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## **Quality and Safety of Milk in Bangladesh: What do Consumers Believe in?**

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## **Quality and Safety of Milk in Bangladesh: What do Consumers Believe in?**

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### **Abstract**

The paper attempts to analyze quality and safety attributes of milk for which consumers are willing to pay and make their decisions to purchase using the framework of conjoint analysis. The study also examines consumer's level of preference concerning quality and safety attributes of milk in relation to their socio-economic factors. The data used for this analysis is collected from a consumer survey of 900 households conducted in April 2006 and a supplementary survey specifically designed for the conjoint study with a sub-sample of 380 households from the original 900 samples- 260 in Dhaka city and 120 in Mymensingh city of Bangladesh, conducted in 2008.

Buyers of raw fresh milk appeared to be fairly indifferent about level of fat content, have marginally more preference for milk from local breeds rather than crossbreeds but have strong preference for milk in which water has not been added. Low price is also strongly preferred to high price, which is an indication that consumers do not associate high price with higher quality, given that several other attributes such as breed of the cow and adulteration are not easily verifiable at the point of purchase. Water addition is the most common form of adulteration of milk in the country. Consumers perceive that water addition has two potential negative effects on the quality of milk. First, addition of water may make the milk 'impure' or 'unsafe' if contaminated water is added, and it dilutes milk so fat content is reduced in water added milk. Therefore, preference for fat content is partly indirectly expressed through preference for milk without added water. There are other forms of adulteration such as adding powdered milk, chemicals to avoid spoilage but ordinary consumers can't easily verify these at the time of purchase to make a choice. Buyers of pasteurized milk are also indifferent about fat content but have strong preference for milk in polypack rather than in paper carton and for low price. It was found that the consumers gave highest consideration on freshness of raw milk followed by taste and purity. In case of pasteurized milk, taste was the most important criteria, and fat content the least.

It appeared from conjoint analysis that, other things being equal, the most preferred profile of raw fresh milk is 'milk from local breed cow with low fat without water adulteration and at low price' and the least preferred is 'milk from a crossbred cow with low fat, added water and at high price'. In case of pasteurized milk, the most preferred profile is 'full cream milk in polypack at low price' and the least preferred profile is 'low fat milk in paper carton at high price'. Among the selected attributes of raw fresh milk, other things being equal, an average buyer in his/her purchase decision give 31% weight on price, 28% on water adulteration, 22% on breed of the cow and 19% on fat content. In case of pasteurized milk, among the three selected attributes 49% of weight is given on price, 30% on packing and 21% on fat content.

Regression analysis showed that fat content, cow breed, milk purity, milk price, religion, household expenditure per month and district dummy significantly affected product profile preference rating of raw milk.

The result of this study could be used for designing safety and quality standard of milk for domestic market and gradually update those standards as new information on quality criteria and consumer preferences emerge from new research.

**Keywords: Milk quality and safety**

## **Introduction**

Food quality and safety is a growing concern to consumers. A series of studies conducted at developed country market environments conclude that consumers purchase food product based on characteristics such as its tenderness and the expected taste according to its overall appearance. Consumers also relate taste characteristics to freshness, leanness and colour (Kuberod et al, 2002, Demey *et al* 2003, Becker, 1999; Acborn and Dopingo, 2000, Steenkamp and van Trijp, 1996, Piedra *et al*, 1996; Grunert, 1997; Schupp *et al*, 1998; Bredahl *et al.*, 1998). However, similar studies in developing country conditions are non-existent or rare.

Perceived quality and safety lead to purchase a food product only when the quality as perceived is high enough for the consumer to be willing to pay for the price demanded by the seller. The relationship between perceived quality and price is often referred to as value for money. Measuring willingness to pay (WTP) for quality and safety attributes has been a major stream of research in agricultural economics. Hedonic pricing methods (Baltzer, 2002) or, more recently, mixed multinomial logit approaches (Bonnet and Simioni, 2001) have been used to estimate WTP in cases where market transaction data are available. In those cases where market transaction data are either not accessible or non-existent, conjoint analysis has been the popular method for analyzing consumer's perception on food quality and safety on purchase of food products (Bech-Larsen and Grunert, 2003; and Grunert, 2005).

The paper attempts to analyze quality and safety attributes of milk for which Bangladeshi consumers are willing to pay using the framework of conjoint analysis. It also examines

consumer's preference rating of milk concerning quality and safety attributes in relation to their socio-economic factors.

### **Empirical Model**

The approach used in this study recognizes explicitly that the importance of consumers' perception and attitudes as they relate to behavioural intention in the decision-making process for purchase of a product. In the design and launch of successful new products or understanding changing consumer preferences for existing products, questions are asked on whether a product attribute is important or unimportant to the consumer, what product attributes is most or least desirable in the consumer's mind, what is the market share of preferences for leading competitor's products versus an existing or proposed product. Conjoint analysis can be used to answer such questions. ((SPSS, 2005; Louviere *et al*, 2005). It can be employed to sort out the relative importance of product attributes to consumers such as safety and quality attributes of milk product.

Conjoint analysis is derived from Lancaster's theory of demand (Lancaster, 1966), which posits that the utility an individual will derive from consuming a given product is a function of the characteristics of the product. Symbolically  $U_i = U(Z_i)$  where  $Z_i$  is a vector of the attribute values for alternative  $i$  from the choice set at the disposal of the decision maker. Since utility is not directly observable, a choice variable representing ratings or rankings of the product attributes are used in empirical work in place of utility. The choice variable is related to utility as follows:

$$R = 1 \quad \text{if} \quad 0 < U < \gamma_1$$

$$R = 2 \quad \text{if} \quad \gamma_1 < U < \gamma_2$$

$$R = \omega \quad \text{if} \quad U > \gamma_{\omega-2}$$

Where  $U$  is the unobservable utility levels,  $R$ 's are the preference ratings for specific attribute of the product and  $\gamma$ 's are the threshold variables or cut-off points linking the respondents' actual preferences with the ratings. Using the choice variable, the empirical model takes the following general form:

$$R = \alpha + \beta X + \lambda Y + e \quad (1)$$

where  $R$  is a vector of preference ratings for product attributes (0, 1, 2,...,n),  $X$  is a vector of non-stochastic variables capturing the levels of attributes,  $Y$  is a vector of non-stochastic variables capturing the consumer's socioeconomic characteristics reflecting the variability of tastes across portion of the population to which the model of choice behaviour applies,  $\beta$  is a vector of marginal utilities for the levels of attributes,  $\lambda$  is a vector of marginal impacts of individual's socioeconomic background and  $e$  is a disturbance term. The marginal values  $\beta$  and  $\lambda$  are estimated from observations on  $R$ ,  $X$  and  $Y$ . Consumers with the same estimated  $\lambda$  have similar preferences, and would make up one segment of the market. Thus, estimates of  $\lambda$  can be used to assess preferences across households to determine if a segmentation approach to quality improvement is warranted.

For conjoint analysis, the researcher creates the product profiles composed of selected attributes including price and attribute levels, and asks respondents to rate, rank or evaluate

those various product profiles. The characteristics of the product are described in terms of its factors and levels. The factors are the general attribute categories of the product, such as fat content, colour and price.

The advantage of conjoint analysis is lower cost (less expensive) and less variance (more precise) compared to other techniques such as experimental auction or contingent valuation, due to the repeated measure design. (Louviere *et al*, 2005). In this approach only a subset of all possible profiles called orthogonal array is used in the experiment (SPSS, 2005).

In conjoint analysis studies, the researcher assumes that the product being evaluated can be defined in terms of a few important characteristics. It is further assumed that when a consumer makes a decision about such a product, the decision is based on trade offs among these characteristics. The purpose of a conjoint analysis is to estimate utility scores, called part worth, for the characteristics. Utility scores are measures of how important each characteristic is to the respondent's overall preference of a product (Louviere *et al*, 2005).

Output from a conjoint analysis includes importance ratings of attributes, part worth estimates showing preferences for attribute alternatives and correlations relating product rankings from the conjoint model with observed rankings. The utility scores analogous to regression coefficients are called part worth and can be used to find the relative importance of each factor. Conjoint analysis was done using SPSS version 15 (SPSS, 2005).

A regression analysis was done using model (1) to identify factors affecting product profile preferences. The dependent variable for household  $i$  was the preference rating for profile  $k$  of product  $j$  ( $k = 1, \dots, n$ ). So there were 12 observations for each household, and about 4560 for

the entire sample. The values of the independent variables were repeated for the 12 profiles for each sample household.

### **The Data**

The data used for this analysis is collected from a consumer survey of 900 households conducted in April 2006 by Bangabandhu Sheikh Mujibur Rahman Agricultural University and International Livestock research Institute for assessment of urban demand for animal products in Bangladesh and a supplementary survey in 2008 specifically designed for the conjoint study. Application of the conjoint technique requires data to be collected on product profiles defined by a set of quality and safety attributes.

During the detailed survey respondents were not directly asked to rank criteria and indicators of quality and safety of different types of milk that they purchased, but preliminary analysis of the responses on ratings of products based on different uses and attributes provided some indications of the most important criteria and indicators of quality and safety that the sample respondents used in their buying decisions. These were combined with a PRA to make a short list of criteria for designing a supplementary survey among a sub-sample of 380 households from the original 900 samples- 260 in Dhaka city and 120 in Mymensingh city.

A structured questionnaire was developed to capture the relevant variables necessary for the study including a product profile table for raw fresh milk and pasteurized milk based on the relevant quality and safety attributes. The orthogonal design of SPSS conjoint procedure (SPSS, 2005) was employed to select 12 profiles (first eight are design and last four are hold outs) out of all the possible combinations for each raw milk and pasteurized milk (Table 1 and



2). A conjoint card was prepared for each profile of a product that depicts pictorial representation with colour pictures of the various levels of the three attributes. This procedure facilitated easy transferring of the ideas of each product profile for explanation to the respondents which in turn improved the quality of the data collected. Since other data on respondent characteristics and consumption patterns were collected during the detailed consumption survey conducted earlier, this supplementary survey was focused only on the product profile data.

Table 1 Conjoint orthogonal design for raw fresh milk in Dhaka and Mymensingh cities

Profile	Breed	Fat content	Purity	Price/litre
1	Cross	High	Pure	Low (27)
2	Cross	Low	Water added	High (33)
3	Local	High	Water added	Low
4	Local	Low	Water added	Low
5	Cross	Low	Pure	Low
6	Cross	High	Water added	Medium (30)
7	Local	High	Pure	High
8	Local	Low	Pure	Medium
9	Cross	Low	Pure	High
10	Local	Low	Pure	Low
11	Local	High	Pure	Medium
12	Cross	High	Pure	High

Table 2 Conjoint orthogonal design for pasteurized milk in Dhaka and ymensingh cities

Profile	Fat content	Packing	Price/Litre
1	Full cream	Polypack	High (38)
2	Low	Polypack	Medium (35)
3	Full cream	Paper cartoon	Medium
4	Low	Polypack	Low (32)
5	Full cream	Polypack	Low
6	Full cream	Paper cartoon	Low
7	Low	Paper cartoon	Low
8	Low	Paper cartoon	High
9	Low	Paper cartoon	Medium
10	Full cream	Paper cartoon	High
11	Full cream	Polypack	Migh
12	Low	Polypack	High

Special care was taken to collect data on the product profile scoring. To prevent mistakes like overvaluation of attributes presented in the upper part of the profile cards, all the three attributes and their levels and the meaning of the ratings were first introduced to the interviewee. Rating of preference was defined on a scale ranging from 1 to 10, where 10 means the most preferred quality for the respondent's consumption, 1 the least preferred, and ratings 2 to 9 represented preference between the two extremes. First, enumerators verbally explained the meaning of the levels of attributes represented by one product and the meaning of the corresponding rating. Then the respondent was asked to explain his (her) understanding of the levels of attributes and the ratings. After considering all 12 profiles, respondents would evaluate each profile by assigning value or rating that would reflect his/her preference. After that the interviewee was given 12 product profile cards for one product and asked to rate them without any order on a scale of 1 to 10 as explained earlier.

## **Results**

Milk and milk products are preferred items in daily diet of average Bangladeshi households. In the past, only raw fresh milk and traditional sweets and ghee (clarified butter) made of fresh milk used to be consumed. Now a days various new forms of products, e.g. pasteurized milk, powdered milk with different fat content, have been introduced in the market giving opportunities for choices to be made about those products, especially among products which are close substitutes. So respondents were asked about the regularity of consumption of various products before asking to rate preferences because it was assumed that households which did not at all consume a product even occasionally might not know very well about that product to be able to rate it properly. The results about the frequency of consumption of different products

are summarised in Table 3. Raw fresh milk is the most widely and regularly used product in both the cities followed by pasteurized milk. Raw fresh milk is more widely and regularly consumed in Mymensingh compared to Dhaka and opposite is the case for pasteurized milk.

The results of conjoint analysis with estimated part worth and related statistics for the best specifications for raw milk and pasteurized milk based on test statistics and % reversals are shown in Table 4. The results are statistically reliable as both Pearson's R and Kendall's tau statistics are highly significant at a probability of less than 1%. Estimated number of reversals is relatively small except for price in case of raw milk which indicates that the assumptions made with respect to different attributes about direction of consumer preference were quite consistent.

Table 3. Proportion of households consume and regularity of consumption of different dairy products in Mymensingh and Dhaka cities

Products	Mymensingh		Dhaka		All	
	Consume	Regularly consume	Consume	Regularly consume	Consume	Regularly consume
Raw fresh milk	93		89	53	90	58
Fermented milk	3	1	41	5	28	4
Non-pasteurised fresh milk	1	1	23	6	15	4
Skimmed milk	2	1	5	1	4	1
Pasteurized milk	63	14	94	49	83	37
UHT milk	15	2	40	11	32	8
Powder full cream	74	40	87	48	82	45
Powder half cream	12	7	37	12	29	10
Condensed milk	41	9	42	20	48	16

Source: Field survey

Buyers of raw fresh milk appear to be fairly indifferent about level of fat content, have marginally more preference for milk from local breeds rather than crossbreeds but have strong preference for milk in which water has not been added. Low price is also strongly preferred to high price, which is an indication that consumers do not associate high price with higher quality, given that several other attributes such as breed of the cow and adulteration are not

easily verifiable at the point of purchase. The preference for milk from local breed is consistent with their ratings given to local vs crossbreed. Water addition is the most common form of adulteration of milk in the country. Consumers perceive that water addition has two potential negative effects on the quality of milk. First, addition of water may make the milk 'impure' or 'unsafe' if contaminated water is added, and it dilutes milk so fat content is reduced in water added milk. Therefore, preference for fat content is partly indirectly expressed through preference for milk without added water. There are other forms of adulteration such as adding powdered milk, chemicals to avoid spoilage but ordinary consumers can't easily verify these at the time of purchase to make a choice.

Buyers of pasteurized milk are also indifferent about fat content but have strong preference for milk in polypack rather than in paper carton and for low price. However, if buyers carefully check the product specifications on the packs, especially when the packs are of similar nature. Some brands of low fat milk is UHT rather than pasteurized, hence the difference is more easily observable. Some consumers prefer lower fat so they buy full fat milk they remove some fat after boiling.

Among the selected attributes of raw fresh milk, other things being equal, an average buyer in his/her purchase decision give 31% weight on price, 28% on water adulteration, 22% on breed of the cow and 19% on fat content. In case of pasteurized milk, among the three selected attributes 49% of weight is given on price, 30% on packing and 21% on fat content.

It may be recalled that the sample consumers considered fat content as the least important criteria to determine quality and safety at the time of their recent purchases of raw fresh milk,

rather they gave highest consideration on freshness followed by taste and purity. In case of pasteurized milk, taste was the most important criteria, and fat content the least.

Table 4. Estimated part worth or utility of raw fresh and pasteurized milk quality and safety attributes for sample households in Dhaka and Mymensingh cities

Factors	Raw fresh milk			Pasteurized milk		
	Levels	Coefficient	St error	Levels	Coefficient	St error
Fat	Low fat	0.173	0.105	Low fat	-0.017	0.091
	High fat	-0.173	0.105	Full fat	0.017	0.091
Breed	Cross	-0.275	0.105	na		
	Local	0.275	0.105			
Purity	Water	0.000	0.000	na		
	Water not	0.853	0.210			
Packing				Paper cartoon	-0.412	0.091
				Polypack	0.412	0.091
Price/litre	Low (27)	0.494	0.127	Low (32)	0.912	0.110
	Medium	0.000	0.000	Medium (35)	0.000	0.000
	High (33)	-0.494	0.127	High (38)	-0.912	0.110
Constant		5.710	0.152		6.356	0.096
Pearson's R		0.965***			0.978***	
Kendall's tau		0.857***			0.857***	
Kendall's tau		1.000***			1.000***	
Reversals	Price	20%		Purity	6%	

Note: In case of raw milk, factor levels for purity were modelled as linear more, price linear less and breed and fat content as discrete, while in case of pasteurized milk, factor levels for price were modelled as linear less and for fat content and packing as discrete..

\*\*\* indicate significant at less than 1% level,

Source: Field survey

Adding part worth of individual attributes to get total utility of a profile, it appears that, other things being equal, the most preferred profile of raw fresh milk is 'milk from local breed cow with low fat without water adulteration and at low price' and the least preferred is 'milk from a crossbred cow with low fat, added water and at high price' (Table 5). In case of pasteurized milk, the most preferred profile is 'full cream milk in polypack at low price' and the least preferred profile is 'low fat milk in paper cartoon at high price' (Table 6).

The results of the OLS regression to identify factors affecting product profile preferences for raw and pasteurized milk are shown in Table 7. The coefficients of most of the product attribute variables are highly significant.

Table 5 Estimated total utility of the 12 profiles of raw fresh milk rated by consumers

Profile	Breed	Fat content	Purity	Price/litre	Total utility
1	Cross	High	Water not added	Low (27)	0.89
2	Cross	Low	Water added	High (33)	-0.60
3	Local	High	Water added	Low	0.60
4	Local	Low	Water added	Low	1.54
5	Cross	Low	Water not added	Low	1.23
6	Cross	High	Water added	Medium (30)	0.45
7	Local	High	Water not added	High	0.47
8	Local	Low	Water not added	Medium	1.30
9	Cross	Low	Water not added	High	0.25
10	Local	Low	Water not added	Low	1.79
11	Local	High	Water not added	Medium	0.96
12	Cross	High	Water not added	High	-0.09

Source: Field survey

Table 6 Estimated total utility of the 12 profiles of pasteurized milk rated by consumers

Profile	Fat content	Packing	Price/Litre	Total Utility
1	Full cream	Polypack	High (38)	0.48
2	Low	Polypack	Medium (35)	0.39
3	Full cream	Paper cartoon	Medium	-0.39
4	Low	Polypack	Low (32)	1.30
5	Full cream	Polypack	Low	1.34
6	Full cream	Paper cartoon	Low	0.52
7	Low	Paper cartoon	Low	0.48
8	Low	Paper cartoon	High	-1.34
9	Low	Paper cartoon	Medium	-0.43
10	Full cream	Paper cartoon	High	-1.30
11	Full cream	Polypack	High	0.43
12	Low	Polypack	High	0.52

Source: Field survey

In case of raw milk, preference rating for a profile decreased if higher rating was given for high fat content, rating increased if higher rating was given for local breed cow and milk without added water, rating decreased if higher rating was given for low price (which means low price

was considered an indicator of poor quality). The rating was also significantly higher for Muslim consumers and residents of Dhaka, and as overall household expenditure increased.

In case of pasteurized milk, rating for a profile decreased if higher rating was given to high fat content and also for high price level (indicating that high price was an indicator of better quality). Rating for a profile increased if polypack as a packaging system was rated higher. Residents of Dhaka also generally gave significantly higher rating for a profile compared to Mymensingh residents.

Table 7 Determinants of preference rating of raw and pasteurized milk

	Raw milk $\beta$ (st error)	Pasteurized milk $\beta$ (st error)
(Constant)	5.375*** (0.171)	5.709 (0.194)
Fat content (High/full=1, low=0)	-0.223*** (0.031)	-0.058* (0.035)
Cow breed (local =1, cross=0)	0.368*** (0.032)	-
Raw milk purity (water not added=1, water added=0)	0.520*** (0.033)	-
Package (Polypack=1, paper cartoon=0)	-	0.449*** (0.035)
Milk price ( low=1, medium =0, high= - 1)	-0.522*** (0.038)	-1.059*** (0.043)
Age of household head, yrs	.000 (0.0145)	-0.003 (0.003)
Religion dummy (Muslim=1, non-Muslim=0)	0.311*** (0.134)	0.099 (0.152)
Education of household head, yrs	0.015 (0.017)	-0.017 (0.019)
Total household expenditure per month, Taka	9.02E-006*** (0.000)	-2.70E-007 (0.000)
District dummy (Dhaka =1, Mymensingh=0)	0.561*** (0.0.689)	0.976*** (0.078)
R <sup>2</sup>	0.43	0.45
F-value	92.93***	119.08***

## **Conclusion**

This paper assessed consumers' perception on quality and safety attributes of milk in Bangladesh. It was found that the application of conjoint analysis in assessing consumers' preference rating of milk in relation to quality and safety gave consistent results. In case of raw fresh milk, the consumers showed preference for local breed, low fat, without water adulteration. Results of conjoint analysis show that, other things being equal, the most preferred profile of raw fresh milk is 'milk from local breed cow with low fat without water adulteration and at low price' and the least preferred is 'milk from a crossbred cow with low fat, added water and at high price'. In case of pasteurized milk, the most preferred profile is 'full cream milk in polypack at low price' and the least preferred profile is 'low fat milk in paper cartoon at high price'. Among the selected attributes of raw fresh milk, other things being equal, an average buyer in his/her purchase decision give 31% weight on price, 28% on water adulteration, 22% on breed of the cow and 19% on fat content. In case of pasteurized milk, among the three selected attributes 49% of weight is given on price, 30% on packing and 21% on fat content.

The result of this study could be used for designing safety and quality standard of milk for domestic market and gradually update those standards as new information on quality criteria and consumer preferences emerge from new research.

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