Detection of formalin in fish and milk and perception of the household-heads on formalin contamination in Bangladesh

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Abstract

Bangladeshi people are consuming fish and milk almost every day. Bangladesh imports sellected type of *carp* fish from neighboring countries. Mixing of formalin in fish and milk as preservative is known to many people. The study aimed to determine the presence of formalin in fish and milk at the household level throughout the country. Multistage sampling was done to select 210 households of 7 divisions of Bangladesh. Qualitative information was collected from fish retailers and consumers about the use of formalin in fish and milk. Detection of formalin was carried out on fish samples from 6 wet markets in Dhaka city and 210 selected households. Pasteurized liquid milk from Dhaka city markets and cow milk from selected 210 households were tested using formalin detection kit developed by BCSIR. The Focus Group Discussion (FGD) respondents stated that they do not add chemicals or formalin in fish. But 70% of the respondents ensured that imported fishes and small fishes namely Kaachki fish collected from Mymensingh and Chittagong are contaminated with formalin. Majority of them said that dishonest businessmen usually add formalin during off-loading of fish from the vehicle or at wholesale level or at cold storage. Formalin was found in 46 out of 70 fish samples in Dhaka city. But 384 fish samples and 210 cow milk samples from 210 households and 12 milk samples of 3 popular brands in Dhaka city were found free from formalin. Local fishes were formalin free because the fisherman catches fish locally and sale those in local market within 3 to 4 hours even without using ice for preservation. Most of the household heads were educated and from middle income group who had good perception about formalin contamination. The study also indicated that 92% of household heads agreed to spend 5 to 10% extra cost for formalin free food. It reveals that formalin use is not a severe problem so far in rural markets but exists as a threat in the city markets.

Keywords: Fish, Milk, Formalin contamination

Introduction

Bangladesh is a densely populated and an agro-based developing country. It develops a strong economy by improving agricultures, fisheries and livestock sectors. The household income and expenditure survey in 2011 reported that the people in Bangladesh consume 49.5 gm, 45.8 gm, and 59.9 gm of fishes at national, rural and urban level respectively. They consume 33.7 gm, 31.8 gm, and 39.2 gm of milk at national, rural and urban level respectively[1].

Fish production has increased significantly over the decades, but could not yet meet the growing demand of the country[2]. About 80 MT of fish and fishery products enter into Bangladesh every day through the Teknaf border from Myanmar[3]. About 90% of animal protein in our diet comes from fish and livestock[2]. This fisheries sector contributes to 5.1% of the total national animal protein consumption. Fish products are the largest export commodity contributing to 8% of its exchange earnings, and in 2012 Bangladesh earned US$ 592.5 million[4].

Fishes are very perishable commodity. Using ice is a common practice of fish preservation in the country. But a lot of fishes are wasted due to improper use of ice and transportation which count losses to the traders[5]. It sometimes reported that formalin is added or sprayed to the fishes by the fish traders while transporting to domestic marketing chain to prevent spoilage and increase shelf life[6].

Milk is wholesome nutritious food for all mammals including human being. Milk in its natural form has the apex food value[7]. Milk is also perishable and its shelf life is few hours. The quality of milk is deteriorated due to adulteration which is usually done by adding inferior cheaper materials like water, cane sugar and powdered milk[8].

Formalin is frequently used as one of the most

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common preservatives for fish and milk. It is however, not approved for usage in aquaculture in Europe and Japan because of its association with cancer and tumor development[9]. Use of formalin in food for human consumption is also banned in Bangladesh[10].

Formalin (or 40% aqueous solution of formaldehyde) is very injurious to human health. Some studies suggest that large formaldehyde exposures, for example from drinking formaldehyde solutions, are potentially lethal[11]. The Agency for Toxic Substances and Disease Registry (ATSDR) has established a chronic inhalation minimal risk level (MRL) of 0.003 ppm (0.004 mg per cubic meter, mg/m^3) based on respiratory effects in humans[12]. Even those who spray or inject formalin over a long period of time will likely suffer from health complications such as blindness, asthma and even lung cancer[13]. Continuous addition of formaldehyde through the edible items in human body may cause uncontrolled cell growth or cancer in any part of body like stomach, lung and respiratory system[14]. Moreover, inhalation of formalin causes respiratory system cancer such as sulfuric acid mists, mineral acid, metal dusts and heat[15].

This study attempts to assess presence of formalin in fishes and milk in different markets of Dhaka city and in the households of 14 Upazillas of the 7 divisions in Bangladesh and the perception of household heads on formalin contamination in the country.

Methodology

This is a cross sectional study conducted during the period from July 2014 to June 2015. The data were collected using both qualitative and quantitative methods.

Qualitative data collection

Focus group discussion (FGD): Two FGDs were conducted, one at Mohammadpur Bazaar and the other at Kawran bazaar in Dhaka city. Each group was comprised of ten fish retailers; at least one participant was opponent to mixing formalin to fishes to get in-depth information. The discussions were facilitated by the researchers using interview guide and continued around one and a half hour during noon as it was their convenient time to take part in discussion. The discussion was basically focused on formalin adulteration of fish specifying the occurrence of adulteration at several supply chains. A voice recorder was used to collect data and it was then transcribed.

Selection of locations for collection of food samples

Dhaka City: A total of 70 fish samples of 13 fish varieties were collected randomly from six markets of Dhaka city.

Besides, 12 milk samples were collected from the local markets of Dhaka city to detect presence of formalin in those milk samples.

Selection of Upazillas: Multistage sampling was done to select initially the seven districts (Rangpur, Sirajgonj, Bagerhat, Bhola, Feni, Kishoregonj, and Habiganj), one from each of the seven divisions of Bangladesh. Two Upazillas from each district were then selected by simple random sampling. The selected 14 Upazillas were Rangpur Sadar, Mithapukur, Sirajgonj Sadar, Belkuchi, Bagerhat Sadar, Kochua, Bhola Sadar, Lalmohon, Feni Sadar, Sonagazi, Kishoregonj Sadar, Bhairab, Habiganj Sadar, and Ajmiriganj. Then one Union from each Upazila was selected randomly and finally one village from each Union was selected randomly which fulfills the following 2 criteria:

(1) Must have a local market in the village where fish and milk is sold

(2) At least the village market sits for 2 days in a week so that data can be collected on market days.

After selecting the study village, 15 households from each selected village were selected randomly for detecting formalin in fish and milk before cooking that they procured or collected either from market or from own farm. A total of 384 fish samples from 38 fish varieties and 210 milk samples were collected to detect presence of formalin. The name of the fish samples available and selected for testing the presence of formalin were rui *(Labeo rohita)*, katol *(Catla catla)*, mrigal *(Cirrhinus cirrhosis)*, silver carp *(Hypophthalmichthys molitrix)*, kali baush *(Labeo calbasu)*, elish *(Tenualosa ilisha)*, tilapia

(Oreochromis mossambicus), boal *(Wallago attu)*, aaeer *(Sperata aor)*, baeem *(Mastacembelus armatus)*, chitol *(Chitala chitala)*, koi *(Anabas testudineus)*, sorputi *(Puntius sarana)*, pangas *(Pangasius hypophthalmus)*, grass-carp *(Ctenopharyngodon idella)*, chingri *(Penaeus monodon)*, puti *(Puntius chola)*, tangra *(Batasio batasio)*, chapila *(Gonialosa manmina)*, kholse *(Colisa fasciata)*, kachki *(Corica soborna)*, mola *(Amblypharyngodon microlepis)*, dela *(Salmophasia phulo)*, pabda *(Ompok pabo)*, baila *(Awaous guamensis)*, taki *(Channa punctate)*, chuna *(Trichogaster chuna)*, rupchanda *(Pampus argenteus)*, carp *(Cyprinus carpio carpio)*, chela *(Chela laubuca)*, shing *(Gagata youssoufi)*, vetki *(Lates calcarifer)*, kakra *(Brachyura)*, parshe (*Liza parsia)*, loitta *(Bombay duck)*, shapla *(Dasyatis zugei)*, gulsha *(Mystus cavasius)*, etc. The milk samples tested were only the cow'milk at the household level, since branded milk packets were unavailable.

Qualitative detection of the formalin: The following formalin detection methods were used:

Fish: At first, using a wash bottle the samples were washed thoroughly specially the gill, fin and tail with small quantity of water. Two mililiter washed-out water was taken in a test-tube using a supplied dropper. Then 15 drops of No. 1 solution was added in to the test-tube containing fish washed-out water. After well stirring, the solution was allowed to settle for 30 seconds. Then 15 drops from solution No. 2 was added in the same test-tube. After well stirring, the solution was allowed to settle for 30 seconds. Then 15 drops from solution No. 3 was added. Then, if the color of the solution changes into pink or red, the presence of formalin would be confirmed. On the other hand, if the color of the solution remains unchanged, there is no formalin in the sample.

Milk: Firstly, 1 spoon of raw milk was taken on a spoon that was supplied in the formalin detection kit test kit for milk was developed by Bangladesh Council of Scientific and Industrial Research (Figure 1). Then 4-5 drops of the solution were added in the spoon containing raw milk and wait for few minutes. If the color changed into only violet color as indicated on instruction, then the presence of formalin in the sample is ascertained. On the other hand, if the sample'changed or shown pink color that indicated the absence of formalin.

Quantitative method: Socio-economic data of 210 households of 14 Upazillas of 7 divisions were collected. A structured questionnaire was used to collect data emphasizing their socio-economic information including gender, religion, age, marital status, education level, monthly family income, family size, and perceptions on formalin adulteration. The initial draft questionnaire was field tested, revised and finalized the questionnaire incorporating the suggestion received from the field.

Data collected from the household heads were compiled, tabulated and analyzed in accordance with the objectives of the study. Data from the survey were statistically analyzed using the Statistical Package for the Social Scientist (SPSS, version 21) and Microsoft excel.

Figure 1: Formalin detection solution for fish and milk.

Results and discussions

Focus group discussion: Two FGDs were conducted in Mohammadpur and Kawran Bazaar on 23 and 25 January 2015. The findings of FGDs are summarized as follows: About two-third of the respondents reported that imported fishes and small fishes namely Kachki fish collected from Mymensingh and Chittagong are mainly contaminated with formalin. Majority of the respondents said that corrupted business men usually add formalin during supply chain at off-loading of fish from the vehicle or at wholesale level or at cold storage. One third of the respondents confessed that formalin is also adjoined during ice making. Formalin is added to water which is used for making ice. Formalin contaminated ice are usually coming mainly from Barishal and costs 200 taka per piece (18 liters) whereas formalin free ice costs 80 taka/piece (18 liters). One-tenth of the FGD respondents stated that fishes are usually dipped in formalin contaminated water for few minutes. Formalin is also injected into the fish abdomen. All retail sellers use salt to remove the sticky appearance of the fishes. Moreover, majority of them use saffron colour (jorda colour) to make fish brighter in appearance. Usually they use jorda colour in Gulsha, Puti and Pabda fish. They also provide the information regarding the identification of formalin contaminated fish. The eye ball is pale and eyes are inserted inwards the body, because of dry and lack of usual stickiness. The gills are usually blackish in colour. Fish does not retain the original flavor.

Dhaka city: Table 1 indicates that out of 70 fish samples 46 fish samples show the presence of formalin. That means about two-third (65.7%) of 13 varieties of fishes were found formalin contaminated. It was also found that 33.3% of rui, 25% of katol, 80% of chingri, 75% of kachki, 66.6% of chapila, 50% of tilapia and 100% of rupchanda, kali baus, mrigel, aeer, chitol and grass carp were formalin contaminated. On the other hand, only tengra was not found formalin contaminated. Similar studies were conducted by Uddin et al., in 2011[9]. The study indicated almost 50% of fish samples contain formalin in Dhaka city.

Upazilla level: Testing formalin contamination in 384 fish samples of 37 fish varieties from the selected Upzilas showed no contaminations at all (data not shown). Similarly Rahman et al., in 2012[14] also found that all the village markets were totally free from formalin contamination. The fishes at the household level were found formalin free may be due to fishes were purchased from local village market where the

Table 1: Detection of formalin in different fish varieties collected from Dhaka city

Name of the fish	No. of sample	Presence of formalin in no. of samples	Percentage (%)
Rui	12	4	33.3
Katol	8	2	25
Chingri	10	8	80
Kachki	8	6	75
Chapila	6	4	66.6
Telapia	4	2	50
Rupchanda	6	6	100
Kali baus	4	4	100
Mrigel	2	2	100
Aeer	4	4	100
Chitol	2	2	100
Grass carp	2	2	100
Tengra	2	0	0
Total	70	46	65.7%

fishermen sales the fish after catching them, the fish market stays for 3 to 4 hours and fish sellers complete their sale within this time. Besides, the village fish retailers may have no knowledge on formalin use and perhaps they never need it. Local fishermen catch fishes from local rivers, canals, beels, baors etc. and they never thought of preservation as they sale fishes in local markets. Distance from fish catching area to market and time required for selling fish did not need to use formalin. It was interesting that the people in rural Bangladesh have limited chances to suffer from formalin contaminated fish.

Detection of formalin in milk

Dhaka city: Purposively the brand name of the milk printed on the packets available in the Dhaka city market is not mentioned in this study. A total of 12 milk samples/packets were purchased from different shops in 12 different locations in Dhaka city and tested for the presence of formalin in them. The study revealed that there was no formalin in the milk samples and thus the milk samples tested were found formalin free in Dhaka city. This may be due to direct supply of sealed milk packets of the companies to the local shops in the city.

Upazilla level: A total of 210 samples of milk was collected and analyzed. The study found that all the 210 milk samples of 14 villages of 14 Upazillas in Bangladesh were formalin free. On the other hand similar study was conducted by Chanda et al., in 2012[7] where 10% of milk sample were formalin contaminated in Barishal district of Bangladesh.

This indicates that cow milk available at Upazilla levels is not contaminated and the sellers or consumers do not use formalin as preservative of milk. Therefore, the milk at the rural household level is safe and at least free from adulteration with formalin. This may be due to the cautiousness of the milk consumers and producers.

Source of fish at Upazilla: Figure 2 showed that 99% of the respondents purchased fish from the market and the remaining 1% from the pond.

Socioeconomic status of the Upazilla level respondents: The table 3 shows that 93% of the respondents were male. Most of the respondents were literate, 44% of them have completed their S.S.C and H.S.C and 39% of the respondents have completed graduation. In addition, 55% of the respondents belong to middle income group.

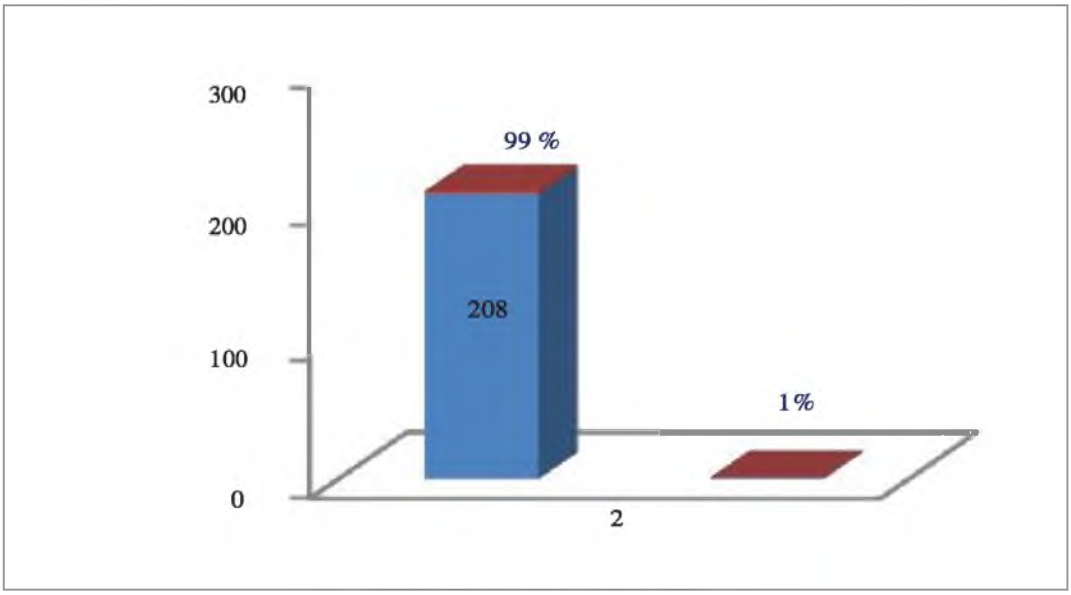

Figure 2: Source of fish.

Table 2: Socio economic status of the respondents

Socioeconomic Status	Parameter	Number of respondents	Percentage (%)
Sex	Male	196	93
	Female	14	7
Educational level	Illiterate	8	4
	Primary education	27	13
	S.S.C+ H.S.C passed	93	44
	Graduate	82	39
Income level	Low Income	42	20
	Middle Income	117	55
	High Income	51	25

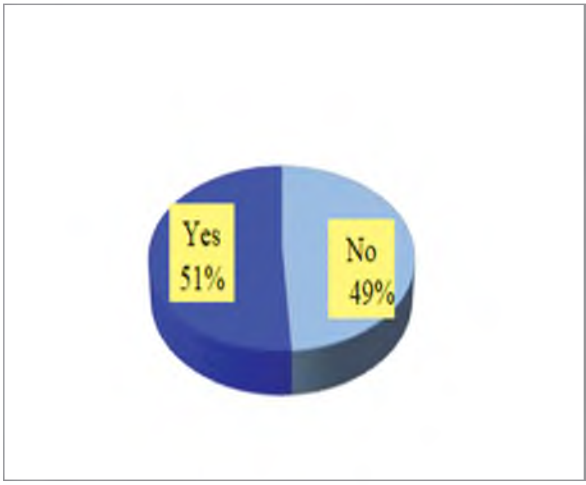

Figure 3: Do you know how to remove formalin from food?

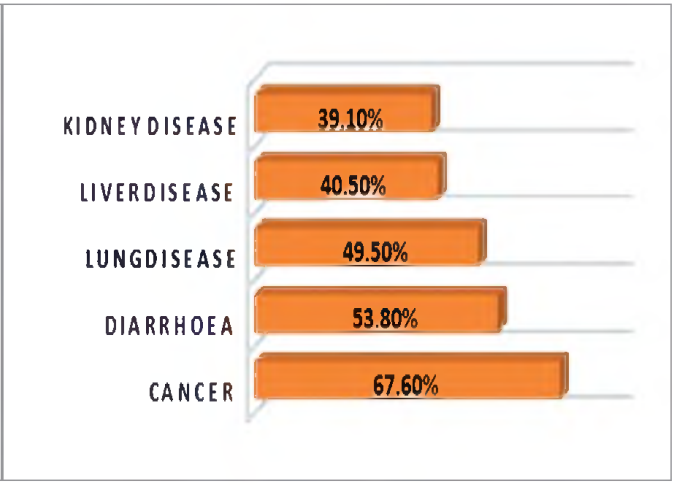

Figure 4: Perception regarding the health bazards of formalin

Perception on formalin contamination

Figure 3 indicated that 100% of the respondents were aware about formalin. It also revealed that 51% of the respondents were clued-up about removal of formalin from food.

Chronic exposure to formaldehyde by inhalation in humans has been associated with respiratory symptoms and eye, nose, and throat irritation[16-19]. Figure 4 investigated that majority of the respondents had similar opinions. Cancer would be the outcome of formalin contaminated food intake believed by 67.6% respondents, whereas diarrhea would be the outcome stated by 53.8% respondents, lung disease by 49.5%, liver disease by 40.5%, and kidney disease by 39.1% respondents.

Paying extra money for formalin free foods: Considering the importance of formalin free foods and the consequences of consuming formalin adulterated food, the It was found that majority of the respondents (92%) agreed to spend 5 to 10 % extra money to buy formalin free foods, whereas only 1% agreed to spend 20% or more extra price for formalin free food. Now-a-days live fish is being sold in city markets with very high cost, because people want to get rid of formalin contamination.

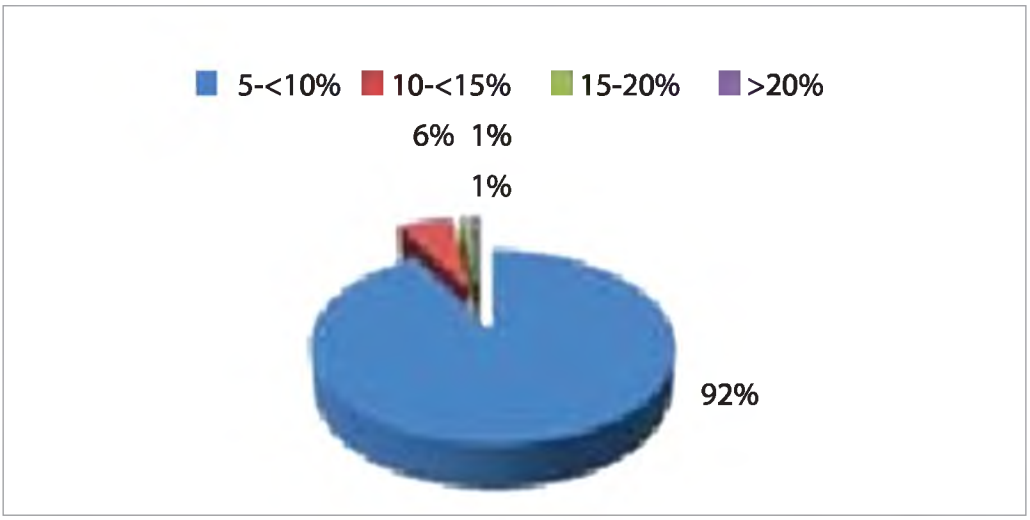

Figure 5: Willingness on excess expenditure on formalin free food.

Conclusion

Formalin as a preservative is used in milk and fish to keep them fresh for longer period. Formalin is being used in imported fishes and at wholesale level. Retailers are not found guilty in adding formalin in their products. Qualitative detection of formalin in six wet markets of Dhaka city revealed that more than fifty percent of the fish samples were formalin contaminated. Such findings prompted the researchers to detect formalin at household level in seven districts of seven divisions of the country. The fishes and milk purchased from local markets were usually free from formalin. Even the respondents expressed their desire to pay higher prices for the formalin free products. This study observed that formalin contamination is not considered as a serious problem in rural markets but surely a big concern in the city markets. The Government efforts to reducing formalin contamination is though appreciated as more organized initiatives and efforts to be undertaken to eliminate adulteration for safeguarding public health.

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