

## Consumers' Awareness of Chemically Treated Fruits: A Study on Consumers of Dhaka City

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### Abstract

*Use of chemical in food and food adulteration has always been a long standing issue of consumer in both developed and developing countries. Many different government bodies in segregated geographical regions instated laws and regulations in order to protect consumers from harmful effects of consuming toxic foods. The citizens of Bangladesh however are still in danger of consuming foods which are chemically treated with hazardous materials (such as calcium carbide, sodium cyclamate, cyanide and formalin, etc.). Many different national newspapers are constantly reporting the use of malicious substances fruits, vegetables, fish, foods and food stuffs. This paper illustrates consumers' awareness of adulterated food items through a questionnaire of 252 respondents at Dhaka. The collected data was coded using SPSS Version 17 and analysed for frequency distribution, cross tabulation and correlation analysis. Regression analysis was further used to analyze associate relationship between dependent variable and the independent variable. The results showed strong relationship between the dependable variable (awareness level) and the independent variables; i.e. sources of information ( $r=0.897$ ,  $p<.01$ ), awareness of chemical booths ( $r=0.827$ ,  $p<.01$ ) and awareness of Laws ( $r=0.698$ ,  $p<.01$ ).*

*Keywords: chemical treatment, consumer awareness*

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## **1.0 Introduction**

### **1.1 Background and Justification**

Whether one purchases grapes or grapefruits, the likelihood of the fruit being chemically treated (adulterated) is quite high and is a common problem in both developed and developing countries. Though various laws and controls exist, a large number of foods on sale in the UK contain substances which are potentially harmful for health (Sumar and Ismail, 1995).

Fresh Florida orange is one example of how some foods are currently treated in developed countries: After being harvested, it is washed with detergent to remove pesticides, mould and dirt. A fungicide is sprayed on to retard rotting. Then, to satisfy consumer preference for orange-colour oranges, the naturally greenish Florida fruit may be dyed by using ethylene gas and a red colouring agent that some studies have linked to bladder cancer in laboratory animals (the growers dispute the relevance of the findings). As a final sprucing, and to prevent excessive moisture loss, a petroleum-based wax or shellac is applied and the fruit is sometimes buffed (The Newyork Times, 1982).

However the example mentioned above fails in comparison to developing countries; the problems are more intense in nature. In a developing country such as Bangladesh, nutrition experts and government officials alike are concerned that harmful chemical used to adulterate fruits, foods and foodstuff has reached a dangerous proportion posing serious health hazards in the country (The Daily Star, 2011).

A seminar, "Hazards of food contamination in national life: Way forward" organized by the Daily Star (a local Bangladeshi newspaper) and RDRS stated "Basic food items on the market like rice, fish, fruits, vegetables, and sweetmeats are adulterated with hazardous chemicals in an indiscriminate manner". It was expressed that the proportion of adulterated food items on the market varied between 70 and 90 percent (The Daily Star, 2011).

Consumers in Bangladesh lack adequate information about the prices of goods and its quality (Nelson, 1970). Producers on the other hand tries to achieve comparative advantage of lower prices while maintaining higher profits, thus leading to the use of cheaper, often hazardous, industrial chemicals in food.

Hazardous chemicals such as calcium carbide are now being used to ripen green tropical fruits, such as bananas, mangoes, guavas, papayas, tomatoes and pineapples (Amin et al., 2004; Prothom Alo, 2005). Chemicals are also being used to colour vegetables in an effort to make cucumbers and tomatoes more appealing (Faruque, 2003). Some traders have also been adulterating food items, such as popular sweetmeats, soft drinks, beverages, confectionaries and others, using low-cost textile dyes to draw customers (Billah, 2007).

Consumption of foods and foodstuffs processed with hazardous chemicals: a case study of Bangladesh, illustrating the serious problems with adulterated foods (Hossain et al., 2008) and they assessed the situation of chemically treated foods in Bangladesh at a staggering high point and also depicted the perception of consumers within Dhaka, Bangladesh.

Therefore, this manuscript used the above mentioned findings as a backbone to address the changes (if any) of consumer's perception of purchasing adulterated fruits of residents at Dhaka, Bangladesh.

## 1.2 Literature Review

Hazardous chemicals may be defined as any chemical that may cause acute or chronic health effects (Hossain et al., 2008).

Ethylene is known to be a plant hormone that triggers fruit ripening. It has been reported that if ethylene is applied exogenously it helps fruit ripening (Medlicott et al., 1988). Ethylene -treatment is usually given at the packing house or at the point of distribution. Ethephon is known as one of the most common ethylene-generating chemical and post harvest treatments. Ethephon accelerates ripening and improves the peel colour of the mangoes (Lakshminarayana et al., 1975). The disadvantages of using Ethephon in low shelf life and poor quality; it is also an expensive product.

In response, developing countries (i.e. Bangladesh) use low-cost calcium carbide to ripen fruit. Calcium carbide is imported from countries such as China, Taiwan and South Africa. Acetylene gas is generated from calcium carbide, which initiates the ripening process in a similar manner to ethylene. This practice is commercially used in Brazil and Senegal (Medlicott, 1986).

The use of calcium carbide changes the skin colour of the fruits and initiates the enzymatic action that breaks down the glucose resulting in a quick ripening of the fruits. A raw fruit can possess the distinct colour of a full ripen

fruit with the use of calcium carbide; thus increasing the shelf life of the product.

### **1.2.1 Effects adulterated food on Consumers' Health**

In 1990, food safety was a hot regulatory issue in the US, where around 5000 people died of food poisoning annually compared with 600 in Britain (The Economist, 2003). Food adulteration may cause many diseases: including liver cancer and cirrhosis, which may result from the consumption of adulterated foods, are on the rise. Chemicals used in foodstuffs are potent carcinogens which cause cancer in many tissues of the human body. They (chemicals) also cause temporary food poisoning, which sometimes leads to severe diarrhoea (Hossain et al., 2008).

A comprehensive list of the diseases, which the different doctors and pharmacists mentioned may result from eating foods mixed with hazardous chemicals, includes food poisoning, paralysis, food allergies, diarrhoea, allergies, cancer and gastroenteritis.

Studies show that the use of formalin is the most dangerous to the human body as it may cause different diseases, including liver cancer and cirrhosis (Rashid, 2007). Even those who spray or inject formalin are in danger, for in doing so over a long period of time, they will likely suffer health complications such as blindness, asthma and even lung cancer (Hossain et al., 2008).

### **1.2.2 Extent of Chemicals Used**

The Bangladesh Pure Food Ordinance 2005 prohibits use of any poisonous chemicals or ingredients like calcium carbide, formalin, patricides or toxic colour or flavour in any food, which may cause harm to human body. But the periodic tests that the Consumers' Association of Bangladesh conducts find presence of harmful and banned chemicals in food products almost routinely. These reports only confirm the widely-held belief that consumer food products ranging from packed spices and fruit juices to fruits are adulterated to the extent of being poisoned as far as long-term public health is concerned (The Daily Sun, 2011)

The presence of chemicals within fruit-flesh and have addressed the changes of biochemical and nutritional properties of fruits because of treating with fruit ripening agents (Hakim et al., 2012) and they reported the presence

of Lead (Pb) in chemically ripened (market and lab treated) pineapples and bananas, and Arsenic (As) in pineapples collected from market.

Results of their findings are illustrated in Fig 1.

**Figure 1: Properties of Pineapple and Banana at different conditions (adapted from Hakim et Al, 2012).**

Name of Sample		Total Mineral	Total Fat	Total Protein	Total Sugar	Vitamin C	β-carotene	Arsenic (As)	Lead (Pb)
		(g/100 g)				(mg/100 g)	(μg/100 g)	ppm	(μg/g)
Pineapple	Naturally Ripened	0.61	0.02	1.24	9.25	15	78	Nil	Nil
	Treated with Ethephone at Laboratory Condition	0.95	0.03	0.91	9.30	14	63	Nil	0.12
	Collected from Market	0.85	0.03	0.85	9.85	10	31	0.025	0.15
Banana	Naturally Ripened	0.93	0.02	1.37	11.2	13	54	Nil	0.12
	Treated with Ethephone at Laboratory Condition	0.94	0.03	1.33	12.3	9	47	Nil	0.31
	Collected from Market	0.97	0.03	1.01	13.7	7	38	Nil	0.24

### 1.2.3 Laws in Bangladesh against chemically treated foods

Present laws in Bangladesh include:

- The Bangladesh Pure Ordinance 1959 – Ordinance to provide better control of manufacture and sale of food for human consumption (Now under revision)
- The Bangladesh Pure Food Rules, 1967 – Generic Standards for 107 food products
- The Food Grain Supply (Prevention of Prejudicial activity) ordinance, 1956 – Ordinance that provides special measure for prevention of prejudicial activity to store, movement, transshipment, supply and distribution of food grains.
- The Radiation protection Act 1987 – The institute of Food and Radiation Biology (IFRB) of Bangladesh Atomic Energy commission is primarily involved in food irradiation research and development

- e. The Iodine Deficiency Disorder (IDD) Prevention Act 1989 – Banned non-iodized salt from market, aimed at eliminating IDD
- f. The Essential Commodity Act 1990 – The Act is to maintain or increase the supply of essential commodities including food stuff. It also includes storage, transportation, distribution, disposal, acquisition, use or consumption of any essential commodity.
- g. Fish and Fish Products (Inspection and Quality control) Rules 1997 – Under the Ordinance of 1989 and other related provision made, the government had rule: Fish and Fish products (Inspection and Quality Control) Rules 1997. These rules are meant to develop quality control of fish and fish products.
- h. Others – In addition to the above, other Laws and Regulation exists including
  - i. Animal Slaughter and Meat Control Ordinance 1983
  - ii. Pesticides Ordinance 1971 & the Pesticides Rule 1985

Although the above laws mentioned are maintained by the Government, previous studies have illustrated that wholesaler and producers are still using chemicals such as calcium carbide, sodium cyclamate, cyanide, urea (a nitrogen-release fertilizer) and formalin in all food items.

### 1.3 Objectives of the Study

Specific objectives of this study include:

- To understand the information source used by consumers to gain knowledge (awareness) of chemically treated food and
- Determine if consumers have awareness of knowing chemical testing booths in markets. Finally
- To determine if consumers have knowledge Laws concerning the use chemical in fruits (food).

To address the objectives of the study, the authors have derived few hypotheses to gain a greater understanding of the study.

The alternative hypotheses derived from the objectives are:

- 1. Information source is positively correlated with awareness level
- 2. Knowledge of Chemical Testing booths is positively correlated with awareness level
- 3. Knowledge of Laws concerning the use chemical is positively correlated with awareness level

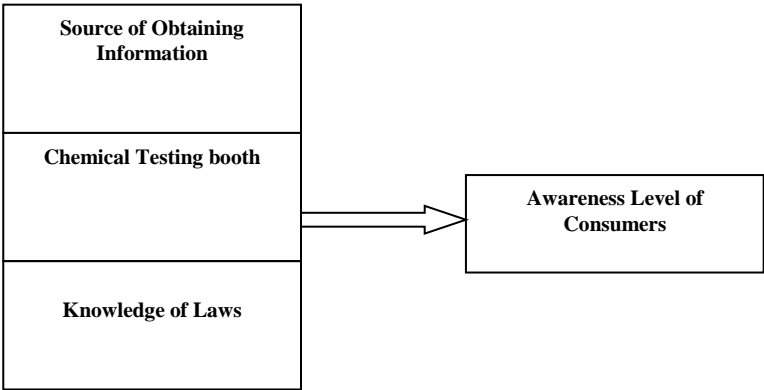


Fig 1: Conceptual Model of Awareness level of consumers© (zaman et. Al.)

2. Materials and Methods

This study used both primary and secondary data collected to compile the paper. The primary sources of data included interviews with consumers at Dhaka.

Reviewing journal articles and articles published in Bangladeshi (both in English and Bangla) served as the secondary data used for this study. An array of literature is reviewed to determine the extent to which chemical including articles published between July 2003 and June 2013 from national newspapers including The Daily Ajker Kagoj, The Daily Star, The Economist,

The Prothom Alo, The Daily Ittefaq, The Financial Express etc. and The New York Times (1982). No laboratory tests were undertaken for this study as it exceeds beyond the scope of the study.

Empirical data were collected from 300 randomly selected respondents from the different parts of the Dhaka city (capital of Bangladesh). Of these, a total of 251 responses were used while the remaining responses were excluded from the analysis due to lack of reliability and consistency.

The capital city was considered for the study as consumers of Dhaka are presumably more aware of the use of hazardous chemicals in foods than consumers in other parts of the country.

Data from consumers were collected from those who purchase fruits and are most likely to be aware of adulterated food. The data was coded using SPSS Version 17 and analysed with frequency distribution and cross tabulation and correlation analysis.

Descriptive research has given a clear insight of the variables' relationship with awareness level. It was also used to find the average, mean of variables and their direction. Pearson's co-efficient was used to determine whether relationship exists between the variables, direction, strength and significance of the relations.

Regression co-efficient for the proposed model were estimated using linear regression model to determine the linearity of the relationship between dependable and independent variables.

The following regression model was estimated to explore the potential relationship among the variables:

$$Y_i = \alpha + \beta (\text{SOURCE OF INFORMATION}) + \beta \text{CHEMBOOTHs} + \beta \text{LAWS} + \epsilon_i$$

$Y_i$  = Awareness Level of consumers

#### **SOURCE OF INFORMATION INCLUDES:**

- PRINT = print media (including newspaper, magazines, journals)
- OUTDOOR = outdoor media (including billboards, banners)
- AV = Audio Visual media (including TV, Radio)
- ONLINE = Online media (including web, social media, online articles, online journals, online news, online magazines)

CHEMBOOTHs = Awareness of Chemical Testing Booth in Markets



LAWS = Awareness of Laws concerning chemically treated fruits (food)

3. Results and Discussion

A total of 251 responses out of 300 responses were used, the rest of the responses were discarded due to inconsistency or lack of answers. The demographic characteristics of the respondents are illustrated in Table 1.

Table 1: Descriptive Statistics of Respondents

Gender	Male	154	61.4
	Female	97	38.6
	Total	252	100.0
Age	18-24	77	30.6
	25-31	51	20.2
	32-38	34	13.5
	39-44	25	9.9
	45+	65	25.8
	Total	252	100.0
Occupation	SERVICE HOLDER	61	24.2
	ACEDEMIC	28	11.1
	BUSINESS	25	9.9
	SELF EMPLOYED	18	7.1
	HOUSEWIFE	50	19.9
	STUDENT	68	27.0
	RETIRED	2	.8
	Total	252	100.0

From the total respondents (N=251), 154 (61.4%) were males and 97 (38.6%) were females. Highest majority of the respondents consisted of students (27%), followed by housewives (19.9%), while retired (0.8%) individuals consisted of the lowest respondents.

Of the 150 consumers questioned in this study, a staggering 111 (74%) consumers believed that many sellers/producers use hazardous chemicals in foods and foodstuffs, 32 (21.3%) had heard about the use of hazardous chemicals being used in food and only 7 respondents (4.7%) had no awareness that chemicals were used.

Descriptive statistics of the dependent variable and independent variable are also illustrated in Table 2.

Dependent Variable was the overall awareness level of respondents of chemically treated fruits

Independent Variables were:

1. Source of Information
2. Knowledge about current laws against chemically treated fruits (food)
3. Awareness of Chemical Testing booths in the market

	N	Minimum	Maximum	Mean	Std. Deviation
Awareness of Chemical Testing Booth in Markets	252	1	3	1.45	.063

	N	Minimum	Maximum	Mean	Std. Deviation
State your level of awareness of the use of chemicals	252	1	4	1.66	.075

	N	Minimum	Maximum	Mean	Std. Deviation
Print Media Source	252	1	2	1.08	0.271
Outdoor Campaign	252	1	2	1.83	0.373
Audio Visual	252	1	2	1.57	0.196
Online & Elec. Media	252	1	2	1.95	0.222

**Table 1: Descriptive stat of dependent & Independent variables**

	N	Minimum	Maximum	Mean	Std. Deviation
Awareness of Laws concerning chemical treated food	252	1	3	1.64	.131

Correlation is a bivariate measure of association (strength) of the relationship between two variables. It varies from 0 (random relationship) to 1 (perfect linear relationship) or -1 (perfectly negative linear relationship).

The different correlation is subject to a two tailed statistical significant at two levels of highly significant ( $p<.01$ ) and significant ( $p<.05$ ).

**Table 2: Correlation Matrix for Variables Information Source, Chemical Booths, Law and Overall Awareness Level**

	Print	Outdoor	AV	Online	ChemBooth	Laws	Awareness LVL
Print	-	0.674	0.221	.090	0.256	0.415	0.897**
Outdoor	0.674	-	0.234	0.316	0.842*	0.221	0.586**
AV	0.221	0.234	-	0.121	0.135	0.052	0.765**
Online	.090	0.316	0.112	-	0.092*	0.799**	0.623**
ChemBooth	0.256	0.842*	0.135	0.092*	-	0.034	0.827**
Laws	0.415	0.221	0.052	0.799**	0.034	-	0.698**
Awareness LVL	0.897**	0.586**	0.765**	0.623**	0.829**	0.698*	-

Parentheses indicates \* $P<.05$ , and \*\* $P<.01$

Table 3 represents the correlations among source of information (print, outdoor, AV, online), awareness of chemical booths, awareness of laws against chemically treated fruits (food) and the overall awareness level of respondents.

All independent variables: source of information (print, outdoor, AV, online), awareness of chemical booths, awareness of laws against chemically treated fruits (food) are found to have significant correlation with the dependent variable (overall awareness level of respondents).

Regression analysis is used to analyze associate relationship between dependent variable and one or more independent variable. In this study, stepwise regression was used to assess the relationship among the variables. It refers to the procedure in which the independent variable enters or leaves at a time. To find the most influential independent variable that explains the overall awareness level of consumers in Dhaka. Table 4 represent the data of the stepwise regression analysis.

**Table 4: Stepwise Regression Analysis**

Independent Variable	B	SE	$\beta$	R <sup>2</sup>	Adj R <sup>2</sup>
<b>Step1</b>				0.521	
Source	0.638	0.064	0.805		
<b>Step 2</b>	0.527	0.065	0.435	0.812	0.158

Source	0.104	0.079	0.653		
ChemBooth					
<b>Step 3</b>				0.912	0.130
Source	0.762	0.652	0.522		
Chembooth	0.192	0.091	0.484		
Laws	0.162	0.083	0.713		

In the first step, Print media has been found to explain 52% variation of awareness level.

In the second step, Chemical booths sources of information along with chemical testing booths has been found to explain 81% of variation of awareness level. Chemical booths alone can explain only 15.8% variation in overall awareness level.

In the third step, source of information, chemical testing booths and awareness of laws have been found 91% variation in awareness level of consumers. Laws alone can explain only 13% variance in overall awareness level.

**Results of the Hypotheses**

Hypothesis 1: Source of media has strong correlation with overall awareness level

The correlation analysis shows source of information is strongly significantly ( $r = 0.897$ ,  $P < .01$ ) correlated with awareness levels of consumers in Dhaka. Moreover, stepwise regression analysis represent that source of information (type) is significantly and positively related to awareness level. The correlation is significant at 0.01 level (2 tailed) and the outcome of the significant 2 tailed is less than 0.01.

Thus the hypothesis is proven as there is a correlation between source of information and awareness level.

Hypothesis 2: Knowledge of chemical testing booths in markets has strong correlation with overall awareness level

The correlation analysis shows Knowledge of chemical testing booths in market is strongly significantly ( $r = 0.827$ ,  $P < .01$ ) correlated with awareness levels of consumers in Dhaka. Moreover, stepwise regression analysis represent that Knowledge of chemical testing booths in markets is significantly and positively related to awareness level. The correlation is significant at 0.01 level (2 tailed) and the outcome of the significant 2 tailed is less than 0.01.

Thus the hypothesis is proven as there is a correlation between Knowledge of chemical testing booths in markets and awareness level.

Hypothesis 3: Knowledge of Laws concerning chemical testing booths in the market has strong correlation with overall awareness level

The correlation analysis shows Laws against chemicals is strongly significantly ( $r = 0.698$ ,  $P < .05$ ) correlated with awareness levels of consumers in Dhaka. Moreover, stepwise regression analysis represent that Knowledge of Laws of chemical in foods is significantly and positively related to awareness level. The correlation is significant at 0.01 level (2 tailed) and the outcome of the significant 2 tailed is less than 0.01.

Thus the hypothesis is proven as there is a correlation between Laws against chemicals in food testing booths in markets and awareness level.

#### **4. Conclusion**

Data indicates that consumers in Bangladesh (especially in Urban areas) are aware of the fact that chemicals are being used to ripen fruits.

The following suggestions have been formulated after conducting this study:

1. Source of information is positively affected on awareness level. Therefore the quality and frequency of the information sources is important for consumers. Initiatives should be taken in order to assess the best source for knowledge dissemination on a greater scale.
2. Knowledge of chemical testing booth is also positively affected on awareness level. Chemical testing booths therefore should be installed and operated in all markets rather than in local market or in specific areas. This will increase customers' awareness of the amount of chemicals used in fruits (food) and will enable them to make a conscious choice.
3. Knowledge (awareness) of Laws needs to adapt planning perspective, incorporating both assimilation and dissemination to consumers of both the dangers and the strictness of the current Laws against the use of chemicals in food and food stuff.

It is evident that consumers are facing consumer sovereignty, not in awareness or knowledge, but on the dimension of choices. Most consumers are aware that chemicals are being used in food; to ripen fruits and preserve fish. The empirical results showed a satisfactory fit of the proposed model and suggest that information source; knowledge of chemical testing booths and laws on chemically treated food has an important effect on consumers' awareness of chemically treated food.

To sum up, the current testing booths need to be enhanced to reach more audience and Law enforcement agencies should be stricter in dealing with producers/supplier using harmful chemical. Also, marketing intermediaries should also take upon the responsibility to ensure safety of foods and foodstuff in the supply chain.

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