the depots. There were no foot dip facilities at all in any *Bagda* depots except one in Chakaria, Cox's Bazar (Table 5).

Table 5. Infrastructure facilities of *Bagda* depots

Major aspects	Observation
Roof	76% tin, 16% concrete, 8% straw
Ceiling	76% tin, 16% concrete, 8% straw
Walls	80% bricks, 20% tin
Floor	99% cemented and 1% mosaic
Windows	96% no net, 4% net
Doors	96% no net, 4% net
Stainless steel table	85% has table but in no use, 15% has no table
Animal control fencing	100% has fencing
Ice plant	No
Ice storage	Yes
Sanitary latrine	90% has no sanitary latrine
Drainage	Yes
Electricity	Yes
Water source	Tube well
Foot dip	99% has no foot dip, less than1% has foot dip

Condition of Bagda during receiving at depots

The major considered aspects in the study were container type, icing, head removal, grading, transport, distance between farms and depots, total quantity of shrimp and prawn received (previous year), total quantity of ice used (previous year), and cost of ice. About 60% bamboo baskets and 40% plastic drums are used in depots. In depots, 90% raw materials are received without iced condition. About 100% *Bagda* is received without grading. Rickshaw, rickshaw van and boat are also used for transportation of *Bagda*. The distance between farm and depot is in the range of 1-20 km. The total *Bagda* received last year varied from 2-1100 ton by an individual depot. The price of ice varied from TK.1.50-2.00/per kg depending on demand and availability of ice (Table 6).

Table 6. General condition of *Bagda* during receiving at depots

Major aspects	Present status
Container type	60% bamboo basket, 40% plastic drum
Icing	90% not in iced condition, 10% iced condition
Head	Head on
Grading	100% non graded
Transport	47% van, 40% rickshaw, 7% boat, 6% man
Distance between farm and depot	1-20km
Total quantity (last year)	2-1100ton
Ice quantity(last year)	2-1200 ton
Ice cost	Tk. 2/kg

Handling and transportation of Bagda at depots

At depots, beheading and size grading of shrimp were not practiced but rejection of *Bagda* (<1%) was happened due to peeling. Usually after receiving, *Bagda* were washed with tube well water and preserved in ice (ice-shrimp ratio 1:1). Before transporting the *Bagda* were packed in plastic drum covered by polythene sheet. Before transporting the raw materials to the factory maximum holding time of *Bagda* at depot was 2-10 hrs. The distance from depots to factory varied from 20-200 km and required 1-4 hrs to reach at factory. The waiting time for delivery of *Bagda* to the factory was about 1-2 hrs. Lifebuoy soap, bleaching powder, detol, savlon etc. were used for personal washing, washing of floor, basket, mats, weighing machine etc. in the depots (Table 7).

Comparison between depot owners' opinions interviewers' observation about the losses of shrimp during previous year

According to depot owners, less than 1% *Bagda* received from suppliers/farmers was spongy. The quantity rejected due to discolouration was 1-2% and body crushing was 0.5-1%. Less than 1% raw materials was found to contain water in their body. The depot owners reported that there was no *Bagda* with foreign materials, dirts and mud during

receiving at depots. The total amount of discarded shrimp due to the above mentioned causes was about 1-2%.

On the other hand, the interviewers found quality defect of *Bagda* as a result of spongy texture was less than 1%, discoloration 1-3%, body crushed 1-2%, with excess water 1-2%, with foreign materials less than 1%, with dart and mud less than 1% and unfit for export <1%. The workers cleanliness and overall knowledge about post harvest quality management of *Bagda* at depot may be considered as poor to moderately good (Table 8).

Table 7. Handling and transportation of *Bagda* at depots

Major aspects	Present status
Head removal	No
Peeling	Less than 1%
Size grading	No
Washing	Yes
Icing and ice ratio	Use ice in the ratio of 1:1
Packaging	Plastic drum with polythene
Maximum holding time	2-10 hours
Container	100% plastic
Distance from factory	20-200km
Time to reach at factory	1-4 hrs
Waiting time for delivery	1-12 hrs

Table 8. Comparison between depot owners' opinions interviewers' observation about the losses of shrimp for the year of 2003

Major aspects	Depot owners' opinions	Interviewers' observation
Spongy	Less than 1%	Less than 1%
Discoloration	1-2%	1-3%
Body crushes	0.5-1%	1-2%
With excess water	Less than 1%	1-2%
With foreign materials	0%	Less than 1%
With dirt and mud	0%	Less than 1%
Discarded	1-2%	1-3%
Workers cleanliness	-	80% poor, 20% fair
Workers knowledge	-	90% poor, 10% fair
Depots cleanliness	-	87% poor, 13% fair

Factory managers opinion about the shrimp quality for the year of 2003

According to factory managers, use of bamboo baskets as containers for shrimp was none, while 100% plastic baskets were used to carry the shrimp at receiving point. Core temperature of shrimp above 5°C at receiving point was 1-5% while core temperature above 10°C was none. The quality defect due to spongy texture was 1% and discoloration was below 1%. There was no report of body crushing and contamination with foreign materials, dirt and mud during receiving in the industry. The shrimp received with excess water was only less than 1%. The total discarded amount due to all types of defects was only 1-2%. According to the factory managers, temperature was recorded at different stages of processing. For the storage of un-processed shrimp there were chill rooms in all the processing industries. All the factory managers were agreed that receiving of shrimp at high temperature was most important factor for the growth of *Salmonella* (Table 9).

Table 9. Factory manager's opinion about the shrimp quality for the year of 2003

Quality aspects	*Bagda* factory
Shrimp receiving point :	
- Shrimp in bamboo basket	- 0%
- In plastic basket	- 100%
- With core temperature above 5°c	- 1-5%
- With core temperature above 10°c	- 0%
- Spongy	- 1%
- Discoloration	- Less than 1%
- Body crushed	- 0%
- With excess water	- Less than 1%
- With foreign materials, dirt, mud	- 0%
- Discarded from all	- Less than 1-2%
Temperature recording at different stages of processing	Yes
Non-processed shrimp storage room	Chill room
Panning room	Yes
Points most vulnerable to *Salmonella* growth	Receiving of shrimp at high temperature

The quality of finished products depends on the quality of raw materials. Therefore, to produce good quality shrimp and shrimp products, the raw shrimp should be wholesome. Moreover, the wholesomeness of finished products depends on the harvesting, post-harvest care, transportation, handling and sanitation and hygiene aspects at farms, depots and industry levels. In view of the above points, it can be said that the overall condition of *Bagda* farms in all the survey areas regarding infrastructure facilities, harvesting and production, post-harvest care and transpiration are not so satisfactory. Mazid *et al*. (2001) studied the production, processing, transportation and handling of shrimp at farm level and reported that the overall management procedures of

the farms in respect of drying the pond bottom, ploughing, liming, fertilization, feeding, post harvest handling, transportation and marketing system are very poor. It has been also reported that shrimp being a perishable item, its quality is depended on many factors including harvesting condition, handling and storage time and temperature. In the present study, it was found that most of the farms are lack of ice storage facilities and shrimp are left at the farm site for about 5-8 hours without ice. In addition, most of the farmers (90%) have no knowledge about the quality of shrimp. As a result, shrimp gradually lose their freshness, contaminated with microbes and become deteriorated. In every study area at farm level, it is observed that shrimps were mainly transported to depots manually and by rickshaw and van under unsanitary condition, and shrimp were subjected to excessive pressure and rough handling.

Most of the depots of the study areas were not properly equipped or not provided with adequate facilities for shrimp handling. The overall sanitary conditions were also poor. In most cases, there was no ice supply facility in depots. The facilities for temporary preservation were also unsatisfactory. Most of the depots had proper roof, ceiling, wall and floor. The depots were also with drainage system but there was no drainage covering grids in most cases. The information about the depots also revealed that the serious threat to the quality of shrimp may come from inadequate infrastructure facilities which can facilitate the microbial contamination of piled shrimp. Deterioration of shrimp quality in the depots was caused by microorganism (Fatima *et al*., 1988; Cheng and Lain, 1979). Personnel hygiene and sanitation as a whole in the depots of the study areas were not satisfactory. Many hygienic problems may arise from depot personnel/staffs themselves. In most cases, shrimp handlers were not aware about the importance of personnel hygiene. Depot operators or owners were not conscious about modern technologies for handling operation. Many of the depots were not given priority to the improvement of sanitary condition. Moreover, most of the depots in the study areas were found to have no door or window screens facilities against flies, cockroaches, insects etc. and rats were also found to move around. Since the shrimp handler/operators of the depots were mostly illiterate, indifferent, they take little interest in maintaining good sanitation and hygiene. None of the depots were found to use chlorinated water for foot dip or washing. Water was the chief vehicle through which diseases are transmitted. Therefore, adequate supply of good quality water for cleaning purposes must be ensured in the depots. At the depots shrimps were held until bulk amount of shrimps were collected before transported to the factory. Shrimps were transported to the factory mostly in plastic container. However, shrimps often packed under pressure cause physical damage (Hussain and Uddin, 1995). Lack of sufficient ice, improper handling and lack of suitable transport facilities in time were responsible for considerable loss of shrimp both in quality and quantity.

REFERENCES

Cheng, C.Y. and Lain, J. L. 1979. Studies on the decomposition of frozen shrimp II. Deterioration during iced and refrigerated storage. *Nat. Sci. Council Monthly* (R.O.C) 7: 1136.

Fatima, R., Khan, M. A., Qadri, R. B. 1988. Shelf-life of shrimp (*Penaeus merguiensis*) stored in ice (0°C) and partially frozen (-3°C). *J. Food Sci. Agric.,* 42: 235.

Hussain, M. M. and Uddin, M. H. 1995. Quality control of marketing of fish products: Needs of infrastructure and legal support. Paper presented in the national workshop on Fisheries resources, Development and management, held on 29 October to 01 November, Dhaka, Bangladesh.

Mazid, M. A., Ahmed, S. U., Kamal, M. and Ialam, M. N. 2001. Bangladesh Agricultural Research Council (BARC) Completion report on project "Studies on the Improved Production, Processing, Transport and Handling of Shrimp and Their Cost Benefits at Farm Levels". Bangladesh Fisheries Research Institute (BFRI) and Department of Fisheries Technology, Bangladesh Agricultural University, Mymensingh.

Rahman, M., Yasmin, L., Kamal, M., Islam, M. N. and Ochiai, Y. 2001a. Quality changes in freshwater prawn *Macrobrachium rosenbergii* during ice storage. *Bull. Fac. Edu. Ibaraki Univ. (Nat. Sci.)*, 50: 39-49.

Rahman, M., Yasmin, L., Kamal, M., Kamruzzaman, M., Islam, M. N. and Ochiai, Y. 2001b. Effect of delayed icing on the quality changes in freshwater prawn *Macrobrachium rosenbergii* during subsequent storage. *Bull. Fac. Edu. Ibaraki Univ. (Nat. Sci.)*, 50: 51-57.

Rahman, M., Yasmin, L., Kamal, M., Mazid, M. A. and Islam, M. N. 2001c. Effect of delayed icing on the quality changes in brakish water shrimp *Penaeus monodon* during ice storage. *Pukl. Jour. Biol. Sci.*, 4(11): 1390-1394.

Reilly, A., Bernate, M. A. and Dangla, E. 1985. Quality changes in brakish water prawns (*Penaeus monodon*) during storage at ambient temperature, in ice and after delays icing. In Reilly, A. (ed). Spoilage of Tropical Fish and Product Development. *FAO Fishery Report 317 Suppl.*, 474 p.