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PRESENCE OF FORMALIN IN SMALL INDIGENOUS SPECIES OF FISH AT SYLHET SADAR

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Abstract

Formalin contamination in edible fishes is strictly prohibited in Bangladesh. Although studies reported formalin contamination in many different commercial large table fish's items but research pinpoints the formalin contamination in Small Indigenous Species (SIS) of fishes are scant. The present study was aimed at detecting the presence of formalin in SIS from different fish markets of Sylhet Sadar Upazila, Bangladesh. Five SIS taxa explicitly *Coricaso borna* (Kachki), *Amblypharyngodon mola* (Mola), *Gudusia chapra* (Chapila), *Mystus tengra* (Tengra), *Puntius ticto* (Tit punti) were purposely sampled during winter season (November to December, 2014) and summer (May to June, 2015) from eight fish markets for the detection of formalin content by using formalin testing kit developed by Bangladesh Council of Scientific and Industrial Research (BCSIR). A total of 160 SIS individuals were collected, where 50 samples were contaminated with formalin in which 32 samples (40%) were in summer and 18 (22.5%) in the winter season. The rate of formaldehyde contamination was higher in *C. soborna* (100% both in summer and winter) followed by *G. chapra* (75% in summer and 12.5% in winter) and *A. mola* (50% in summer and 0% in winter) respectively. The formalin contamination was found statistically significant (P value <0.05) for Chapila and Mola in both season. It is, therefore, strongly recommended to ensure the institutional and government support and extension aids for improving the formalin testing methods, marketing systems and market facilities that can ensure a good quality fresh/safe fish in the markets for consumers.

***Keywords*:** Formalin contamination, SIS, fish, season, food safety, consumers

Introduction

Fishes are considered as healthy diet due to its highquality protein, omega 3-fatty acid and other essential nutrients, low cholesterol and fat content as compared to other meats (Rhea, 2009; Pal, 2010). In Bangladesh fisheries play a significant role in generating employment, earnings foreign exchange as well as for food security. At the recent time fishery ranks fourth in world inland fish production (FAO, 2014). The small indigenous species (SIS) fishes in Bangladesh are generally considered to be those, which grow to a length of about 5 cm to 25 cm at maturity (Felts *et al*., 1996; Hossain *et al*., 1999). From 289 freshwater fish species of Bangladesh, over 150 species have been classified as SIS (DoF, 2012; Hossain, 2013).The SIS fishes are providing an essential source of protein, macroand micronutrients, vitamins and minerals, which can play an important role to prevent malnutrition problem in Bangladesh (Hossain & Afroze, 1991; Thilsted *et al*., 1997). The Punti (*Puntius sp*.) contains a double amount of iron and Mola (*Amblypharyngodon mola*) contains three times more calcium and 50 times more vitamin A compared to many big fishes like Silver carp (*Hypopthalmichthys molitrix*) and Rui (*Labeo rohita*); (Villif & Jorgensen, 1993). These small fishes are an important item in the daily diet of the people of all categories and the majority of poor people in Bangladesh to fulfill their protein demand by consuming small fishes as poor people can't afford to purchase high priced large carp species (Hossain *et al*., 1994).

Sylhet is the northeastern part of Bangladesh and very important source of freshwater, here a large amount of fish are captured due to the abundance of rivers, *beel* (static lake), *haor* (bowl or saucer shape shallow depression), and canal etc. (Hossain, 2013). SIS fishes are available all the year round in Sylhet but maximum yield observed in the rainy season because of *haors*, *khals*, *beels*, floodplain areas are inundated with water

during this time and SIS take shelter on this habitats and also perform their breeding. After catching, both small and large fishes are highly susceptible to spoilage by microorganisms and biochemical reactions during post-mortem process (Ismail, 2005). The rate of spoilage depends on seasons. The intensity and abundance of bacterial flora depend

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on aquatic environmental conditions and ambient temperature variation and expected to influence the intestinal microbiota of fishes which can accelerate the spoilage rate of fishes (Hovda *et al*., 2012). The bacterial loads are higher in summer than winter season (Rheinheimer, 1985). Seasonal variation explicitly summer and winter temperature variation influences wild fishery species as considerably higher yield in summer than winter seasons (Bari *et al*., 2015). The higher temperature and maximum yield of fishes in summer season lead to preserve the fishes for a long time. Fishesare a highly perishable food item, it can be kept fresh in ice condition for 8 to 14 days depending on the species (Rahman *et al*., 2012). The qualityloss occurs due to rough handling when the fishes are transported to market in iced condition by means of trucks, carrier launches and railways for short and long distance transport (Reza *et al.,* 2009). Therefore, to cope with this problem some fish traders used chemicals like formalin for fish preservation to make them stiff and appear fresher for the long period of time and to prevent deterioration (Haque & Mohsin, 2009).

Formalin is a solution of 37% formaldehyde dissolved in water, formalin solution used for fish preservation should contain 10-15% methanol which inhibits the formation of a highly toxic compound (Rahman *et al.,* 2012). According to Kawser (2007), annually about 80,000 L formalin enters into Bangladesh, it is being used in multiple purposes like preservation of fish, fruit and other food items. Formalin preserved fish is very detrimental for human health due to its toxic and volatile nature, it causes respiratory disorder and carcinogenic to human bodies (Ross *et al.,* 2002; IARC, 2004). The intensity of using formalin is varied in season, and it is higher in summer as summer has a higher temperature which can increase spoilage rate of fishes compared to the winter season. Although formalin contamination in edible food is strictly prohibited according to the declaration of Bangladesh Government. However, it is considereda concurrent critical public health hazard throughout the country (DoF, 2009; Yeasmin *et al.,* 2010). Several studies reported the presenceof formalin inlarge table fish's items but researchpinpoints the formalin contamination in SIS are scant. Therefore, the present study aimed to know the presence of formalin in SIS in different fish markets of Sylhet Sadar Upazila, Bangladesh.

Materials and Methods

Selection of fish markets

The Sylhet district is situated in 24.70^{o}north latitudes and 91.67^{o}east longitudes. Sylhet district is divided into twelve Upazilas. Sylhet Sadar is one of them and is famous for the production, marketing and transportation of fresh or wet fish. A huge number of fresh fishes are coming every day in the different markets of Sylhet Sadar Upazila for local consumption. The people of Sylhet region prefer the fresh fish and there is a good demand for these products which is increasing day by day to all kinds of people irrespective of poor and rich. The present study was thereby intended to conduct in this area and primarily eight fish markets were selected near to the Sylhet Agricultural University, Sylhet as per vision of the study (Figure 1). These are Adorsho Fish Market (AFM), Ambar Khana Fish Market-1 (AKFM1), Ambar Khana Fish Market-2 (AKFM2), Rikabi Bazar Fish Market (RBFM), Lala Bazar Fish Market (LBFM), Kazir Bazar Fish Market (KBFM), Kazitula Fish Market (KFM)and Shibgonj Fish Market (SFM).

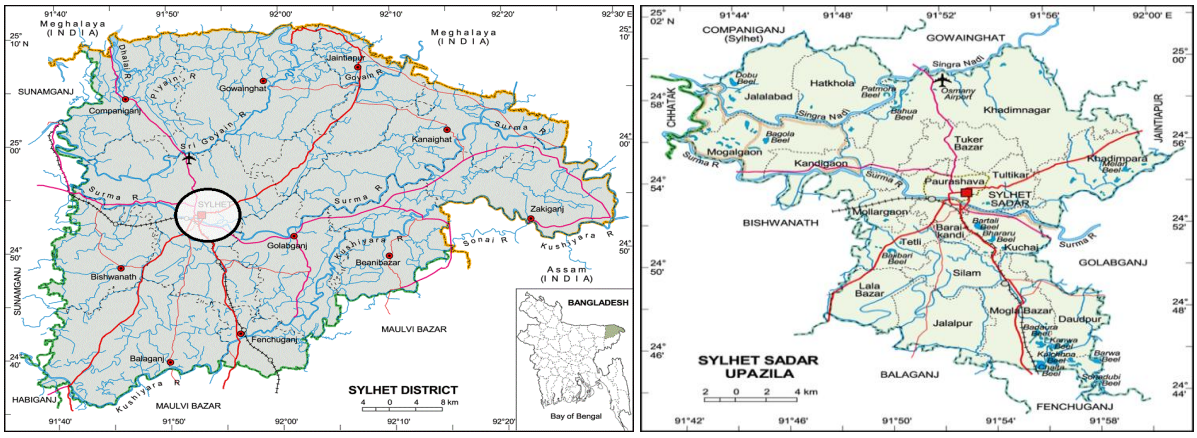


Fig. 1. Map showing the study areas and sampling site situated in the Sylhet, north-eastern part of Bangladesh (Adapted from Banglapedia 2015)

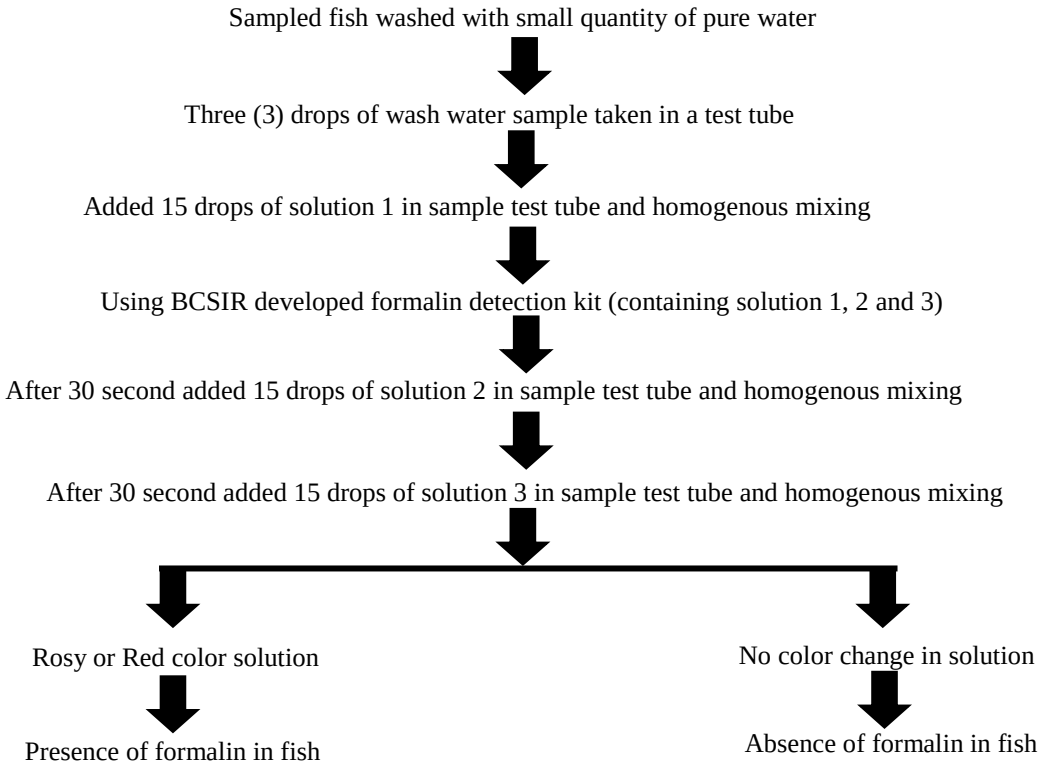
Collection of the SIS fishes as specimens

SIS fishes taxa explicitly Kachki (*Coricas oborna* Hamilton, 1822), Mola (*Amblypharyngodonmola* Hamilton, 1822*)*, Chapila (*Gudusia chapra* Hamilton, 1822), Tengra (*Mystus tengra* Hamilton, 1822), Tit punti (*Puntius ticto* Hamilton,

1822) were investigated from eight different fish markets in two seasons explicitly summer and winter. All of the fishes were collected from natural water bodies (*River, Lake, Haor, Baor, Beel and natural pond*) of Bangladesh. The majority of fishes originated from Sylhet, Sunamgonj, Chittagong, Rangamati, Comilla, Chandpurand Barishal. The Kachki (*Corica soborna*) predominantly imported from Chittagong and Rangamati, and other fishes imported from different parts of Bangladesh. A total of 160 samples under aforesaid five fish taxa were collected from these markets for the identification of formalin and sources of formalin. The samples were collected in a plastic box or other temperature insulated pot separately to avoid mixing with another fish at the laboratory until use. The samples were used within 24 hours of collection. Samples were collected during winter (November to December, 2014) and summer (May to June, 2015) seasons.

Identification of formalin on selected fish through the formalin Test Kit

The Bangladesh Council of Scientific and Industrial Research (BCSIR) developed formalin detection kit for the fish sample. The procedure (Flowchart 1) used for the detection of formalin in selected five SIS samples from eight different markets of Sylhet Sadar Upazila.



Flowchart 1. The schematic diagram for the detection of formalin in selected SIS fish sample by using BCSIR developed formalin detection kit

Data analysis

All the collected data were tabulated, summarized, scrutinized carefully and recorded properly in a master sheet by using Microsoft Excel and SPSS software for statistical analysis. Student t-test with 95% confidence level (P-value <0.05) was carried out to compare the intensity of formalin in the summer and winter season within SIS fishes.

Results and Discussion

Presence of formalin in selected SIS fish samples

Among the studied 160 sample of SIS specimens, formalin detection was found positive in 50 samples (31.25%) during the four-month study period (considering two seasons explicitly summer and winter) (Table 1). Islam *et al.* (2015) noted that out of 939 wet fish samples 213 fishes were contaminated with formalin. Rahman *et al.,* (2012) reported formalin in 17.3% sampled (26 fish contaminated with formaldehyde out of 150) in Sylhet. In Dhaka Metropolitan city, among 800 fishes, 50 fishes were contaminated with formalin which was almost 5% of total consumable fishes (10.25% formalin in large and 2.25% in SIS fishes)and its intensity varies from market to market and species to species (Haque & Mohsin, 2009). Bari *et al.* (2013) reported 16 out of 192 fishes were contaminated with formalin in Tangail and 33 out of 171 fishes in Tongi. Uddin *et al.* (2011) reported that 42% fish sampled were contaminated with formalin in Dhaka. According to Paul *et al*. (2014) among the five fish markets of Jessore district (Boro Bazar, Monirampur Bazar, Benapol Bazar and Jhikorgacha Bazar) 10% SIS were formalin contaminated which was higher than larger fishes and among SIS fishes among them highest contamination found in15% sample of *C. soborna*. It is evident that formalin contamination in SIS fishes is a growing problem, the fish traders frequently use formalin to keep the fish fresh without concerning the food safety issues.

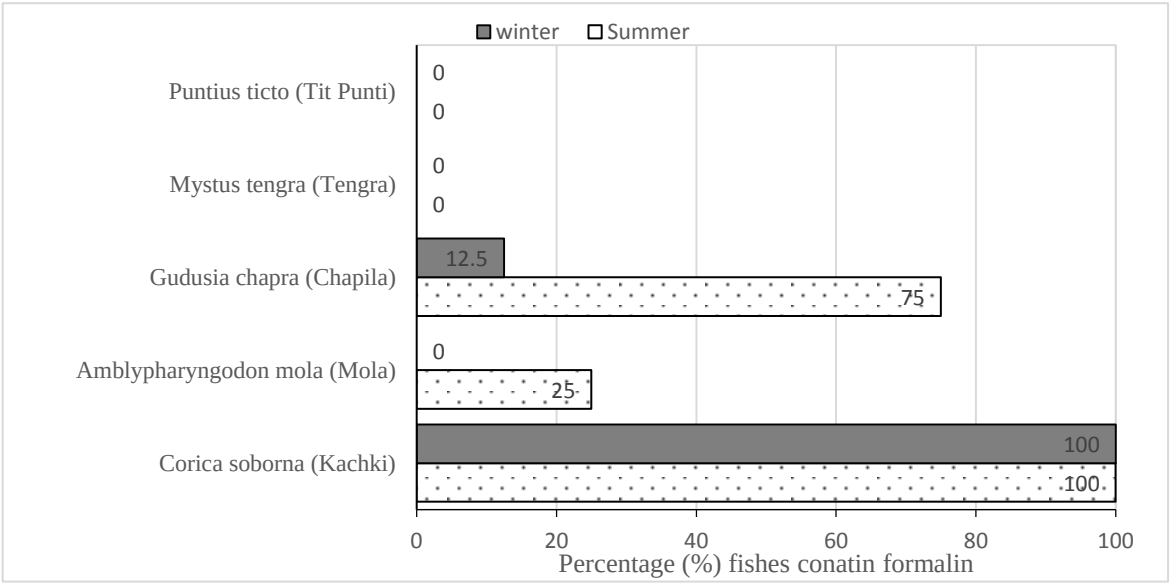


Fig. 2. Presence of formaldehyde (formalin) in the sampled SIS fishes during summer and winter seasons in Sylhet Bangladesh

Seasonal variation of formalin in SIS

Among the 160 SIS samples, 32 (40%) samples were contaminated in summer and 18 (22.5%) were in winter seasons (Table 1). The highest formalin contamination rate was found in Kachki,*Corica soborna* (100%) followed by Chapila, *Gudusia chapra* (75% and 12.5%) and Mola, *Amblypharyngodon mola* (25% and 0) in both seasons explicitly summer and winter (Figure 2). However, fishes like local *M. tengra* and *P. ticto* were free from formalin. It indicated that the misuse of formalin was more prone in *C. soborna*, *G. chapra* and *A. mola* than other locally available small fishes (*M. tengra*, *P. ticto*). *G. chapra* and *A. mola* fishes were contaminated with formalin in summer seasons more than winter ($P < 0.05$).

Table 1. SIS specimens, sources, and formalin detection during summer (May-June/2015) and winter season (November-December/2014)

Fish Market[1]	Scientific (vernacular) identity of the SIS taxa	Habitat (Source of Fish)	Detection of Formaldehyde[2]			
			Summer		Winter	
			May	June	Nov	Dec
AFM	*Coricasoborna*(Kachki)	River and Lake	+	+	+	+
AKFM1	*C. soborna*	River and Lake	+	+	+	+
AKFM2	*C. soborna*	River and Lake	+	+	+	+
RBFM	*C. soborna*	River and Lake	+	+	+	+
LBFM	*C. soborna*	River and Lake	+	+	+	+
KBFM	*C. soborna*	River and Lake	+	+	+	+
KFM	*C. soborna*	River and Lake	+	+	+	+
SFM	*C. soborna*	River and Lake	+	+	+	+
AFM	*Amblypharyngodon mola* (Mola)	Haor and Pond	-	-	-	-
AKFM1	*A. mola*	Haor and Pond	-	-	-	-
AKFM2	*A. mola*	Haor and Pond	-	-	-	-
RBFM	*A. mola*	Haor, Pond & River	-	-	-	-
LBFM	*A. mola*	Haor and Pond	-	-	-	-
KBFM	*A. mola*	Haor, Pond & River	+	+	-	-
KFM	*A. mola*	Haor, Pond & River	+	+	-	-
SFM	*A. mola*	Haor and Pond	-	-	-	-
AFM	*Gudusiac hapra* (Chapila)	River and Haor	+	+	-	-
AKFM1	*G.chapra*	River and Haor	+	+	-	-
AKFM2	*G.chapra*	River and Haor	+	+	+	+
RBFM	*G.chapra*	River and Haor	+	+	-	-
LBFM	*G.chapra*	River and Haor	-	-	-	-
KBFM	*G.chapra*	River and Haor	+	+	-	-
KFM	*G.chapra*	River and Haor	+	+	-	-
SFM	*G.chapra*	River and Haor	-	-	-	-
AFM	*Mystus tengra* (Tengra)	Haor and Pond	-	-	-	-
AKFM1	*M. tengra*	Haor and Pond	-	-	-	-
AKFM2	*M. tengra*	Haor and Pond	-	-	-	-
RBFM	*M. tengra*	Haor and Pond	-	-	-	-
LBFM	*M. tengra*	Haor and Pond	-	-	-	-
KBFM	*M. tengra*	Haor and Pond	-	-	-	-
KFM	*M. tengra*	Haor and Pond	-	-	-	-
SFM	*M. tengra*	Haor and Pond	-	-	-	-
AFM	*Puntius ticto* (Tit punti)	River, Pond &Haor	-	-	-	-
AKFM1	*P. ticto*	River, Pond &Haor	-	-	-	-
AKFM2	*P. ticto*	River, Pond &Haor	-	-	-	-
RBFM	*P. ticto*	River, Pond &Haor	-	-	-	-
LBFM	*P. ticto*	River, Pond &Haor	-	-	-	-
KBFM	*P. ticto*	River, Pond &Haor	-	-	-	-
KFM	*P. ticto*	River, Pond &Haor	-	-	-	-
SFM	*P. ticto*	River, Pond &Haor	-	-	-	-

[1] Fish Market code: Adorsho Fish Market (AFM), Ambar Khana Fish Market-1 (AKFM1), Ambar Khana Fish Market-2 (AKFM2), Rikabi Bazar Fish Market (RBFM), Lala Bazar Fish Market (LBFM), Kazir Bazar Fish Market (KBFM), Kazitula Fish Market (KFM) and Shibgonj Fish Market (SFM).[2]Formalin detection '+' denotes presence of formaldehyde and '-' absence.

The study revealed that the higher formalin contamination in the most of the specimens sampled during summer compare to the winter seasons in most of the fish markets may be associated with the higher ambient temperature, as of retailers often want to prevent or delay the spoilage fishes. The intestinal microbial flora of fish changes in parallel with environmental changes as result summer season contained higher temperature which leads to higher bacterial load than winter (Baten *et al.,* 2018; Hagi *et al*., 2004; Holben *et al*., 2002).The locally available fishes (Tit punti, tengra) were less chance to contaminate with formalin, on the other hand, imported fishes (Kachki, Chapila, Mola) were very frequently contaminated with formalin. This experiment also was in line with other different studies, who reported the imported fish were more prone to formalin contamination than locally available fishes (Hossain *et al.,* 2008; Bari *et al.,* 2013). The survey also indicated that the overall hygienic and sanitary condition of the markets were very poor. It was observed that fish sellers/traders were affected by various types of skin disease, inhalation problem and eye irritation

problem etc. It is, therefore, urgent need to ensure the institutional and government support, improving monitoring system and implement formalin testing methods, marketing systems and market infrastructure or hygiene that can ensure a good quality fresh fish/safe fish in the markets for the retailers and consumers.

Conclusion

Among five types of fish species, *C. soborna* was the most formalin contaminated followed by *G. chapra* and *A. mola*. The SIS fishes are more prone to formalin contamination in summer than the winter season. Because of fish spoilage or quality deterioration is related to temperature and long distance transportation which influences the dishonest fish trader to use the formalin for the preservation of fish for a long time. Awareness should be built on the hazardous effect of formalin-treated fish. The government and other agencies need to take necessary action to prevent such type of malicious activities by the fish traders to safeguard consumer as well as a fish handler. The future direction of research should be done for value chain analysis of formalin-treated fish in different sources from the supermarkets to rural markets and nutritional quality changes in formalin treated fish muscles.

References

Amin A K M R, Parvez I, Zaman M B and Amin H A. 2009.Study of the present status of endangered small indige-us species (SIS) of Fish in the Natural Waters of the north-West Part of Bangladesh. J. Envir. Sci. and N. Res. 2(2):163-168.

Banglapedia. 2015. National Encyclopedia of Bangladesh. (ed), S. Islam. Dhaka: Asiatic Society of Bangladesh. Retrieved March 17, 2017, from http://en.banglapedia.org

Bari L, Islam A, Ferdous Z, Azman A, Khatun S and Hossain I. 2013.A comparative study of using formalin in fish of Tangail and Tongi Town. J. Biol. Sci. 21:43-49.

Bari S M, Khalil S M I, Mamun M A A, Islam M J, BatenM A and Hossain M M. 2015.Seasonal Variation in Population Dynamics of Helminth Parasites in *Clariasbatrachus* from Natural wetlands of Sylhet, Bangladesh. Int. J. Nat. Sci. 5(2):86-89.

Baten M A, Hossain M M, Bapary M A J, Islam M J, Elahi A T M M and Hossain M M. 2018. Seasonal variation in bacteriological count between native vs exotic climbing perch, *Anabas testudineus* (Bloch, 1972) at north-Eastern Bangladesh.Bangladesh J. Fish. 30(1):103-111.

DoF (Department of Fisheries). 2009. Fish Fortnight Publication. Department of Fisheries, Ministry of Fisheries and Livestock.

DoF (Department of Fisheries). 2012. National Fish Week 2012 Compendium (In Bangla). Bangladesh: Department of Fisheries (DoF), Ministry of Fisheries and Livestock, the People's Republic of Bangladesh, Dhaka, Bangladesh.

FAO (Food and Agriculture Organization). 2014. The State of World Fisheries and Aquaculture Report. pp. 13-15.

Felts R A, Fajts F and Akteruzzaman M. 1996. Small Indigenous Fish Species Culture in Bangladesh (Technical brief), IFADEP Sub Project 2, Development of Inland Fisheries, 41p.

Hagi T, Tanaka D, Iwamura Y and Hoshino T. 2004. Diversity and seasonal changes in lactic acid bacteria in the intestinal tract of cultured freshwater fish. Aquaculture, 234(1-4):335-346

Haque E and Mohsin A B M. 2009.Intensity of Formalin Use for Consumable Fish Preservation in Dhaka City, Bangladesh. J. Fish. Int. 4(3):52-54.

Holben W E, Williams P, Saarinen M, Särkilahti L K and Apajalahti J H A. 2002. Phylogenetic analysis of intestinal microflora indicates a novel Mycoplasma phylotype in farmed and wild salmon. Micro. Ecol. 44(2):175-185.

Hossain M A and Afroze S. 1991.Small fish as a resource in rural Bangladesh. Fishbyte 9(2):16-18.

Hossain M A, Afsana K and Azad A K M. 1999.Nutritional value of some small indigenous fish species (SIS) of Bangladesh. Bangladesh J. Fish. 3(1):16-20.

Hossain M A, Toyub M A, Islam M N and Hasan M R. 1994.Effect of species combination on the growth of major and Chinese carps in demonstration ponds under Feni district, Bangladesh. J. Agril Sci. 21(2):257-266.

Hossain M M. 2013. Evaluating the performance of co-management organizations (CMOs) in sustainable benefits sharing in Tanguarhaor, Bangladesh. [In]: Mustafa M G, Khan N A, Akhtaruzzaman A F M, Harun A K Y. and Chowdhury R M (eds.). Co-Managed and Climate Resilient Ecosystems. USAID's IPAC Project, IRG and the WorldFish, Dhaka, Bangladesh, pp. 182-201.

Hossain S, Hossain M S and Rahman M A. 2008. Formaldehyde Content in the Rui Fish (Labeorohita) in Bangladesh and Effect of Formaldehyde on Lipid Peroxidation in Rat Liver and Intestinal Tissues. J. Med. Sci, 8(4):405-409.

Hovda M B, Fontanillas R, McGurk C, Obach A and Rosnes J T. 2012. Seasonal variations in the intestinal microbiota of farmed Atlantic salmon (*Salmo salar* L.). Aqua. Res. 43(1):154-159.

IARC.2004. Monographs on the evaluation of carcinogenic risks to humans, vol. 88, formaldehyde, 2-Butoxyetha-l and 1-tert-Butoxy-2-propa-l. Lyon, France: International Agency for Research on Cancer.

Islam R, Mahmud Aziz S A, Sarker A and Nasreen M. 2015. A Comparative Study of Present Status of Marketing of Formalin Treated Fishes in Six Districts of Bangladesh. Food and Nut. Sci. 124-134.

Ismail H M. 2005. The role of omega-3 fatty acids in cardiac protection: An overview. Front. Biosci. 10:1079-1088.

Kausar I A. 2007. About 80,000 kg formalin fish enter country every day: no policy for fish import yet, A report published in Daily star. http://www.bangladesh-web.com/view.php?hidRecord=152599.

Pal M. 2010. *Fish hygiene.* MSc Lecture notes. Addis Ababa University, Faculty of Veterinary Medicine, DebreZeit, Ethiopia. pp. 1-11.

Paul L, Mondal D K, Paul M, Riar M G S and Ali A. 2014. Intensity of formalin misuse for fish preservation in five markets of Jessore district, Bangladesh. Int. J. Nat. Sci. 77-81.

Rahman M M, Ahmed S, HosenM M and Talukder A K. 2012. Detection of formalin and quality characters of selected different fishes in Sylhet city, Bangladesh. Bangladesh Res. Pub. J. 161-169.

Reza M S, Bapary M A J, Ahasan C T, Islam M N and Kamal M. 2009. Shelf life of several marine fish species of Bangladesh during ice storage. Int. J. Food Sci. Tech. 44:1485–1494.

Rhea F. 2009. Microbiology handbook: Fish and seafood. Leatherhead Food International Ltd. Surrey, United Kingdom.

Rheinheimer G. 1985. Aquatic Microbiology, 3rd ed. University of Kiel, West Germany. Wiley, Chichester, New York, Brisbane, Toronto. 257p.

Ross P F, Draayer H and Itoh O. 2002. An international collaborative study on a method for determination of formaldehyde in veterinary vaccines. Biol. 30:37-41.

Thilsted S H, Ross N and Hasan N. 1997. The role of small indigenous fish species in food and nutrition security in Bangladesh, NAGA Newsletter, Jul – Dec. 13 pp.

Uddin R, Wahid M I, Jesmeen T, Huda N H and Sutradhar K B. 2011. Detection of formalin in fish samples collected from Dhaka City, Bangladesh. Stamford J. Phar. Sci. 4(1):49-52.

Villif A and Jorgensen L B 1993. Analysis of naeringgsstoffat l, in An Environmental Monitoring System for GOLDA project: CARE – Bangladesh Interim Report.

Yeasmin T, Reza M S, Khan M N A, Shikha F H and Kamal. M. 2010. Present status of marketing of formalin treated fishes in domestic markets at Mymensingh in Bangladesh. Int. J. Bio. Res. 1 (4):21-24.