5.0 DISCUSSION

Research findings of the present investigation regarding fisheries activities of the fishermen community indicated that 79.20% were directly involved in fishing in the sea and river whereas only 0.22% were fish traders. This result was not in agreement with the findings of DOF (1993) which revealed that there were 22% professional and 74% non-professional fishermen in Chanda beel. The higher percentage of fishermen found in this investigation was because the study area was situated in the coastal belt and the availability of fish in the sea encouraged the fishermen to fish.

Majority of fishermen carried out fisheries activities in partnership pattern whereas only 7.63% fishermen did their work individually. Almost similar results were found by a survey of DOF (1990). However, other researchers found different result (Mannu, 1999; CPP, 1996; and DOF, 1993). Mannu (1999) studied the socio-economic conditions of the sea going fishermen at Kuakata and reported that no fishermen caught fish individually. DOF (1993) in a study on the fishermen community of Chanda beel reported 85% fishermen carried out their activities individually. A survey on the professional fishermen was done in Tangail district under the Compartmentalisation Pilot Project (CPP, 1996) which indicated that 69% fishermen fish individually. Most fishermen of the study area went fishing far away from the coast. In addition, fry collections in the coastline were not carried out individually.

Findings of the present investigation indicated that 85.31% fishermen worked through out the year. Ahmed (1996) found similar result stating that 81% carried out fishing throughout the year. However, Mannu (1999) reported that 72% were full time fishermen.

The present investigation revealed that 89.60% and 76.99% fishermen had no craft and gear of their own. While Mahabubullah (1986) reported in his study on "Socio-economic scenario of the polder fishing community of Bangladesh" that 64% had no boats and 61% had no gears. Most fishermen in the study area were poorest of the poor and worked as a day labour in other fishing boat.

This investigation found that fishermen in the study area practised four different types of preservation and processing techniques, which were very traditional. Fishermen did not maintain hygiene and sanitation and open latrines were the common phenomenon in the studied area. Johnson and Esser (2000) reported similar observations. Icing procedure practised by the fishermen of the study area was similar to the proposed method of Clucas and Ward (1996). The investigation revealed that the shelf life of iced product was only 7 days. This was due to the fact that the quality of ice used by fishermen in the studied area were not of good quality. Also, fishermen did not maintain appropriate ratio of ice and fish.

Pre-processing technique was similar in the case of drying, salting and smoking procedures. But, it was found that during pre-processing; fish offal, bycatch and spoiled fish were discarded within or immediately adjacent to the processing areas. Johnson and Esser (2000) also observed such scenario. Fisherman mentioned that splitting of fish resulted increased surface area and enhanced the rate of drying as found by Wood (1982). Similar observation was also reported by Mills (1979) who found that longitudinal split facilitate drying. However, this is contradicted with the findings of Vanveen (1955) and Johnson (1997). They found that many countries in Southeast Asia produced highly acceptable product where fish were beheaded and gutted, but not splited. Salting was done in an earthen pit covered with polythene sheets. However, Dagbjartsson (1982) did not observe such method. The whole procedure of traditional fish salting practised by the fishing community in the study area was found to be similar to the findings of Johnson and Esser (2000).

The investigation found that fishermen did not maintain any specific ratio of salt added to fish. But, Dagbjartsson (1982) indicated that approximately 80 kg of salt should be used for 200 kg of tuna. Fishermen also used the locally produced lower quality salt. However, Clucas and Ward (1996) recommended the use of good quality of salt. The result of this investigation revealed that salting gives extra weight and desired flavour as observed by Johnson and Esser (2000). Different types of salting application are carried out in different part of the world (Clucas and Ward, 1996). However, fishermen in the study area usually practised rubbing of salt. Smoking procedures carried out in the investigated area were very traditional. In the West Africa, improved traditional kiln (The Ivory Coast Kiln) and The Chorker Oven were widely used for smoking purposes. In recent years, many countries also used mechanical and electrical kiln for smoking (Clucas and Ward, 1996).

Screen (physical control measure) and Nagas (chemical control measure) were used during the processing of fish. Esser (1991) revealed that infestation during salting was prevented by simply fitting an insect proof lid to salt tank in Indonesia. Similarly, erecting mesh screens or netting over drying racks prevented gravid females gaining access to fish during drying, limiting infestation (Doha, 1964; Esser, 1991; Esser, 1992). Doha (1964) observed fish processors in Pakistan erecting simple tent made of mosquito netting over the drying rack. Over 30 attractive ingredients had been used (Johnson and Esser, 2000) whereas only one chemical (Agro-chemical) was used by fisherman for processing of fish. Hanson and Esser (1985) made similar observation. They reported that in Indonesia, large numbers of processors were controlling blowfly infestation in their fish with household insecticides and crop protection products. Similarly, processors in Thailand were found to be relying on the application of illegal insecticides to control blowfly infestation in drying fish (Esser, 1992; 1994; Johnson, 1997). Walker (1987) observed that dichlorvos, in the form of household

insecticide aerosols were sprayed onto fish in Nigeria. Walker (1988) also noted that additional products included DDT and lindane for the control of blowfly infestation of cured fish.

The investigation found that after completion of drying salting and smoking, all the dried fish were stored in storeroom without any packing. The storeroom contained a platform15-20 cm off the floor. In open condition, dried fish were kept for transportation and marketing. It was also found that fishermen used bamboo baskets and jute bags as packaging materials. Rubbi, ***et. al.***, (1982) reported two types of packages for marketing of dried product i.e. fish wrapped inside gunny bag only and wrapped with polythene inside the gunny bag.

Most fishermen (45.58%) families consumed 1-500gm fish daily whereas only 5.75% consumed 1500-2000gm. Muhit (2000) reported in his study that 46% fishermen took fish as their meal per month.

The present investigation found out that the fishermen were amongst poorest of the poor. Most of the fishermen earned Tk. 500-1000 (25.88%) and Tk. 1000-1500 (38.38%) per month respectively. Earning of Tk. 1500-2000 and Tk.2000-2500 remained between 10% and 12% respectively. These findings of the present investigation were similar to the findings of Bailey (1994) who noted that fishermen and their families in South and Southeast Asia often are considered to be the poorest in the society. Mahabubullah (1986) reported that 71% earned 400 taka or above per month. DOF (1993) stated that average income of majority of the fishermen were 15000 Tk/year. DOF (1990) reported that 70% of the fishermen had an average daily income of Tk.20-25, while rest 30% earned Tk 25-40. CPP (1996) found that 54% fisherman income of 50 taka daily. Mannu (1999) reported that 89% earned an average of 25000 taka per year. Ahmed (1999) studied the socio-economic conditions of the coastal fishermen and observed that 73.33% had their daily income above Tk. 50 while other fishermen (26.67%) earned less than Tk. 50 during the fry catching season. Rabbani and Sarker (1997) noted that income of the majority of the fishermen ranged from 2000-3500 taka per month.

This investigation revealed that 37.28% fishermen were engaged with the NGO's for obtaining credit while rest received credit either from the arotder or did their business on their on. Arotder had maximum contribution in fisheries business in the study area. This amounted to 40.82%. While 21.90% fishermen carried out fisheries business with their own investment. CPP (1996) reported that 70% took loan from moneylender. Ahmed (1996) found out that 92% of fishermen were member of some associations, clubs and co-operatives. A similar study was conducted by DOF (1993) on fishermen community of the Chanda beel and revealed that 5% fishermen were members of co-operatives and 34% aware of NGO programs.

The spoilage and degradation of dried fish and its shelf life depended largely on microbial population, moisture content and source of other factors. All the preservation technologies involving use of heat, radiation and /or chemicals aim at reducing or eliminating these spoilage factors. Both short term and long term preservations of dried fish and fisheries products have been attempted. In the present study 18 dried and 10 fresh fish samples had been analysed for organoleptic, microbiological and biochemical parameters.

The organoleptic evaluation of food products to any processing technology is very important in determining the consumer acceptability. The organoleptic evaluations including colour, texture, odour and taste were individually judged by a taste panel. For simplicity of evaluation, only overall acceptability (average) was computed. Organoleptic status of four common dried fish sample collected from Kuakata in summer and winter were fairly good. The results indicated that the organoleptic score of winter were higher than summer. However organoleptically, the dried fish products were better in winter season.

The present study also indicated that among the 10 other dried fish, only two dried fish, Churi and Shaplapata were of low quality compared with other dried fish studied. However, the overall organoleptic quality of the tested dried products was acceptable for human consumption.

The organoleptic score of fresh fish sample were found to be more or less the same. The scores varied between 7.00 to 7.57 in 10-0 points scale, the highest being the best. However, fresh samples were found to be moderately acceptable.

Bacteriological examinations for evidences of insanitary handling include determinations of total viable count and coliform organisms often referred to as " indicator organisms" in food microbiology. The use of such indicators recognises that it is impossible to examine foods for every possible pathogen and that sanitation is linked inseparably with the wholesomeness and microbiological safety of foods (Olson and Shelton, 1973).

Coliform organisms are associated most directly with equipment and employee sanitation. Since this organisms are readily destroyed by moderate heat, such as may be used in processing ingredients, their presence in the finished product tends to indicate recontamination. One member of the coliform group, *Escherichia coli* is widely used as an indication of possible contamination by pathogenic micro-organisms associated with the gastrointestinal tract, and because of its origin, it may be considered an indication of faecal contamination and, therefore, of filth (Olson and Shelton, 1973).

The SPC of three samples, Parshe, Shark and Phasa varied between 3.2 x10^4 cfu/gm to 4.8 x 10^4 cfu/gm while the SPC of the other sample, Bombay duck, S_3 was 7.8 x 10^3 cfu/gm. The three samples had little differences while S_3 showed one log cycle differences in summer. In winter, Parshe, Shark and Bombay duck showed similar pattern of result to that observed in summer.

Cho *et. al.* (1988) reported the viable bacterial counts ranged from 10^3 to 10^7 cfu/g in dried fish. Ito *et. al.* (1984) observed that the viable bacterial count of dried Sardine was 4.9×10^4 cfu/g and dried Jel fish 1.0 ×10^7 cfu/g respectively. The present investigation also indicated that SPC of 10 other dried fish varied widely. Although the present level of moisture content were quite unsuitable for the growth of bacteria, yet in the tropical region like Bangladesh, without proper packaging, it was almost impossible enough to prevent uptake of water, and some degree of spoilage was almost inevitable during storage. Kamruzzaman (1992) reported that dried fish products even with low moisture content stored under no protection against high humidity might be vehicle for bacteria responsible for food spoilage.

Ichine *et al.* (1977) studied twenty five samples of commercial dried fish and stated their average total bacterial count were 1.2 x 10^6/g. Mansur (1989) determined the total bacterial count of traditionally dried fish found total bacterial count of 1.5 x10^6 **,** 1.0 x 10^5, 1.8 x 10^5, 1.6 x 10^5 and 1.6 x 10^5cfu/g in *Labeo rohita, Barbus serana, Channa striatus,* Corica *soborna* and *Gudueis chapra* respectively. Haq and Kamal (1989) observed the total bacterial count of 1.8 x 10/g in dried *Mugil cuscosia* collected from a local market.

ICMFS (1988) mentioned the limit for standard plate count (SPC) for microorganisms per gram weight for different fish samples to be 10^5 cfu/gm. It was also reported that when the total bacterial count in food reached a level of 10^6 cfu/gm, the food is considered as spoiled.

Out of 10 fresh fish sample, SPC of seven samples varied between 4.25 to 7.9 x 10^4cfu/gm. While the remaining three fish, (Parshe, Gang tengra and Ilish) showed SPC of 1.32 to 5.6 x 10^5cfu/gm. Counts of all fish samples were lower than the acceptable limit (10^6 cfu/gm) (Paul, 1994).

Coliform in food is indicative of sewage contamination and act as indicator organisms for contamination (Frazier and Westhoff, 1974). In the present study, among the eighteen dried fish samples, total coliform count for thirteen were <3/gm. Count for remaining five dried fish sample ranged between 4 to 28 / gm and the faecal coliform of all dried samples were <3 MPN/gm. The highest coliform count was found in Rupchanda (28 MPN/gm). This may be due to unhygienic processing and preserving condition. Cho *et. al.,* (1988) reported that the initial coliform count of dried shrimp and shucked shellfish was 10^2 per gm and Ito *et. al.* (1984) reported coliform count of dried pomfret to be at the rate of 98 per gm. Sachithananthan (1976) observed the presence of *Escherichia coli* on locally dried fish in Sri Lanka. The finding of the present study showed that coliform count was much lower than the findings of Cho *et. al.,* (1988) and Ito *et. al.,* (1984).

Out of 10 fresh fish sample, total coliform count for 9 were in the range of 7 to 43 MPN per gm, the remaining one (FS_4) sample indicated 210 / gm. Only this sample exceeded the limit for total Coliform count (<100 /gm).

The faecal coliform count varied between 9 to 93 for all the fresh fish. Boiragi, Bishtara, Ilish, Chat baila and Kankon had faecal coliform counts of 21, 93, 20, 11 and 15 respectively which exceed the allowable limit of 10 per gm. Parshe, Gang tengra and Tular danti showed faecal coliform load of 9 per gm. which was very close to the upper limit. Faecal count of the rest two fresh fish samples, Phasa and Taposhi varied between 4 and < 3 per gm. respectively. However, it is evident that most of the fresh fish samples under tests were heavily exposed to coliform contamination of both faecal and non-faecal origin.

Investigations were carried out on proximate composition of both dried and fresh fish. Moisture, ash, protein and fat contents of four common dried fish (Parshe, Shark, Bombay duck and Phasa) in summer ranged from 19.31 to 24.22%, 19.93% to 24.46%, 8.12% to 16.02% and 7.45% to 15.02%. While in winter, it varied between 55.25% to 64.06%, 58.35% to 68.09%, 2.97% to 8.22% and 3.35% to 7.84% respectively. Amongst the four parameters, greatest variations were observed in protein content followed by moisture contents. Moisture and protein content was higher in all the four species in both summer and winter.

Proximate composition of 10 other dried samples of 10 species followed similar pattern with the four common dried fish in summer and winter. It is observed that moisture (18.23% to 23.61%), protein (40.69% to 66.52%), fat (7.1% to 26.13%) and ash (5.08 to 12.14%) varied widely over the 10 other dried species.

Moisture content of fresh samples varied over a range, from 65.33% to 78.92%. Likewise, protein (8.58% to 19.06%), fat (6.12% to 12.99%) and ash (1.07 to 8.41%) content varied widely in 10 fresh fish analysed.

A survey was conducted by the Indian Central Institute of Fisheries Technology (Hussain, *et.al.* 1992)) at four fish drying yards on the species used, drying practices and the quality of the dried products. The moisture content of the samples

varied over a large range from 12.3% to 54%. They also reported that protein (17.2% to 78%), fat (3.7% to 17.8%) and ash (1.4 to 21.6%) content varied widely in 23 different dried species.

Kuppuswarmy *et.al.* (1958) stated that the moisture content of Indian dried fish varied from 2.5 to 17.5 % and the protein from 44 to 71%. According to Qudrat-i-khuda *et al.* (1962) protein content of sun-dried shutki of both marine and fresh water fishes varied from 55.50 to 74.18% in *Labotes surinamensis* (Katkoi) and *Chanina marulius* (Gazar) respectively. Bhattacharyya *et.al.* (1985) reported that the market samples of sun-dried *Gudusia chapra* had moisture ranging from 9.61 to 18.64% and storage life of 15 to 35 days.

According to Connell l (1976) TAM-N is used as spoilage indicator of marine fish. Total Volatile Basic Nitrogen (TMA-N) is a quality index of freshness of fish.. The results of TVB-N of four dried fish in summer varied 48.28 **m** 0.87 to 70.73 **m** 0.22 mg-N/100g. While, TMA-N of this four dried fish were 43.5 **m** 0.46, 34.14 **m** 0.69 mgN/100g, 56.17 **m** 0.29 and 44.15 **m** 0.96 mg-N/100g respectively. In winter, TVB-N and TMA-N of the four common dried fish varied over a range of 33.31 **m** 0.75 to 62.23 **m** 0.71 mg-N/100g and 22.81**m** 0. 08 to 51.13 **m** 0.45 mg- N/100g).

According to Tsai, *et. al.*, (1989) the standard limit of TVB-N and TMA-N content of dried fish is <138 mg-N/100g and <18 mg-N/100g. The TVB-N content of present investigation is much lower than that of standard limit of acceptability. While, TMA-N of the present investigation exceeded the limit. Four common dried fish in summer had pH values 7.37 **m** 0.21to 8.13 **m** 0.05. While, this values in winter varied 7.93 **m** 0.09 to 8.27 **m** 0.09.

The results revealed that TVB-N content of other dried fish ranged from 26.84 **m** 0.38 to 72.11**m** 0.69 mg-N/100g). The values of TMA-N of other dried fish showed a similar pattern with that of the TMA-N content of four common dried fish both in summer and winter. Amongst 10 other dried fish sample, lowest pH value was observed in Saplapata while highest pH value was found in Kukurjib respectively (7.63 ± 0.06 and 8.33 ± 0.05).

In case of fresh fish, TVB-N content varied between 10.92 **m** 0.23 to 25.75 ± 0.80 mg-N/100g. Similar pattern of result was observed for TMA-N content (7.70 **m** 0.67 and 18.50 ± 0.77). It was observed that out of 10 fresh samples 7 showed comparatively higher TVB-N (16.30 ± 0.77 to 25.75 ± 0.80 mg-N/100g). The sample, FS_8 (taposhi) indicated a much lower content of TVB-N (10.92 ± 0.23mg-N/100g) in comparison with the other fresh samples. This values were much lower than acceptable limit which ranged between 30 – 40 mg-N/100g (Connell, 1976).

The results focused that TMA-N content of fresh fish followed a similar pattern with TVB-N of that species. TMA-N values of all 10 fresh fish studied varied between 7.70 ± 0.67 to 18.50 ± 0.77 mg- N/100g. The highest TMA-N (18.50 ± 0.77 mg N/100g) content was found in sample FS_6 (Gang tengra). However, three samples FS_2, FS_6 and FS_7 (Phasa, Gang tengra, and Ilish) exceeded the standard limit (10-15 mg N/100g) of acceptability. pH of the 10 fresh fish were 6.7 **m** 0.7 to 7.03 **m** 0.5.

Hossain, (1994) reported that sun-dried squid (*Illex argentinus*) had TVB-N and TMA-N content of 78.2 mgN/100gm and 43.01mgN/100gm on dry matter basis. Rubbi, *et. al.*, (1982) studied extensively on the biochemical composition of 8 dried fish (marine) collected from local fish market of Dhaka city and reported that TVB-N and TMA-N content widely varied between 39.17 mgN/100g to 112.9 mgN/100gm and 23.07 mgN/100g to 68.12 mgN/100gm. The pH of these samples ranged 7.6 to 8.9.

The growth of microorganisms on the dried fish depends on the various factors, such as moisture pH and other factors. Amla and Mazumder, (1989) found that pH of four irradiated fish products varied 7.2 to 7.9.

Kamruzzaman (1992) stated that the requirement of a satisfactory dried products should be: (a) similarity to fresh fish in flavour and texture and free from ripened flavours caused by prolonged bacterial, enzymatic, oxidative and chemical changes; (b) compactness; (c) ready and rapid reconstitution; (d) retention of good palatability between six months and one year. The reasons for the failure of the dried products to reach perfection were due to the irreversible changes that took place during drying (denaturation) and severe damage suffered by the cellular (Jason, 1965).

Reconstitution power and physical properties of a sample always shows a close relationship. Reconstitution rate is slow in case of tough, rubbery and compact texture with few interfibrillar spaces. The dried samples were allowed to soak in water at room temperature for 150 minutes and in hot water (80^0C) for 60 minutes. Water reconstitution rate (%) varied between 45.98% to 79.74% and 53.63% to 74.99%. The studies on the reconstitution rate (%) of the dried products soaked in water at normal room temperature and hot water (80^0C) demonstrated that reconstitution rate was comparatively faster at hot water compared to samples kept at room temperature except for Bombay duck. The dried product, Bombay duck showed an inverse relation with other dried products. The reason could not be assessed.

Reconstitution rate was found to be slow in Potka fish. It may be attributed to poor texture such as tough, rubbery and compact structure of the fish.