1 Whole milk	Not smelly	Water not added	Price (BDT/lt) 50
2 Whole milk	Smelly	Water added	Price (BDT/lt) 35
3 Whole milk	Smelly	Water not added	Price (BDT/lt) 45

Consumer preferences and demand for livestock products in urban Bangladesh

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Table of Contents

List of Tables

Acknowledgements

Abstract

Demand for animal products has been increasing rapidly in Bangladesh due to urbanization and increases in per capita income. There are rudimentary indications that demand for improved food quality and safety has also been increasing and that consumers were willing to pay higher prices for such attributes of products. However, there is little empirical evidence on the criteria and indicators of quality and safety that consumers use in their buying decisions, or that suppliers use in differentiating products to promote sales, or the extent to which consumers are willing to pay for such attributes. This study is the first attempt to comprehensively characterize and quantify Bangladeshi urban demand for animal products with a focus on quality and safety. Based on a multi-stage sample survey of 900 households from Dhaka and Mymensingh cities, successive analyses present statements of preference based on ratings, identified quality criteria, stated sources of supply and recent purchasing behaviour both at home and away from home, and econometric analysis of relationships between price ratings and quality ratings across attributes, so as to generate willingness to pay for those attributes. The findings show that officially defined grades and quality standards of livestock products are either absent or poorly defined and enforced. On the other hand, producers and consumers in the market use specific attributes or criteria and indicators to differentiate quality and safety of livestock products and they also charge and pay different prices based on those attributes. Although targeted at urban populations, considerable variation between locations in terms of the product preferences and attributes used to differentiate quality was identified. Establishment of standards and grades will become necessary to meet consumer demand on the one hand and facilitate producers and market agents to respond to consumer demand on the other. Whether smallholders will have any comparative advantage in supplying an expanding market requiring more homogenous and better quality and safer products need to be studied regularly along with studies on consumer demand because of the dynamic nature of the emerging and evolving market, the industry and the sector.

Key words: demand, quality, safety, livestock products, Bangladesh

1   Background and objectives

Demand for meat and dairy products has been increasing rapidly in Bangladesh as in other developing countries, propelled by income and population growth and urbanization. Although nearly 40% of the population live below the poverty line, reasonably good economic growth during the past few years has also created an expanding middle and high income population, especially in the urban areas, where dietary patterns have been changing rapidly toward higher levels of consumption of high value products like milk, meat, eggs, fish, fruits and vegetables. Per capita daily consumption of milk increased from 22 gms in 1983–84 to 32 gms in 2005 and that of meat and eggs from 10 gms to 18 gms during the same period (Hossain and Deb 2009).

Such an expanding market for animal products should create an opportunity for transformation of the livestock production and marketing sectors. This should particularly create an opportunity for smallholder mixed crop–livestock farms to commercialize livestock enterprises for income and employment generation, and so contribute to poverty alleviation. This will require a change in the production-marketing behaviour of producers and market agents—they have to change from 'trying to sell what is available from production' to 'producing and selling what is demanded in the market'. Such a transformation has been occurring slowly. Traditionally smallholder mixed farmers used to keep livestock for multiple functions—draught power, own consumption of milk and meat, saving and investment, replacement of own herd etc. They used to sell any small surplus product after home consumption and any live animals whenever there was a need for cash, or occasionally at the time of festivals when prices rose. Over time, the extent of commercialization among some smallholder livestock keepers and mixed farmers has been increasing slowly, but that has been inadequate to match the rapidly expanding demand. Therefore, a commercial livestock production sector, especially in case of poultry, has emerged to fill the gap. The relative importance of the commercial sector is expected to increase gradually though the dual structure—smallholder mixed farms and commercial medium to large-scale farms—is expected to continue for a considerable period.

Along with increased demand for quantities of traditional animal products, it is generally observed that consumer demand for new products are also increasing. Moreover, demand for reliable quality, food safety and scale of delivery has also been increasing in the urban areas. A manifestation of this is the price premia in formal markets (supermarkets and other such outlets) for products similar to those sold in traditional wet markets. The emergence of supermarkets may be a response to consumer demand for better quality, safety and convenience, and their willingness to pay price premia for these attributes. However,

quantitative evidence on the nature and extent of demand for specific quality and safety attributes are scarce. This is more so in the case of products in informal markets.

There are officially-defined standards for pasteurized and powdered milk and legal restriction on the use of water or other foreign material for adulteration but there are no standards for other traditional dairy products and for fresh meat or live animals. A similar situation prevails in many developing countries. In the absence of adequate officially defined grades, standards and quality characteristics and in the absence of mechanisms to assuring those standards in the country, local standards are appearing in some situations—both in formal and informal markets. Both consumers and suppliers perhaps use certain criteria and indicators to differentiate those qualities and standards, e.g. various notions of 'quality' that may not be easily measurable (e.g. texture, taste), convenience and of trust and reputation in sellers. Some of these may be associated with rather significant 'price premia.' However, an understanding of the nature of products and their quality and safety attributes that consumers prefer and are willing to pay for is essential for market actors and producers to respond to those preferences. Also understanding these attributes and their price premia may provide a basis for initiating specification and harmonization of local grades and standards. Such research work will help refine official standards on quality and safety for regulatory purposes based on local empirical information rather than hypothetical western norms which are sometimes used but cannot be enforced and have no real relevance for the level of economic development in the country.

The objectives of this study are the following:

i.   To analyse the nature of preferences for different livestock products among urban consumers, especially the nature of preferences for quality and safety attributes of the products, the criteria and indicators consumers use in differentiating quality and safety and the prices they pay for such attributes

ii.   To assess the nature of demand for different livestock products within the household budget, and its implications for the production and marketing sectors.

Data sources and the methodology used are presented in Section 2 of this study. Results based on descriptive statistics on dairy and meat product preferences based on various attributes appear in Section 3. Effect of attributes of different products on perceived prices are assessed in Section 4. Consumption patterns based on statements about recent purchases are presented in Section 5. Results of an econometric demand model for estimation of elasticity of demand including effect of a quality and safety based index are presented in Section 6. A final section presents conclusions.

2 Data source and methodology

2.1 Sampling procedure

The current study was conducted in two cities—Metropolitan Dhaka (comprising parts of Dhaka, Narayangonj and Gazipur districts), and Mymensingh. Metropolitan Dhaka is the capital city of Bangladesh and represents a good combination of heterogeneous classes of urban people with different local culture especially in terms of food consumption behaviour, religion, and socio-economic conditions. On the other hand, Mymensingh is a representation of typical medium sized old towns in Bangladesh.

A sampling frame was carefully developed in consultation with the Bangladesh Bureau of Statistics (BBS), the central statistical agency of the Bangladesh Government, which conducts countrywide census and sample surveys on various issues. The BBS has already developed a good sampling frame popularly known as the Sample Vital Registration System (SVRS). The SVRS was introduced by the BBS in 1980 to determine annual population change during inter-census period. Initially it covered 103 primary sample units (PSU) each comprising of about 250 compact contiguous households with permanent residents. Its scope was limited to recording births and deaths. Since then the scope of the survey has been expanded several times by including various other parameters and the number of PSUs to cover wider areas. An integrated multi-stage sample design was introduced with effect from July 2000 with 1000 PSUs distributed between urban and rural areas throughout the country.

Currently there are 26 and 10 PSUs in Metropolitan Dhaka and Mymensingh city, respectively. Considering the diversity of settlement pattern and economic conditions of the households, especially income groups, across the defined PSUs, 12 PSUs were selected purposively from Metropolitan Dhaka and 6 from Mymensingh city. The selected PSUs of Metropolitan Dhaka are located in seven Thanas (Police stations), namely, Mirpur, Mohammadpur, Dhanmondi, Badda, Demra, Narayangonj and Gazipur. The selected PSUs of Mymensingh are located in Kotwali Thana. However, because of purposive sampling of the PSU, the sample to some extent under-represents the lowest income households, especially those living in shanty towns and poorer parts of the two cities. For those households, concern about quality of animal products is perhaps less important as they consume small quantities of such products. This aspect needs to be taken into account while interpreting results, especially household budget shares and related information for demand analysis.

From each of the selected PSU, 50 households were selected at random for the survey. Thus a total of 600 samples were drawn from Metropolitan Dhaka and 300 from Mymensingh. Sampling with replacement technique was adopted to handle problem of missing households.

2.2 Questionnaire design and survey procedure

In order to design the survey questionnaire, questions on quality and safety of meat and dairy products and possible ways of quantifying consumer perceptions and preferences for these had to be determined. The Bangladesh Standards and Testing Institute has defined standards representing quality and safety of some food products, especially processed products like pasteurized and powdered milk, but there is no officially defined standard for most fresh food products produced and marketed in the country through the traditional or formal supply chains. However, it is generally believed that producers and consumers use local informal standards based on preferences of consumers, as well as needs of transecting agents and that consumers use specific criteria and indicators to differentiate quality and safety attributes of products.

The literature on demand for food suggests that consumers' perceptions of quality, safety and convenience are important factors that influence willingness to pay for and consume livestock products (for a review, see Grunert 2005). In developing country markets for animal products, consumers and producers differentiate products on the basis of specific criteria representing quality, safety and convenience which should be observable and measurable.

In the absence of any literature on such criteria and indicators in the Bangladesh context, a rapid appraisal was conducted among 10 consumer households at their residences, markets, shops and eating places, 10 traders and 4 supermarkets in Dhaka and Mymensingh cities, soliciting their opinion on criteria and indicators they normally used or had in mind when considering quality and safety of different dairy and meat products. The qualitative answers indicated that distinction between quality and safety was not always very clear in the minds of most consumers. Indeed, most consumers considered safety as an essential part of quality. This was also reflected in the criteria and indicators they used to differentiate product attributes as some criteria might be associated with quality, others with safety and some might represent both. Thus, no clear distinction between quality and safety was made in the detailed survey for collecting data. Rather, based on a synthesis of the various opinions on quality and safety criteria during the PRA, a set of criteria and related indicators was chosen for inclusion in the detailed survey to solicit information on consumer preferences for each product. The chosen criteria and indicators for the selected products are summarized in Table 1.

Table 1. *Choice of criteria and indicators of quality and safety for dairy and meat products included in the survey*

Products	Preference criteria and indicators of quality and safety	
	Use of the product	Attributes of the product
Dairy products		
– Raw fresh milk	– Drinking	– Taste
– Non-pasteurized	– Mixing with tea/coffee/	– Nutritive value
– Packed fresh milk	hot drinks	– Health risk (safety attribute)
– Pasteurized milk	– Making yoghurt	– Hygieneness (safety attribute)
– UHT milk	– Making/sweets/cheese	– Shelf life (quality and safety)
– Full cream powder milk	making	– Availability
– Half cream powder milk	– Overall preference	– Handling convenience
– Skimmed milk		– Brand (quality and safety attribute)
– Condensed milk		– Price
– Fermented milk		– Breed of animal
– Lassi		– Fat content (safety attribute)
– Yoghurt		– Colour
– Cheese		– Flavour (quality and safety
– Butter		attribute)
– Ghee		– Packaging
– Cream		– Labelling
– Ice-cream		– Source of product
– Sweets		– Vitamin enriched or not
– Chocolate milk		– Overall preference
Meat products		
– Beef	No variety in uses	– Fat content
– Buffalo meat	specified	– Cut
– Goat meat		– Colour
– Sheep meat		– Appearance
– Chicken		– Display location
– Local hen egg		– Certification by health authority
– Commercial hen egg		– Breed of animal/bird
– Duck egg		– Sex and age
		– Production system

a. Not all criteria and indicators were applicable for all the selected products. For example, if a product is not likely to be used for direct drinking or making cheese, the product would not be rated for those characteristics. Such exclusions are built into the data matrix in the questionnaire. For some attributes, levels or categories were defined for rating, e.g. in case of fat content two levels (high vs. low) were considered, for breed, two options (local vs. cross/exotic) were considered.

Preference rating is a response variable that can be measured on an ordinal scale showing the strength of preference for an item in comparison to one or more other items of a similar nature. Ideally preference for any product or service is an individual affair. Even for products that are collectively consumed in a household, actual preference level may differ among household members. Collective consumption and the inherent preference then represent only an average level of preference for the household as a whole. Whether preference rating

data should be collected from individuals or from households (representing the average or norm for the household) can be debated. However, in this study, preference rating data have been collected for the household on various forms of milk, milk products and different types of meat. The preference rating for a particular product has 10 possible outcomes or categories: 1 = strongly dislike,…, 10 = strongly like. For example, a consumer household might strongly prefer pasteurized milk for drinking but not for making yoghurt, in which case, rating for drinking could be 10 or close to 10 but rating for making yoghurt could be very low. If a consumer household strongly prefers beef of local breed rather than crossbreed, rating for beef from local breed could be very high and that for crossbreed very low. Rather than ranking, a rating procedure was adopted because it is possible to rank products based on preference rating but the reverse is not possible. Moreover, rating allows determination of not only relative preference but also the distance or strength of the relative preference. Thus rating data can be subjected to analysis by a variety of analytical methods (see for example, Jabbar and Diedhiou 2003).

The detailed survey was conducted during May and June 2006. The questionnaire included information on household characteristics, preference rating for various dairy and meat products according to alternative use of the product as well as attributes of the product, detailed expenditure on dairy and meat products and semi-aggregate expenditure on other food and non-food items, and an aggregate estimate of overall household income and expenditure. In a conventional household expenditure or budget survey, usually sufficiently disaggregated records are collected in order to ensure a high degree of accuracy of the estimates. Given the focus of this study on quality and safety issues and the need to collect detailed data to address those aspects, more disaggregated data on food and non-food expenditures could not be collected due to time constraint and possible interviewee fatigue. Also data for a full year is usually collected to take into account seasonality in consumption and expenditure but in this survey, detailed consumption data were collected for 30 days prior to the survey. However, it was observed that urban households had a regular pattern of monthly expenditure and most people bought many items at regular intervals, e.g. some items daily, some weekly or biweekly and others monthly, so the reported figures should be considered as reasonably accurate estimates.

Enumerators were drawn from the graduate student pool of two universities and were trained both before and during pre-testing the questionnaire. The final survey was conducted under close supervision of the research team members. Although the household head was approached for the interview, the principal household food manager was actively involved during the interview. In many instances, several household members contributed to the answers, which helped to capture the position and preference of the household rather than of an individual household member.

2.3   Analytical techniques

Descriptive statistics were used to discern general characteristics of the data. Logit analysis of preference rating and Almost Ideal Demand Systems (AIDS—see e.g. Deaton and Muellbauer 1980) models were used for conducting more comprehensive analysis on demand for quality and safety in livestock products. The theoretical and empirical specification of these models and their results are presented in the subsequent sections.

3 Descriptive analysis of preferences for livestock products

3.1 Household demographics

Some general characteristics of the sample households are summarized in Table 2. There are few differences between the two cities except that in Mymensingh there are a higher proportion of non-Muslims than in Dhaka and share of high income sample is higher in Dhaka than in Mymensingh. Given the inherent nature of the two cities and Dhaka being the capital city, these differences seem plausible.

Table 2. *Demographic characteristics of the sample households*

	Mymensingh N = 300		Dhaka N = 600		Both N = 900	
	Mean	SD	Mean	SD	Mean	SD
Age of hh head (yrs)	45.9	13.4	51.6	19.6	49.7	16.0
Schooling of hh head (yrs)	9.4	4.5	13.3	5.0	12.0	5.2
% hh head female	9.3	–	3.7		5.3	–
% by occupation						
– Salaried job	57.7	–	56.9	–	57.2	–
– Business	38.3	–	41.4	–	40.4	–
– Wage workers	4.0	–	1.7	–	2.5	–
% by religion						
– Muslims	85.4	–	97.3	–	93.3	–
– Hindus/others	14.6	–	2.7	–	6.5	–
Average family size	4.9	1.9	4.6	1.3	4.7	1.5
% hh by monthly income						
– Low income	35.1	–	21.1	–	25.8	–
– Medium income	51.3	–	51.7	–	51.6	–
– High income	13.6	–	27.3	–	27.7	–

Note: Low income < Bangladesh Taka (BDT)[1] 10,000, Medium income BDT 10,000–30,000; High income > BDT 30,000.
Source: Field survey.

3.2 Households' preferences for dairy products

3.2.1 Uses of products

Milk and milk products are preferred items in the daily diet of average Bangladeshi households. However, not every household or all members of a household, especially in lower income brackets, can afford to consume them even if they wish to do so. In the past, only raw fresh milk and traditional sweets and ghee (clarified butter) made from fresh milk were consumed. More recently various new products (pasteurized milk, powdered milk with

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1. BDT (Bangladesh Taka). In August 2010, USD 1 = BDT 69.65.

various fat contents, ice-cream) have been introduced into the Bangladeshi market, offering greater variety and substitution opportunities.

The study's respondents were asked whether they consumed certain dairy products, and if so whether they consumed them regularly. Then, respondents were asked to express preferences by rating products. This order of enquiry was used because it is likely that households that did not consume a product at all would not know enough about that product to be able to rate it. The results on frequency of consumption are summarized in Table 3. Raw fresh milk is the most widely and regularly consumed product in both cities, followed by pasteurized milk and full cream powdered milk. Raw fresh milk is more widely and regularly consumed in Mymensingh compared to Dhaka and opposite is the case for pasteurized milk. Full cream powdered milk is also very important in both the cities though the extent and the regularity of consumption are higher in Dhaka. Amongst other products, fermented milk, non-pasteurized packed fresh milk (NPP fresh milk), half cream powdered milk and lassi are more widely and regularly consumed in Dhaka than in Mymensingh. Condensed milk is almost equally important in both the cities.

Table 3. *Proportion of households consuming, 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	68	89	53	90	58
Fermented milk	3	1	41	5	28	4
NPP 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
Lassi	11	3	57	9	41	

* Non-pasteurized packed fresh milk (henceforth referred to as NPP fresh milk).
Source: Field survey.

Preference ratings for the four most prevalent uses of milk were compared for perceived close substitute products. Substantial variation was observed in the two cities (Table 4). Average ratings are presented for those who rated a product for a specified use (those not consuming the product for that use are excluded, so each average rating may not be for the entire sample or the same number of sample households). Apart from rating differences between the two cities, rating differences were also compared for low, medium and high income groups but they were not found to be significantly different, so these are not reported. In cases where differences between income groups were significant, the results are discussed in that regard.

Table 4. *Preference rating of dairy products for different uses in Dhaka and Mymensingh cities (average score out of 10 points)*

Product name	Drinking			Mix with tea/coffee/milo			Making yoghurt		
	Mymen-singh	Dhaka	All	Mymen-singh	Dhaka	All	Mymen-singh	Dhaka	All
Raw fresh milk	8.9	8.4	8.6	5.2	7.3	6.6	5.8	7.7	7.1
NPP fresh milk	10.0	6.3	6.3	0.0	6.5	6.5	0.0	6.0	6.0
Pasteurized milk	7.4	7.7	7.6	4.2	7.1	6.5	3.5	6.4	5.7
UHT milk	7.1	6.7	6.7	2.6	6.4	6.0	1.1	5.4	4.8
Full cream powder	5.9	7.0	6.7	8.2	7.3	7.6	1.9	6.1	5.1
Half cream powder	8.4	6.3	6.5	1.7	6.4	5.9	0.2	5.3	4.9
Skimmed milk	2.0	5.8	5.6	0.7	5.6	5.5	0.7	5.2	5.0
Fermented milk	5.4	6.0	6.0	–	–	–	–	–	–
Lassi	8.3	6.5	6.6	–	–	–	–	–	–
Condensed milk	–	–	–	6.7	6.6	6.6	–	–	–

Continued

Product name	Baking/sweets/cheese making			Overall preference		
	Mymensingh	Dhaka	All	Mymensingh	Dhaka	All
Raw fresh milk	7.3	7.2	7.3	8.9	8.2	8.4
NPP fresh milk	1.8	9.5	8.2	10.0	6.2	6.3
Pasteurized milk	1.0	6.3	6.3	8.0	7.5	7.6
UHT milk	6.7	6.9	6.9	7.1	6.7	6.7
Milk powder full cream	4.4	6.3	6.1	7.8	7.1	7.3
Milk powder half cream:	6.8	6.7	6.7	7.9	6.5	6.6
Skimmed milk	–	–	–	5.3	5.5	5.5
Fermented milk	–	–	–	4.7	5.8	5.7
Lassi	–	–	–	8.0	6.3	6.4
Condensed milk	1.5	6.0	5.6	5.9	6.0	6.0

Note: – Not rated as these are not used for the specified purposes.
Source: Field survey.

Among the four forms of liquid milk—raw fresh, NNP fresh, pasteurized and UHT milk—all are most preferred for drinking and less so for other uses, in both the cities. Also in both cities, raw fresh milk is the most preferred for drinking followed by pasteurized milk, UHT milk and NPP fresh milk. NPP fresh milk is not a widely accessible, nor widely used, product, so the real choice is between raw, pasteurized and UHT milk: the products are preferred in that order in both cities. For mixing with tea/coffee/hot drinks, consumers in Dhaka appear to be indifferent between the four forms of liquid milk but consumers in Mymensingh have a clear preference for raw fresh milk. A similar result is obtained for use of milk in production of yoghurt and for baking/making sweets. Taking all the uses together, overall order of preference is raw, pasteurized, and then UHT milk.

From the two types of powdered milk, there are differences in average preference rating for alternative uses and also between the two cities. For drinking, overall average rating is about the same as the rating for UHT milk, which received the lowest rating among the four liquid milk types. However, preference for drinking is higher for half cream powdered milk in Mymensingh and full cream in Dhaka. Full cream milk received higher rating for mixing with tea/coffee/hot drink, for making yoghurt but less for baking and making sweets in both the cities. In general powdered milk received very poor rating for making yoghurt in Mymensingh where making yoghurt with liquid milk is still a tradition. Taking all the uses together, full cream powdered milk is preferred to half cream powdered milk.

Lassi and fermented milk are used only for drinking and they are the most preferred in Mymensingh and Dhaka respectively. Condensed milk is equally preferred for mixing with tea/coffee/hot drink in both the cities but for baking and making sweets, it is more preferred in Dhaka than in Mymensingh.

3.2.2   Preferences in relation to product attributes

Each product was rated for the following attributes representing both quality and safety: taste, nutritive value, health risk, hygiene, shelf life, availability, handling convenience, price, and overall rating taking into account all the attributes. All the attributes except health risk are self-explanatory where higher rating implies higher preference. Although milk and some milk products are generally described in Bangladesh as complete, healthy, nutritious food, nowadays educated, higher income, better nourished people have also started associating such products with health risk[2] due to high fat and cholesterol content. Thus perception about the health risk of specific milk and milk products might differ widely among consumers depending on their own health and income status as well as perception about the properties of these products irrespective of their actual or intrinsic properties or credence qualities. While for other attributes, better quality or value is given higher rating, in case of health risk attribute the rating was done in a reverse way: lower health risk was given higher rating hence more preferred as a product. This allowed interpretation of ratings for all the attributes in a uniform manner.

The rating results are summarized in Table 5. In general, absolute rating values for most products with respect to most of the attributes are lower for Dhaka compared to Mymensingh.

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2. Health risk due to possible foodborne disease and toxins associated with food poisoning are covered in the attribute 'hygieneness' which defines the sanitary conditions of a product including cleanliness.

Table 5. *Households' rating of milk products by product attributes*

Product name	Taste			Nutritive value			Health risk		
	Mymen-singh	Dhaka	All	Mymen-singh	Dhaka	All	Mymen-singh	Dhaka	All
Raw fresh milk	9.1	8.6	8.7	9.3	8.2	8.6	9.0	6.2	7.1
NPP fresh milk	8.0	6.7	6.7	9.0	6.8	6.8	8.0	5.8	5.8
Pasteurized milk	7.7	8.0	7.9	7.5	7.3	7.4	7.6	6.4	6.6
UHT milk	7.3	7.2	7.2	7.7	6.8	6.9	7.4	6.0	6.1
Milk powder full cream	7.5	7.3	7.3	7.4	6.9	7.0	7.6	6.2	6.6
Milk powder half cream	7.6	6.5	6.6	7.8	6.4	6.5	7.9	6.4	6.5
Skimmed milk	8.0	6.6	6.6	6.8	6.3	6.3	5.0	5.1	5.1
Fermented milk	3.8	6.2	6.1	2.5	5.4	5.2	3.9	4.7	4.7
Lassi	8.4	7.0	7.2	6.9	5.9	6.0	6.7	5.8	5.9
Condensed milk	6.0	6.3	6.3	3.8	5.4	5.1	7.9	5.0	5.4

(Continued)

Product name	Hygieneness			Shelf life			Availability		
	Mymen-singh	Dhaka	Total	Mymen-singh	Dhaka	Total	Mymen-singh	Dhaka	Total
Raw fresh milk	8.2	6.4	7.0	5.7	5.9	5.8	7.2	6.2	6.5
NPP fresh milk	5.0	6.1	6.1	7.3	5.7	5.7	8.0	5.6	5.7
Pasteurized milk	8.6	7.2	7.5	7.7	7.3	7.4	9.9	7.6	8.2
UHT milk	7.9	6.9	7.0	7.8	7.0	7.1	8.1	6.4	6.6
Milk powder full cream	8.7	7.1	7.5	9.5	7.5	8.0	9.7	7.4	8.0
Milk powder half cream	8.5	7.1	7.2	9.1	7.5	7.6	9.9	7.2	7.4
Skimmed milk:	7.0	7.0	7.0	6.8	5.9	6.0	4.5	5.7	5.6
Fermented milk:	4.3	4.9	4.9	3.3	4.8	4.8	2.4	5.3	5.2
Lassi	7.1	5.9	6.0	5.1	5.1	5.1	6.3	5.8	5.9
Condensed milk	6.7	6.1	6.2	7.5	6.3	6.4	9.7	7.0	7.4

(Continued)

Product name	Handling convenience			Price			Overall rating		
	Mymen-singh	Dhaka	Total	Mymen-singh	Dhaka	Total	Mymen-singh	Dhaka	Total
Raw fresh milk	6.6	6.2	6.4	7.8	6.6	6.9	8.7	8.1	8.3
NPP fresh milk	7.5	6.1	6.1	7.5	6.2	6.3	8.0	6.5	6.5
Pasteurized milk	8.5	7.0	7.1	6.4	6.6	6.5	7.6	7.7	7.6
UHT milk	9.7	7.2	7.8	6.0	6.1	6.1	7.4	6.9	6.9
Milk powder full cream	9.9	7.0	7.3	6.1	6.3	6.2	7.8	7.2	7.4
Milk powder half cream	9.5	6.9	7.3	5.8	6.1	6.1	6.4	6.8	6.8
Skimmed milk	8.6	7.2	7.5	4.5	5.9	5.9	7.6	6.1	6.1
Fermented milk	4.6	5.3	5.2	8.5	6.1	6.2	3.1	5.9	5.8
Lassi	6.6	6.2	6.4	6.1	5.9	5.9	7.1	6.2	6.3
Condensed milk	6.6	5.5	5.6	6.5	6.0	6.1	5.4	6.1	6.0

Source: Field survey.

Some highlights of the results are as follows. Among the four forms of liquid milk—raw fresh, NNP fresh, pasteurized and UHT—raw fresh milk is considered the most tasty and nutritious, and the least risky for health. Pasteurized and UHT milk are rated highest (by a small margin) in terms of hygiene, shelf life, availability and handling convenience. In terms of health risk, raw fresh milk is considered least risky by consumers in Mymensingh, where boiled raw fresh milk drinking has a strong tradition. Skimmed milk has been rated moderately for health risk although it is generally believed that skimmed milk is good for health or has very low risk for health. Perhaps these ratings are likely to be based on limited awareness of health risks associated with milk. Fermented milk has been rated low in terms of taste, nutritive value and health risk. The rating for flavour and nutritive value seems reasonable but rating for health risk may reflect lack of awareness about the public health risk, and fears concerning the way this product is usually prepared and marketed. Between full and half cream powdered milk, ratings differ between attributes but for a particular attribute, differences between the two cities are small. Condensed milk has been rated higher in Mymensingh than in Dhaka implying that Mymensingh consumers consider it less risky for health. This may be a reflection of the differences in the degree of awareness about this product, which is generally promoted and sold as a form of milk product.

Rating of a product in terms of its prevailing market price indicates consumer perception of the product's real value for money. A product's higher rating indicates that its price is low, or at least acceptable, relative to the utility generated by its consumption. In Mymensingh, the price-related ratings for raw fresh, NNP fresh and fermented milk are reasonably high. The rating for other products in Mymensingh, and generally all products in Dhaka, are such that it seems consumers consider the prevailing prices of these products to be high in relation to their utility generated.

When all the attributes are considered for overall rating of each product, raw milk tops the list followed by pasteurized milk and full cream powdered milk. This order was the same for overall rating based on different uses (see above). The overall rating values based on uses and attributes are similar even though these ratings were performed independently during the same interview session without cross referring to each another. Therefore, the ratings can be considered robust and representative of consumer perceptions about the characteristics of these products and their market and use values.

3.2.3   Strength of order of preferences among major forms of milk

Raw fresh milk, pasteurized milk, full and half cream powdered milk are the most widely consumed milk products in the urban areas. They are also the most preferred among various dairy products as indicated by preference ratings based on different attributes. Although

ratings indicate the order of preference, alone they do not indicate the significance of differences in preferences. In order to assess the strength of the differences in preference, LOGISTIC procedure in SAS (SAS 1995) was used. This procedure fits a parallel lines regression model based on the cumulative distribution probabilities of the response categories, in our case the preference ratings. Following Jabbar and Diedhiou (2003), the model was defined as:

$$P_i = prob\ (Y = i | X),\ for\ i = 1,\ ...,\ j$$

where, for product I, Y is the response variable with j possible outcomes or categories, X is a continuous predictor variable. In our case, there are 10 response categories for an attribute: 1 = least preferred or strongly dislike,…, 10 = most preferred or strongly like.

For such a data set, PROC LOGISTIC in SAS fits the following model:

$$logit\ (p_1) = log(p_1/(1-p_1)) = \alpha_1 + \beta * X$$

$$logit\ (p_1 + p_2) = log((p_1 + p_2)/(1-p_1-p_2)) = \alpha_2 + \beta * X$$

and so on, to describe a set of parallel regression lines as described above.

PROC LOGISTIC models the cumulative probabilities assuming a common slope parameter associated with the predictor variable, hence called the proportional-odds model as the ratio of the odds of the event Y inferior or equal to j is independent of the category, j. This means that the odds ratio is constant for all categories.

Raw fresh milk was used as a reference product, so other forms of milk were compared with respect to this form of milk. Preference ordering was assessed with respect to the following attributes: taste, nutritive value, health risk, product hygiene, shelf life, availability, handling convenience, price and overall taking into account all attributes. Because the least preferred or strong dislike (Y = 1) end of the rating scale was associated with lower ordered values (ratings) in the response profile distribution, the probability of disliking the milk product was modelled with respect to each of the above attributes. This means, in this analysis, the response levels were sorted in ascending order, so a positive value of a coefficient indicates lower preference compared to raw milk, the base category, and a negative coefficient indicates the opposite.

The results of logit analysis of preferences for different forms of milk are presented in Table 6. The p-values of score chi-square for all the product attributes were statistically significant at less than 5% level, which indicates that the data fitted the model well.

Table 6. *Maximum likelihood estimates of preference rating of different forms of milk in two cities*

Parameter	Taste	Nutritive value	Health risk	Product hygiene	Shelf life	Availability	Handling convenience	Price	Overall rating
α_1	-9.7454**	-9.8868**	-6.7833**	-7.4873**	-6.2542**	-5.4406**	-6.5260**	-7.9034	-9.2311
	(1.0030)	(1.0034)	(0.4512)	(0.8721)	(0.7079)	(0.4103)	(0.7081)	(0.7100)	(1.0027)
α_2	-7.5444**	-8.7875**	-4.6188**	-6.1647**	-4.8627**	-3.8849**	-4.7288**	-5.8186**	-8.1316**
	(0.3429)	(0.5830)	(0.1638)	(0.5022)	(0.3554)	(0.1933)	(0.2916)	(0.2579)	(0.5819)
α_3	-6.8472**	-7.3965**	-3.9975**	-4.4996**	-3.2527**	-2.9846**	-3.7680**	-4.6052**	-7.4368**
	(0.2491)	(0.2995)	(0.1274)	(0.2234)	(0.1644)	(0.1289)	(0.1843)	(0.1511)	(0.4146)
α_4	-5.9167**	-5.8899**	-2.8985**	-3.0891**	-1.5578**	-2.1657**	-2.3574**	-3.4630**	-6.3328**
	(0.1693)	(0.1586)	(0.0893)	(0.1195)	(0.0835)	(0.0935)	(0.1008)	(0.1010)	(0.2465)
α_5	-4.1323**	-4.3096**	-1.7001**	-1.9102**	-0.3131**	-1.1560**	-1.0517**	-2.0465**	-4.3863**
	(0.1013)	(0.1018)	(0.0709)	(0.0800)	(0.0658)	(0.0707)	(0.0695)	(0.0748)	(0.1158)
α_6	-2.8244**	-2.6851**	-0.5850	-0.2889	0.9482**	-0.1152	0.2203**	-0.4942**	-2.6898**
	(0.0833)	(0.0819)	(0.0641)	(0.0637)	(0.0699)	(0.0638)	(0.0642)	(0.0646)	(0.0813)
α_7	-1.8148**	-1.3394	0.4966**	0.8228	2.1657**	0.9555**	1.4080**	0.8543**	-1.1595**
	(0.0747)	(0.0717)	(0.0638)	(0.0654)	(0.0795)	(0.0668)	(0.0698)	(0.0663)	(0.0688)
α_8	-0.3952**	-0.1266	1.4091**	2.0394**	3.5780**	2.2854**	2.5778**	2.2241**	0.2729*
	(0.0655)	(0.0649)	(0.0709)	(0.0745)	(0.0906)	(0.0762)	(0.0792)	(0.0890)	(0.0644)
α_9	0.4184**	0.7203**	1.9217	2.8170**	4.3395**	2.8427**	3.2005**	3.2564**	1.3162
	(0.0658)	(0.0681)	(0.0794)	(0.0866)	(0.1002)	(0.0822)	(0.0873)	(0.1309)	(0.0735)
Pasteurized milk	1.1852**	1.5806**	0.4491**	-0.6772**	-2.0458**	-1.5240**	-1.3783**	0.5013**	1.0065**
	(0.0922)	(0.0939)	(0.0884)	(0.0895)	(0.0973)	(0.0924)	(0.0919)	(0.0898)	(0.0914)
Milk powder full cream	1.9095**	2.2380**	0.5232**	-0.8052**	-2.8486**	-1.5461**	-1.7004**	0.8582**	1.4314**
	(0.0954)	(0.0975)	(0.0885)	(0.0895)	(0.1022)	(0.0923)	(0.0931)	(0.0904)	(0.0929)
Milk powder half cream	2.8584**	2.7830**	0.7963**	-0.4126**	-2.3622**	-0.8666**	-0.9881**	1.1192**	2.1151**
	(0.1119)	(0.1120)	(0.1007)	(0.1007)	(0.1099)	(0.1013)	(0.1019)	(0.1032)	(0.1079)
χ^2 test Prob. with 24 df	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001

Figures in the parentheses are standard errors.
** Significant at 1% level, * Significant at 5% level.

15

Given that there were 10 response categories, the cumulative probability estimation procedure generated 9 intercepts for each equation—α_1 to α_9 in Table 6—which sum to provide the overall intercept and need no further interpretation.

For each attribute, the estimated coefficients of the three forms of milk indicate the preference ordering as well as the distances in preference from raw milk, the base category. The p-values of the estimated coefficients are highly significant, at least at 5%. The results indicate that preferences among the four forms of milk differ according to the specific attributes. For example, in terms of taste and nutritive value, the order of preference was raw milk first, pasteurized milk second, full cream powdered milk third and half cream powdered milk fourth. On a scale of 1 to 10, compared to raw milk, average rating for taste was about 1.2 points lower for pasteurized milk, 1.9 points lower for full cream powdered milk and 2.9 points lower for half cream powdered milk. Rating for nutritive value for these products was lower by 1.6, 2.2 and 2.8 points, respectively. In terms of health risk, the order of preference was the same as in the case of taste and nutritive value but the absolute differences were small and difference between pasteurized milk and full cream powdered milk was not significant. In terms of product hygiene, shelf life, availability and handling convenience, all three forms of milk—pasteurized, full and half cream powder—were more preferred than raw fresh milk. In terms of hygiene, full cream powdered milk was the most preferred followed by pasteurized milk, and half cream powdered milk though the values of absolute differences were small and the difference between pasteurized and full cream powdered milk was not statistically significant. In terms of shelf life, on average, compared to raw milk, rating for full cream powder, half cream powder and pasteurized milk was higher by respectively 2.8, 2.4 and 2.0 points. In terms of price and overall preference, the order of preference is raw milk first, pasteurized milk second, full cream powder milk third and half cream powder milk fourth. On average, compared to raw milk overall preference rating for pasteurized, full cream powder and half cream powder was lower by 1.0, 1.4 and 2.1 points respectively.

3.2.4 Preferences for main forms of milk in relation to selected quality criteria

In addition to the attributes discussed above, respondents were asked to rate three main forms of milk—raw fresh, pasteurized and powdered—in terms of several criteria which also represent quality in some way. These are cattle breed, fat content, colour, smell/flavour, source of the product, brand, packaging, labelling and whether vitamin-enriched. Each criterion was represented by two or more indicators (Table 7). These criteria and indicators were derived from the PRA conducted before the detailed survey was conducted and were included in the survey for collecting quantitative information. Rating was done for each

criterion and related indicators out of a maximum of 10 points. Higher rating indicated that the product was preferred more on the basis of that criterion and indicator.

Table 7. *Preference rating of different forms of milk in terms of selected criteria and indicators of quality in the two cities*

Indicators	Fresh milk			Pasteurized milk			Powdered milk		
	Mymen-singh	Dhaka	Total	Mymen-singh	Dhaka	Total	Mymen-singh	Dhaka	Total
Cattle breed: Local	9.8	8.6	9.0	9.4	8.5	8.7	na	na	na
Cross	6.2	5.7	5.9	6.7	5.5	5.8	na	na	na
Fat content: Whole milk	9.5	7.9	8.4	9.3	7.9	8.2	9.2	7.9	8.2
Half cream	5.6	6.2	6.0	4.8	6.3	5.9	3.7	6.1	5.5
Non-fat	3.6	4.2	4.0	3.7	4.1	4.0	3.3	4.1	3.9
Colour: White	7.3	6.5	6.7	7.2	6.3	6.5	6.6	6.2	6.3
Creamy	8.7	7.6	8.0	8.7	7.6	7.8	8.9	7.4	7.8
Flavour: Good	9.8	9.0	9.2	9.8	8.6	8.9	9.5	8.5	8.8
Bad	1.2	2.2	1.9	0.9	2.2	1.9	1.1	2.2	1.9
Source: Producers/manufacturer	9.7	9.0	9.2	8.7	8.6	8.6	na	na	na
Trader/vendor	4.6	5.8	5.4	4.4	5.9	5.6	na	na	na
Grocery shop	na	na	na	1.9	5.7	4.5	6.7	5.8	6.0
Supermarket	na	na	na	3.8	5.6	5.0	8.1	5.7	6.3
Packaging: Polythene	4.0	6.2	5.7	7.2	5.9	6.2	5.6	5.6	5.6
Sachet	5.1	7.4	6.9	8.6	7.9	8.0	8.4	7.3	7.6
No pack	7.7	2.1	5.4	2.2	1.8	1.9	3.8	1.6	2.1
Tin	na	na	na	na	na	na	9.3	7.9	8.3
Labelling: Yes	8.6	8.2	8.3	9.4	8.4	8.7	9.4	8.4	8.7
No	4.9	3.6	3.9	1.3	2.9	2.5	1.2	3.0	2.5
Vitamin enriched: Yes	na	na	na	9.7	8.3	8.6	9.6	8.3	8.6
No	na	na	na	1.5	2.8	2.5	1.3	2.7	2.3

Source: Field survey.

Local cattle used to be the main source of liquid milk for both rural and urban areas but recent introduction of exotic germplasm for crossbreeding has widened the choice about liquid milk for marketing and consumption in fresh or in pasteurized form. Assuming that consumers might differentiate milk from local and crossbred cows, rating for both raw fresh and pasteurized milk from local and crossbred cows was solicited. It was recognized that consumers could to some extent differentiate or verify the physical properties of raw fresh milk from local and crossbred cows on the basis of some criteria and associated indicators, such as colour and flavour (see below), but the same could not be done in case of pasteurized milk. Labelling of pasteurized milk does not include information on breed of

cows from which milk is sourced. Therefore, the rating should be interpreted as preferences if full information was available. It appears that consumers in both the cities, for both raw and pasteurized milk had stronger preference for milk from local cows, and that the strength of this preference was stronger among consumers in Mymensingh, where access to milk from local cows, especially in fresh form, was better than in Dhaka where pasteurized milk was more widely used. For powdered milk, breed of animal for milk used in its preparation would be difficult to verify by consumers, so rating information for powdered milk by breed was not sought.

Fat content is an important quality criterion in the minds of consumers. Powdered milk is usually differentiated into full cream and half cream and labelled, and fat content in pasteurized milk is also labelled on the pack. But fat content of raw fresh milk in the informal retail market cannot be objectively measured by consumers, but they may use an indicator such as colour (creamy vs. watery) to make subjective judgement about milk's fat content. Ratings for the three forms of milk showed that full or whole milk was generally preferred by consumers in both the cities, and more so in Mymensingh. Non-fat or skimmed milk was least preferred. This was also consistent with the higher preference for creamy colour milk, which was used by consumers as a subjective indicator of fat content and quality.

Some consumers judge quality based on flavour. Flavour may reflect quality in two ways: certain feeds may contribute to undesirable flavour of milk; and spoilage can affect flavour (this can also affect improperly-stored powdered milk). Addition of preservatives may also change flavour. Ratings of good and bad flavour suggest that good flavour was an essential quality criterion in the minds of the consumers.

Consumers sometimes associate the origin or source of supply or purchase point of milk with quality. In some case, the source is known, e.g. a specific supermarket but in other cases, it is merely an information as the real original source is not known, e.g. a vendor selling raw milk may inform the buyer about a locality or a farm as the source of supply in order to assure quality but the buyer may not be able to readily verify that except to trust the vendor. Rating the three products in terms of source of milk, the producer or the manufacturer was the most preferred source of supply in case of raw and pasteurized milk, while secondary sources such as vendors, grocery shops and supermarkets were less preferred. In case of powdered milk, grocery shops and supermarkets were almost equally preferred.

Liquid milk sold in ordinarily sold polythene bag, in sachet or without any pack, in which case buyers bring their own container or unspecified packing material like used polythene bag to collect raw milk. For powdered milk standard tin or polypack is the norm but loose milk is also sold in non-standard unspecific packing material. Ratings on package options suggest that sachet was preferred for liquid milk and tin was preferred for powdered milk. In

Mymensingh non-packed raw milk was most preferred perhaps because consumers could physically see and examine (colour, flavour, smell) what they were buying.

Pasteurized and powdered milk sold in the market were labelled giving brand name and some information on composition and nutritive values but raw fresh milk was not labelled, yet consumers expressed strong preference for labelled products instead of non-labelled products in case of all three forms of milk. In case of raw milk, it might be an indication of revealed but unfulfilled preference. Similarly vitamin enrichment of pasteurized and powdered milk was strongly preferred compared to non-enriched products perhaps because market promotion for such products often highlighted the nutritive values of vitamin and other mineral enrichment, especially for children.

3.2.5 Preferences for brands of pasteurized and powdered milk

Three major brands of pasteurized milk are available in the market—Milk Vita, Aarong and Pran. Milk Vita has been on the market since the early 1970s. It is produced by a milk producers' cooperative established following the Indian Amul principle to some extent (Jabbar 2010). Aarong brand is marketed by BRAC Dairy, an enterprise of the BRAC, which is the largest NGO in the country but its dairy enterprise is run as a profit making activity registered under the company law. BRAC dairy has been in the market since 1998. Pran dairy is another private sector enterprise which has entered the market in the last two to three years. There are a few other minor brands on the market such as Fresh, Rangpur and Aftab dairy. All of these enterprises collect raw milk from rural areas through their network of collection centres and chilling plants for processing at central facilities. Sometimes, especially during lean season, they mix powdered milk with raw milk to produce pasteurized milk. Whether consumers are aware of this is unclear.

Preference rating of the three main brands show that Milk Vita was the most preferred followed by Aarong and Pran (Table 8). About 30% of milk consumed in the country is imported and most of this is in the form of powdered milk in bulk, which is packed in the country and sold under various brand names. Some nine major brands, and a number of minor ones, were identified during the PRA prior to the main survey, and some of these brands have been on the market for longer than others. The marketers/distributors differentiated their brands with respect to some characteristics such as source of raw material (Australia, New Zealand, Denmark etc.), enrichment with certain vitamins and calcium, and these were highlighted in aggressive promotional advertisements. But it was unclear if raw materials (powdered milk) imported from different countries had real intrinsic difference in terms of quality.

Table 8. *Preference rating for different brands of pasteurized and powdered milk*

Product name	Mymensingh	Dhaka	All
Pasteurized milk:			
Milk vita	8.1	8.5	8.4
Aarong	6.7	7.1	7.0
Pran	6.5	6.4	6.4
Powdered milk:			
Nestle	9.5	7.6	8.2
Dano	8.8	7.6	7.9
Diploma	8.4	7.3	7.6
Red cow	8.1	7.4	7.5
Nido	7.5	7.3	7.3
Starship	6.1	6.4	6.3
Anchor	6.0	6.7	6.6
Fresh milk	5.9	6.7	6.5

Source: Field survey.

Respondents were asked to rate preference among the major powder milk brands commonly traded in the country (Table 8). It appears that the older brands like Nestle, Dano, Diploma and Red Cow were more preferred than the other relatively new brands in the market. Like powdered milk, condensed milk was also branded, labelled and sometimes vitamin or mineral enriched, and consumers have rated labelling and vitamin enrichment very highly.

3.3   Household preferences for meat and eggs

3.3.1   Preferences for meat according to quality criteria

Beef (cattle meat) and mutton (goat meat)[3] are the most commonly consumed meats in the country. Small quantities of buffalo meat and sheep meat are sold in city meat markets, but butchers sell buffalo meat as beef, and sheep meat as mutton to consumers who may not know how to identify or differentiate them. The sample households were asked if they consumed different types of meat and if so, regularly. It was assumed, but not objectively verified, that the consumers knew clearly the type of product they bought or consumed, especially that they were able to differentiate beef from buffalo meat and goat meat from sheep meat.[4] The responses showed that beef, mutton and chicken consumption was

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3. Goat meat is sometimes described as chevon and sheep meat as lamb meat. In Bangladesh, mutton usually refers to goat meat and sheep meat is usually called as such.

4. If one does not maintain this assumption, then some interesting anomalies may arise. Perhaps purchase of mutton by accident would result in satisfaction that is either higher or lower than the pre-purchase expectation. However, incentives would exist for mis-labelling by the seller only where the label was put on the lower priced product.

common in both the cities, and very few consumers consumed buffalo meat and sheep meat, especially in Mymensingh (Table 9).

Table 9. *Proportion of households consuming different types of meat in Mymensingh and Dhaka cities*

City and regularity of consumption	Beef	Buffalo meat	Goat meat	Sheep meat	Chicken
Mymensingh					
Consume	83	5	80	3	90
Regularly consume	56	1	17	0	88
Dhaka					
Consume	98	24	91	12	99
Regularly consume	79	3	25	1	89
All					
Consume	93	18	88	10	98
Regularly consume	72	2	23	1	88

Source: Field survey.

Then respondents were asked to rate their general preference for beef, buffalo meat, chevon and sheep meat and chicken at their existing prices on a scale of 1–10, 10 representing most preferred and 1 least preferred. It appears that chicken was the most preferred meat in both the cities but the strength of preference in Mymensingh was stronger than in Dhaka. Consumers in Dhaka had much stronger preference for beef compared to buffalo meat and for mutton compared to sheep meat than consumers in Mymensingh (Table 10). Goat and sheep meat was given a slightly higher rating by high income, than low income, consumers while the reverse was true for buffalo meat. Price differences of these products may be a partial explanation for this difference.

Table 10. *Overall preference rating of different types of meat in the two cities*

Product name	Preference rating by city		
	Mymensingh	Dhaka	Total
Beef	7.2	8.4	8.0
Buffalo meat	4.0	3.0	3.0
Goat meat	4.7	6.5	6.0
Sheep meat	2.7	2.5	2.5
Chicken	9.3	8.5	8.7

Source: Field survey.

Next, the sample households were asked to rate their preferences for only beef (cattle meat), goat meat and chicken given existing prices based on a number of criteria. In case of cattle meat, the criteria were breed of animal, sex and age, feeding system, fat content, meat cut, colour, appearance of meat, appearance of display space for meat and certification by an

appropriate authority such as food, public health or municipal authority. In the case of goat meat, the above criteria were used except breed and age because it is generally known that Black Bengal breed is the only goat breed available in the meat market. There are only a few Jamnapari animals in the country which are usually consumed during festival times and are rarely sold in ordinary meat markets. Also, age grouping of goat carcass was rather difficult in the meat market but sex distinction was possible so was used as a criteria. Relevant indicators for each criterion for cattle and goat meat are shown in Table 11 in which the rating results are also summarized.

Table 11. *Preference rating of cattle and goat meat according to selected criteria and indicators in Mymensingh and Metropolitan Dhaka*

Quality criteria and indicators	Cattle meat			Goat meat		
	Mymensingh	Dhaka	All	Mymensingh	Dhaka	All
Breed: Local	9.7	8.9	9.1	–	–	–
Indian	4.7	6.0	5.6	–	–	–
Cross	4.3	5.4	5.1	–	–	–
Sex and age: Heifer	5.3	7.0	6.5	–	–	–
Young bull	8.1	8.2	8.2			
Mature bull	5.9	6.4	6.3	–	–	–
Bullock	8.5	5.9	6.7	–	–	–
Cow	3.2	4.8	4.3	–	–	–
He-gat	–	–	–	9.0	8.3	8.5
She-gat	–	–	–	3.6	5.1	4.6
Feeding system: Natural	9.6	8.8	9.0	9.4	8.7	8.9
Fatten/artificial	4.4	4.8	4.6	4.9	4.5	4.6
Fat content: Low	6.8	6.6	6.6	7.3	6.6	6.8
Medium	8.0	7.5	7.6	8.0	7.5	7.6
High	4.4	5.7	5.3	4.4	5.6	5.2
Cut: Front leg	8.7	6.8	7.4	8.5	6.7	7.2
Thai	8.8	6.9	7.5	8.8	6.8	7.4
Chest/ribs	9.3	8.3	8.6	8.9	7.7	8.1
Neck, hump, buttock	6.1	5.6	5.7	6.0	5.6	5.7
Boneless meat	6.1	5.6	5.7	6.5	5.4	5.7
Organs	8.3	5.7	6.5	7.9	5.7	6.4
Colour: Red	8.5	6.8	7.3	–	–	–
Greyish	6.4	5.5	5.8	–	–	–
Whitish	2.7	4.5	4.0	–	–	–
Appearance: Fresh/blood present	9.8	8.8	9.1	9.7	8.6	8.9
Old/dry	3.9	3.9	3.9	4.0	3.8	3.8
Watery/wet	1.6	3.5	2.9	1.8	3.4	2.9
Certification of public health/ municipal authority: Yes	9.4	8.0	8.4	8.2	7.9	8.0
No	5.5	3.8	4.2	5.8	3.8	4.3
Display location: Hygienic	9.6	8.4	8.8	9.4	8.3	8.6
Unclean	2.7	3.5	3.2	2.9	3.2	3.1

– Not applicable.
Source: Field survey.

In the case of cattle meat, among the three breeds—local, Indian and crossbreed—consumers in both the cities strongly preferred meat of local breed. Of all the sex and age groups, meat of young bull was strongly preferred and cow meat, which mostly comes from old culled cows, was least preferred. Meat from naturally fed animals was strongly preferred to meat from artificially fattened animals. Medium fat content (extramuscular cover) was most preferred and high fat content was least preferred but the differences in the ratings for different fat content levels were lower in Dhaka than in Mymensingh, which was not easy to explain. Artificially feed or fattened animals and medium and high fat content were less preferred by higher income consumers, perhaps because of their greater awareness than low income consumers about health risks from fatty and artificially fed animals. Also higher income households consume fat from various sources so can afford to reduce fat intake with meat while poorer households consume few fatty foods, so some fat with meat is considered harmless.

Among the different cuts, meat from foreleg, hind leg and brisket was more preferred than cuts from other parts of the carcass as well as organs. This result applied in both cities, although in Dhaka the differences in the rating of different cuts were less pronounced than those in Mymensingh. Preference for boneless meat was moderate in both the cities because making curry was the most common use of beef and a combination of cuts including bones from different part of the carcass reduces the quality of curry. That is why combination of cuts including bone was preferred by most consumers. Boneless meat was primarily used for making minced meat to prepare certain types of menu (e.g. kabab), which was not consumed regularly but was more commonly served during special occasions and festivals. Cooking minced meat on its own as curry was not common in Bangladeshi households.

Red or greyish colour meat and meat chunks with presence of fresh blood were preferred as they were considered as fresh. Meat from carcass with certification stamp from an authorized public health or municipal authority as a sign of safety was strongly preferred compared to meat from unstamped carcass. Consumers also paid significant attention to the hygiene and cleanliness of the display space for meat in the butcher shop. However, it was generally observed that municipal and public health regulations on meat hygiene were poorly observed by butchers due to lax enforcement of the regulations.

In the case of goat meat, meat from male animals fed naturally and with medium fat content was most preferred in both the cities. But artificially fed or fattened animals and medium and high fat content in carcass was more preferred by lower income consumers. There was slightly higher preference for hind leg, foreleg and brisket ribs, compared to cuts from other parts of the carcass but overall rating differences between cuts from different parts of the carcass was minimal. This was especially apparent in Dhaka, perhaps for the same reason

as for beef cuts. Also as for beef, meat with presence of blood as a sign of freshness and certification of the carcass by an appropriate authority as a sign of safety were also strongly preferred. High value was also accorded to the hygiene and cleanliness of the meat display space in the butcher shop.

Chicken was generally sold live. In the past, chicken used to be slaughtered at home but in recent times, some informal chicken traders in wet markets in the cities slaughter and clean the bird once the price has been agreed. Some customers take this service to avoid dirt and hazard at home and also because many households nowadays may not have regular house help to undertake such tasks. Some traders provide this service at a small extra fee while others may negotiate the price inclusive of the service or provide it free to attract customers. The actual cleanliness and hygiene of these slaughter service providers and their facilities were observed to be very poor due to lack of enforcement of municipal regulations. Dressed broiler and local chicken meat was sold at the (small number of) supermarkets in Dhaka and generally higher income consumers bought such products at those outlets. In answer to a question to rate preference for live and dressed frozen chicken, respondents in Dhaka on average gave 8.5 and 4.4 respectively out of 10 compared to 9.6 and 2.3 in Mymensingh. In answer to another questions on preference for different cuts from dressed chicken, respondents in Mymensingh rated 9.5, 7.7 and 6.6 for leg, breast and other parts respectively out of 10 compared to 8.3, 6.8 and 5.5 respectively in Dhaka. These differences between the two cities probably reflected the differences in their level of urbanization, life style, food habit and changing market mechanism to respond to those demands.

With respect to live chicken, respondents were asked to rate preferences based on a number of quality criteria such as breed, sex, type of bird and feeding system. The indicators related to each quality criterion are shown in Table 12. It appears that preference for local chicken was still higher at current prices but the rapidly-expanding commercial broiler industry has also created a general acceptance of broiler.

Table 12. *Preference rating for live chicken in relation to selected quality criteria in Mymensingh and Metropolitan Dhaka*

Quality criteria and indicators	Mymensingh	Dhaka	All
Breed: Local	8.8	8.7	8.7
Exotic/cross	6.3	6.3	6.3
Sex: Male	8.4	7.3	7.7
Female	8.7	6.6	7.3
Type: Young (male/female)	8.4	8.3	8.3
Cock	8.2	6.7	7.2
Hen	8.3	5.8	6.6
Feeding system: Natural/traditional	8.9	8.8	8.8
Artificial/fatten	6.1	5.3	5.6

Source: Field survey.

However, like local chicken, many ordinary consumers still preferred to buy live broiler chicken for slaughter at home or get them slaughtered at the shop in their presence. Naturally fed/raised chicken was more preferred than are commercially raised chicken but differences in preferences between male and female chicken and between young and older chicken seemed to be small.

Preferences for eggs according to quality criteria

Respondents were asked if they consumed different types of eggs available in the market—local hen egg, layer or commercial farm hen egg and duck egg. Eighty-eight percent of respondents in Mymensingh reported consuming local hen and farm eggs and 68% consumed duck eggs while in Dhaka 96, 99 and 80% consumed local, farm and duck eggs. Respondents were asked to rate preferences for the three types of eggs in terms of two alternative uses—either for cooking or for making poached, fried or omelette eggs. Local hen egg was marginally more preferred than farm egg, and duck egg was least preferred for both uses and in both the towns (Table 13). In general average ratings for all types of egg in Dhaka were slightly lower than in Mymensingh.

Table 13. *Preference rating of eggs by uses in the two cities*

Product name	Rating for cooking			Rating for poached, fried and omelette		
	Mymensingh	Dhaka	All	Mymensingh	Dhaka	All
Local hen egg	8.6	7.7	8.0	8.8	7.9	8.2
Farm hen egg	7.9	7.7	7.7	7.8	7.5	7.6
Duck egg	7.5	6.8	7.0	7.2	6.3	6.6

Source: Field survey.

Respondents were also asked to rate preferences for the three types of eggs in terms of attributes such as taste, nutritive value, health risk, hygiene, shelf life, availability, handling convenience, price and overall rating taking into account all the attributes. The results are summarized in Table 14. The results show that local hen egg was more preferred only in terms of taste and overall attributes, and farm egg was most preferred for almost all other attributes. Duck egg was least preferred in terms of a number of attributes. In terms of price, farm egg was rated slightly higher than the other two types indicating that consumers considered farm egg price in relation to its attributes more reasonable than for the other two.

Table 14. *Household's preference rating for different types of eggs by product attributes*

Product name	Taste			Nutritive value			Health risk		
	Mymensingh	Dhaka	All	Mymensingh	Dhaka	All	Mymensingh	Dhaka	All
Local egg	9.5	9.0	9.1	8.2	6.2	6.8	6.2	5.9	6.0
Farm egg	7.1	7.1	7.1	9.2	7.6	8.1	7.9	7.5	7.6
Duck egg	7.2	6.6	6.7	5.6	5.6	5.6	7.6	6.4	6.7

(Continued)

Product name	Hygiene			Shelf life			Availability		
	Mymensingh	Dhaka	All	Mymensingh	Dhaka	All	Mymensingh	Dhaka	All
Local egg	8.2	6.2	6.8	6.2	5.9	6.0	5.4	6.0	5.8
Farm egg	9.2	7.6	8.1	7.9	7.5	7.6	9.9	8.4	8.9
Duck egg	5.6	5.6	5.6	7.6	6.4	6.7	7.5	5.9	6.4

(Continued)

Product name	Handling			Price			Overall rating		
	Mymensingh	Dhaka	All	Mymensingh	Dhaka	All	Mymensingh	Dhaka	All
Local egg	6.8	6.1	6.3	6.9	6.3	6.5	8.0	8.2	8.1
Farm egg	7.0	7.6	7.4	7.7	7.0	7.2	8.4	7.8	8.0
Duck egg	7.0	5.9	6.2	7.6	6.1	6.5	7.2	6.6	6.8

Source: Field survey.

4 Effects of product attributes on perceived price of milk and meat

4.1 General specification of hedonic price model

It has been shown earlier that respondents expressed different degrees of preferences for different types of dairy products and meat in terms of selected attributes as indicated by attribute specific ratings. A relevant question is whether such preference ratings have any relationship with or influence on the existing or perceived price of the relevant product. A product may be highly rated in terms of certain attribute while lowly rated in terms of another attribute. Therefore, the price the buyer would be willing to pay for the product would be influenced by all the relevant attributes, and able to be measured by the associated ratings. Hedonic or implicit price analysis could be employed to study such relationship. Hedonic price analysis is based on the hypothesis that products have attributes that confer utility and that the values of those attributes contribute to the price of the product. The observed product price is therefore a composite of the implicit prices of the product's attributes (Rosen 1974; Lucas 1975).

More formally, let Y represent a livestock product class. Any model of Y can be completely described by a vector of its characteristics. Let $Q = q_1, ..., q_j, ...q_n$ represent the vector of characteristics of Y. Then any model of Y, say y_i, can be described by its characteristics, that is

$$y_i = y_i(q_{i1},..., q_{ij},...,q_{in})$$

where q_{ij} is the quantity of the jth characteristic provided by model i of good Y. The hedonic price function for Y gives the price of any model, as a function of its characteristics. Specifically for y_i,

$$P_y = p_y(q_{i1},...., q_{ij}, ..., q_{in})$$

If $p_y(.)$ can be estimated from observations of the prices and characteristics of different models, the price of any model can be calculated from knowledge of its characteristics. The partial derivative of the hedonic price function with respect to any characteristics gives its marginal implicit price that is the additional expenditure required to purchase a unit of the product with a marginally larger quantity of that characteristic.

In a competitive market, the implicit price of a product is a function of its attributes alone, and not of the attributes of any individual consumer or supplier of the product (Rosen 1974; Oczkowski 1994). This implies that only products are differentiated, while their markets, buyers and sellers are not. However, most empirical studies have found that price was also related to attributes of the buyers and sellers, implying some non-competitiveness in the

market (e.g. Brorsen et al. 1984; Francis 1990; Andargachew and Brokken 1993; Parker 1993; Parker and Zilberman 1993; Williams et al. 1993; Oczkowski 1994; Rodriguez et al. 1995; Jabbar 1998).

In the present study, the respondents were asked to rate the products in terms of various physical attributes as well as in terms of prevailing price assuming that the prevailing price was also an attribute of the product. However, the rating for the price attribute was assumed to implicitly encompass the ratings for all the other attributes. As such, the rating of a product in terms of its prevailing price could be treated as the respondents' willingness to pay that level of price for that product given the ratings on the other attributes of that product. Hence, the relevant data were subjected to hedonic price analysis to see how ratings in terms of various attributes influenced the rating in terms of the price. Separate price functions were fitted for the four major types of milk—raw fresh, pasteurized, full cream and half cream powdered milk, and for beef, mutton and chicken.

4.2   Results of hedonic price analysis of milk

In the case of milk, the product attributes considered were taste, nutritive value, health risk, shelf life, availability and handling convenience. Different sets of socio-economic variables were tried and the ones that gave the best fit were included in the final model. These are age and education of the household head, family size, total food expenditure, a dummy for source of supply or purchase of the product, and a city dummy. Normally season could be a major influence on price but our data was for a one month period prior to the survey, excluding inter-seasonal effects.

The results are presented in Table 15. The estimated models were statistically significant as judged by R2 and F-values. Among various product attributes' ratings, taste appeared to be the most important factor affecting rating of prices. This result holds for all forms of milk. The magnitudes of this coefficient are the largest for all the equations and similar for all forms of milk. The results imply that higher rating on taste was accompanied by a significantly higher rating on price of a form of milk. Perception on nutritive value was found to significantly affect prices of raw fresh, pasteurized and full cream powdered milk. The results implied that higher rating on this attribute for a form of milk was accompanied by a significantly higher rating on price of that form of milk.

Table 15. *Estimated coefficients of hedonic price model for different forms of milk*

	Raw fresh milk	Pasteurized milk	Full cream powdered milk	Half cream powdered milk
(Constant)	0.154	0.824	1.124	1.940
	(0.539)	(0.740)	(0.821)	(3.342)
Taste	0.384**	0.270**	0.301**	0.280**
	(0.031)	(0.030)	(0.025)	(0.111)
Nutritive value	0.167**	0.128**	0.022**	–0.019
	(0.031)	(0.033)	(0.013)	(0.126)
Health risk	0.086**	0.093**	0.094**	0.078
	(0.022)	(0.024)	(0.026)	(0.113)
Hygienic	0.30**	0.019	0.049	0.330**
	(0.012)	(0.011)	(0.032)	(0.132)
Shelf life	0.021	0.114**	0.113**	0.029
	(0.026)	(0.029)	(0.032)	(0.146)
Availability	0.174**	0.002	0.025	0.045
	(0.023)	(0.007)	(0.029)	(0.138)
Handling convenience	0.118	0.224**	0.139**	0.005
	(0.116)	(0.031)	(0.032)	(0.004)
Total food expenditure	0.081	0.032	0.075	0.397
	(0.073)	(0.075)	(0.082)	(0.337)
Age of household head	0.224*	–0.075*	–0.001	–1.255*
	(0.106)	(0.013)	(0.111)	(0.635)
Education of hh head (yrs)	0.019	0.022	0.009	0.080
	(0.13)	(0.013)	(0.019)	(0.053)
Family size	0.035	–0.015	–0.047	0.470
	(0.121)	(0.123)	(0.122)	(0.534)
Dummy for city (Dhaka = 1)	0.319**	0.493**	0.331**	0.974
	(0.098)	(0.100)	(0.123)	(0.490)
Source dummy—delivery by producer	0.001	–	–	–
	(0.077)			
Source—Grocery	–	–	0.003	–0.624*
			(0.090)	(0.356)
Source—Market	–	0.212	–0.123	–0.459
		(0.081)	(0.094)	(0.370)
R²	0.53	0.39	0.41	0.20
F-value	67.18**	35.01**	34.01**	2.95**
N	900	900	900	900

Source: Field survey.

Perception on health risk was found to significantly affect prices of all the forms of milk, except half cream powdered milk. For higher rating of this attribute (indicating lower risk), there was a significant increase in the rating on prices of raw, pasteurized and full cream powdered milk. Perception on shelf life and handling convenience were also found to contribute significantly to prices of pasteurized and full cream powdered milk.

The coefficient of the city dummy variable was significant for raw, pasteurized and full cream powdered milk implying that respondents of Dhaka were willing to pay higher prices for these products compared to those in Mymensingh. Among other socioeconomic variables, only age of the household head had a significant negative effect on rating on the price of half cream powdered milk implying that older household heads had lower preference for this product. The coefficient of grocery shop as a source of purchase of half cream powdered milk was negative and significant implying that higher rating of this source led to a lower rating on price. Prevalence of adulterated products in the market and a generally-held perception that products sold at grocery shops were not always trustworthy might partly explain this result.

4.3 Results of hedonic price analysis of different types of meat

The results for beef and mutton are presented in Table 16. The estimated models were found to be statistically significant judged by R^2 and F-values.

Rating for price of beef significantly increased along with higher ratings for local breed animal, mature bull as the animal type, natural feeding system, medium fat content of the carcass, boneless cut, and whitish colour of meat (indicating meat from younger animals or veal meat). On the other hand, rating for price significantly declined along with increased rating for cow as the animal type, red colour of the meat (an indication of meat from older animals), old/dry as well as water added as the appearance of meat, and age of the household head. Respondents in Dhaka city were willing to pay a significantly higher price for beef than those in Mymensingh.

Rating for mutton price significantly increased along with higher ratings for high fat content in carcass, front leg and thigh as cuts, fresh/presence of blood as appearance of meat, and significantly decreased along with higher rating for neck/hump/buttock as a cut. As for beef, respondents in Dhaka city were willing to pay a significantly higher price for mutton than those in Mymensingh.

The model for live chicken displayed a poor fit, with almost no factors having significant coefficient except breed—a higher rating for local breed led to higher rating of price. The results for the chicken meat function are shown in Table 17. Rating for price of chicken meat significantly increased along with higher ratings for cross/exotic chicken, male chicken, leg as cut, frozen chicken as form and older age of household. Rating for price significantly decreased as rating increased for cock or hen as bird type, breast and other parts as cuts, and as the size of the family increased.

Table 16. *Estimated coefficients of hedonic price models of beef and mutton*

Quality and safety indicators	Beef		Goat meat	
	Coefficient	Std. error	Coefficient	Std. error
(Constant)	1.356	1.088	2.467	1.823
Local breed	0.122*	0.065	–	–
Indian breed	0.021	0.059	–	–
Crossbreed	–0.015	0.059	–	–
Heifer	0.047	0.046	–	–
Young bull	–0.019	0.050	–	–
Mature bull	0.129**	0.047	–	–
Bullock	0.112	0.060	–	–
Cow	–0.107*	0.049	–	–
He-goat	–	–	0.098	0.088
She-goat	–	–	0.092	0.071
Natural/traditional feeding	0.109*	0.049	–0.043	0.103
Artificial feeding/fattening	0.071	0.041	–0.009	0.062
Fat content—Low	0.010	0.038	0.072	0.057
Fat content—Medium	0.130**	0.045	–0.046	0.066
Fat content—High	–	–	0.122*	0.060
Cut—Front leg	0.183	0.129	0.147*	0.077
Cut—Thigh	0.065	0.129	0.166**	0.078
Cut—Chest/ribs	–0.057	0.154	–0.047	0.060
Cut—Neck, hump, buttock	0.158	0.117	–0.187**	0.075
Cut—Boneless	0.454**	0.154	0.080	0.070
Cut—Liver, kidney, stomach	0.473**	0.160	0.052	0.069
Colour—Red	–0.239*	0.133	–	–
Colour—Grayish	–0.011	0.134	–	–
Colour—Whitish	0.343*	0.174	0.058	0.055
Appearance—Fresh/presence of blood	0.341	0.520	0.168*	0.099
Appearance—Old/dry	–0.088*	0.049	0.011	0.074
Appearance—Water added	–0.175**	0.138	–0.031	0.066
Display location—Hygienic	0.181	0.168	–0.034	0.070
Age of household's head	–0.369*	0.201	–0.146	0.302
Education of household's head	0.013	0.023	0.001	0.044
Family size	–0.005	0.240	–0.288	0.365
City dummy (Dhaka = 1)	1.890**	0.276	1.839**	0.721
Food expenditure	–0.158	0.509	0.208	0.208
R^2	0.67	–	0.32	–
F-value	7.15**	–	3.18**	–
N	900		900	

Source: Field survey.

Table 17. *Estimated coefficients of hedonic price model for chicken meat*

Quality and safety indicators	Coefficients	Std. error
(Constant)	−6.961	5.720
Local chicken	−0.095	0.171
Exotic/cross chicken	0.434**	0.173
Sex—Male	0.426*	0.239
Sex—Female	0.098	0.156
Chicken type—Young	−0.439	0.328
Chicken type—Cock	−0.515**	0.183
Chicken type—Hen	−0.503**	0.212
Chicken production system—Natural feed/ traditional feed	0.251	0.311
Chicken production system—Fatten/broiler	−0.147	0.293
Chicken cut—Legs	1.499**	0.337
Chicken cut—Breast	−0.789**	0.378
Chicken cut—Other	−0.848**	0.200
Chicken appearance—Live/freshness	0.027	0.287
Chicken appearance—Frozen	0.474**	0.188
Local chicken market source	0.319	0.920
Broiler market source	1.845	1.116
Dressed broiler market source	−1.138	1.974
Food expenditure	0.158	0.465
Age of HH	3.625**	1.278
Education of HH	0.004	0.060
Family size	−2.196*	1.008
Dummy for Dhaka city	3.236	3.254
R^2	0.86	–
F-value	3.54**	–
N	900	

Source: Field survey.

5 Recent household purchases and consumption of livestock products

5.1 Dairy products

5.1.1 Time of recent purchases of products

Respondents were asked to report the time and the source of their most recent purchase of each dairy product. It appears that 76% of the sample households recently purchased pasteurized milk while only 25% purchased raw fresh milk (Table 18). Also 70–90% of the households purchased full cream powder milk, yoghurt, ice-cream and sweets but few purchased other products. Among the purchasers of raw fresh and pasteurized milk and ice-cream about 50% each bought during the week before the survey, and about two-thirds of the households did so within the month before the survey. For most of the other products, most recent purchase occurred longer than one or two weeks earlier. It should be noted that those who purchased during the week before the survey or during any other week did not always do so daily, so the proportion of households purchasing on a particular day was fairly small, which is consistent with figures shown earlier that a small proportion of households consumed milk regularly though a significant proportion did so irregularly. Moreover, liquid milk and some other products are consumed on the day of purchase or within a short period while for products like powder milk and ghee consumption may be spread over a longer period. A small proportion of households purchased cheese and cream because production and consumption of processed cheese and cream is not common in Bangladesh. Dairy processors like Milk Vita produced a small quantity of processed cheese. Mostly unbranded salty cheese produced by smallholder producers was available in the market. Very small quantities of imported cheese were available in supermarkets and special grocery shops.

5.1.2 Brands of products purchased

Based on recent purchase it was found that in case of pasteurized milk, 83% of the purchasing households bought Milk Vita brand, 11% bought Aarong of BRAC dairy and 6% bought Pran. This pattern was similar across the two cities. Actual countrywide market share of these brands was slightly different with Aarong's share being slightly larger and that of Milk Vita's slightly smaller than the sample results. NPP fresh milk was sold only by Aftab dairy. Only one brand of UHT milk (Pran) was available in the market and it was found that 36% of households of Dhaka and 14% of Mymensingh purchased it recently.

In case of powdered milk, various brands of full cream and half cream milk were sold in the market but Dano, Nido and Diploma were the most popular brands with some differences

in the order of preference in the two cities (Table 19). The important brands of ice-cream purchased by the households were Milk Vita, Quality, Igloo, and Polar (Table 20).

Table 18. *Distribution of respondent households according to time of most recent purchase of different dairy products*

Milk and its product	% of sample hh purchased	% of purchaser households by date of most recent purchase						
		Last week	Last 8–15 days	Last 16–21 days	Last 22–30 days	Total (1–30 days)	Last 31–60 days	Beyond last 60 days
Raw fresh milk	25.7	48.6	16.7	3.3	2.3	65.9	6.9	27.2
Pasteurized milk	76.1	46.4	14.3	2.9	2.7	66.3	8.0	25.7
NPP fresh milk	11.3	7.0	3.1	1.9	0.6	12.6	2.1	85.3
UHT milk	25.1	10.4	7.0	2.2	0.8	20.4	4.9	74.7
Fermented milk	21.2	9.8	3.6	2.9	2.8	19.1	2.8	78.1
Skimmed milk	2.8	4.4	0.4	0	0.2	5.0	1.7	93.3
Milk powder full cream	70.1	17.7	24.0	10.2	11.4	63.3	5.8	30.9
Milk powder half cream	11.6	5.7	3.1	1.2	2.1	12.1	1.4	84.5
Condensed milk	33.8	14.3	6.6	5.1	2.2	28.2	4.6	67.2
Yoghurt	86.2	27.3	29.9	10.0	5.0	72.2	11.3	16.5
Cheese	3.7	4.3	0.7	1.6	0.4	7.0	0.4	92.6
Butter/ghee	56.7	7.9	7.9	16.4	8.6	40.8	10.6	48.6
Cream	2.3	4.8	0	0.7	0.1	5.6	0.7	93.7
Ice-cream	81.4	54.4	14.0	7.2	1.6	77.2	4.2	18.6
Milk sweets	91.1	32.7	24.3	20.9	4.9	82.8	6.3	10.9

Source: Field survey.

Various brands of condensed milk were available in the market. Among these brands Starship, Danish and Goalini appeared to be first, second and third most popular brands among the sample consumers (Table 21). However, order of preferences for different brands differed between the two cities.

For yoghurt, butter, sweets, ghee and cream, defining brand was somewhat difficult because sellers of these products could be categorized into: (a) single outlet shops serving largely local people (in Mymensingh these are common); (b) enterprises with chain stores or multiple branches in different parts of the city (more common in Dhaka); and (c) small shops or traders, some of them tea shops or restaurants without any brand name or recognition in a wider market. Therefore information on brand name was not collected for these products, however, information on brand vs. no-brand could be collected.

Table 19. *Proportion of households purchasing different brands of powdered milk by cities*

Brand name	Mymensingh		Dhaka		Total	
	Full cream	Half cream	Full cream	Half cream	Full cream	Half cream
Dano	41	24	43	27	42	26
Nido	4	26	10	29	7	28
Diploma	26	17	18	4	21	9
Red cow	15	7	12	13	13	11
Lactogen	0	11	1	9	1	10
Goalini	1	0	0	0	1	0
Pran	0	0	2	3	1	2
Milk Vita	1	0	1	4	1	3
Anchor	3	2	3	1	3	1
Fresh	4	2	3	5	3	4
Starship	3	0	2	1	2	1
Myboy	0	0	1	2	1	1
Quality	1	2	3	0	2	1
Danish	2	9	1	0	1	4
No name	1	0	1	1	1	1
All	100	100	100	100	100	100

Source: Field survey.

Table 20. *Proportion of households purchasing different brands of ice-cream in different cities*

Brand name	Mymensingh	Dhaka	Total
Quality	27	47	38
Milk Vita	13	15	14
Igloo	14	12	13
Polour	13	12	13
Chockber	20	6	12
Pran	0	3	2
Aarong	0	5	3
Mina	13	0	5

Source: Field survey.

Table 21. *Proportion of households purchasing different brands of condensed milk by city*

Brand name	Mymensingh	Dhaka	All cities
Danish	46	27	34
Starship	33	36	35
Goalini	20	24	22
Quality	1	10	6
Silver cross	0	4	2

Source: Field survey.

5.1.3 Sources of recent purchases

Respondents were asked to mention the source of their most recent purchases of various dairy products and the reasons for choosing that source. In theory, every time a product is purchased, a household may choose a different source if there is an opportunity to do so. However, since respondents were asked to report source for only the most recent purchase, only one source was reported. For raw fresh milk, home delivery by producer and trader/vendor were the most important sources of most recent purchase in both the cities but home delivery was more important in Mymensingh than in Dhaka (Tables 22 and 23). Supply of fresh milk from the peri-urban areas of Mymensingh was still a common phenomenon while it has become a less common practice in the large Dhaka city. Grocery shops and supermarkets were important sources of purchase of pasteurized milk, UHT milk, powder milk, yoghurt, butter/ghee and ice-cream in both the cities though it was observed during the PRA that the supermarkets in Mymensingh were not really supermarkets proper rather they were better organized grocery shops. Other products were purchased from a variety of traditional sources.

Table 22. *Sources of purchase of dairy products in Mymensingh city (% purchasing households)*

Product consumed	Home delivery by producer	Home delivery by trader/vendor	Local market	Street vendor	Grocery shop	Super-market	Dairy/ sweet shop	All
Raw fresh milk	72	18	6	1	0	0	2	100
Pasteurized milk	1	0	10	6	76	7	0	100
NPP fresh milk	0	0	18	0	77	0	0	100
UHT milk	0	0	5	0	91	5	0	100
Fermented milk	67	17	12	0	5	0	0	100
Skimmed milk	0	0	0	0	0	0	0	100
Milk powder full cream	1	1	26	0	44	28	1	100
Milk powder half cream	0	0	8	2	72	19	0	100
Condensed milk	0	0	19	1	74	4	2	100
Yoghurt	11	4	7	1	6	10	62	100
Cheese/paneer	0	0	0	0	0	1	99	100
Butter/ghee	7	4	12	0	18	8	11	100
Cream	–	–	0	0	0	1	0	100
Ice-cream	2	15	2	8	34	10	1	100
Sweets	1	0	6	1	3	12	67	100

Source: Field survey.

Known seller or shop, and proximity to home, were the most common stated reasons for choosing the purchase outlet in both the cities: especially for raw milk, sweets and yoghurt (Table 24). Some households also reported low price as a reason for choice.

Table 23. *Sources of purchase of dairy products in Mymensingh city (% purchasing households)*

Product consumed	Home delivery by producer	Home delivery by trader/vendor	Local market	Street vendor	Grocery shop	Super-market	Dairy/ sweet shop	All
Raw fresh milk	64	26	8	1	1	0	0	100
Pasteurized milk	6	11	31	1	47	1	3	100
NPP fresh milk	34	35	16	0	10	4	1	100
UHT milk	5	5	37	3	41	3	5	100
Fermented milk	5	6	15	61	4	10	0	100
Skimmed milk	0	4	50	6	22	15	4	100
Milk powder full cream	2	1	36	1	42	16	2	100
Milk powder half cream	2	0	37	1	43	17	1	100
Tinned condensed milk	2	2	33	1	49	13	1	100
Yoghurt	4	1	39	5	2	8	41	100
Cheese/paneer	4	0	23	0	13	0	60	100
Butter/ghee	14	2	36	1	21	4	22	100
Cream	0	0	30	6	9	15	39	100
Ice-cream	3	3	32	17	12	7	26	100
Sweets	1	1	35	1	2	9	51	100

Source: Field survey.

Table 24. *Proportion of households giving reason for choosing specific sources for purchase of dairy products in the two cities*

Product consumed	Mymensingh			Dhaka			All cities		
	Known seller	Low price	Near home	Known seller	Low price	Near home	Known seller	Low price	Near home
Raw fresh milk	66	4	30	74	3	22	72	4	25
Pasteurized milk	10	3	87	20	10	70	18	8	74
NPP fresh milk	0	0	100	35	17	47	34	16	49
UHT milk	7	0	93	31	10	59	27	8	64
Fermented milk	0	34	66	22	28	51	21	28	51
Skimmed milk	12	0	88	24	6	69	20	4	75
Milk powder full cream	23	2	76	23	8	68	23	6	71
Milk powder half cream	44	2	54	21	8	72	26	6	67
Tinned condensed milk	15	0	85	21	11	68	20	9	72
Yoghurt	72	1	27	34	11	55	46	8	47
Cheese	100	0	0	62	4	35	67	3	31
Butter/ghee	2	0	2	38	3	59	40	3	57
Cream	0	0	100	46	21	36	37	15	44
Ice-cream	16	9	75	32	8	60	28	8	64
Sweets	68	3	28	33	7	60	45	6	50

Source: Field survey.

Forty-one percent of the buyers of raw fresh milk in Mymensingh paid in cash and 59% paid in arrears weekly, fortnightly or monthly. The corresponding figures for Dhaka were 60 and 40%. Credit purchase is a common practice in case of home delivery by producers or vendors. In case of all other products, cash purchase was the norm though in a small number of cases (1–6% for different products in Mymensingh and 3–15% in Dhaka) credit purchase was reported. Most probably such purchases were made from local grocery shops or corner stores nearby who normally allowed a small credit to known buyers.

5.1.4 Perceived quality of recently purchased products

Respondents were asked to report if they used one or more of the following criteria for judging the quality of the products purchased: freshness; purity; good flavour or smell; good taste; high fat content; low fat content. Taste might be used as a criterion in current purchase based on past experience, and other quality criteria like freshness, purity and fat content might be used as quality criteria in current purchase partly on the basis of verification at the time of purchase, or on the basis of experience if the seller or the source was trusted. High and low fat contents are treated as separate attributes here as there may be differences in fat content between products of the same type. Responses showed that the sample households used one or more of these quality criteria for each product. Freshness, purity, flavour and fat contents were the most commonly and frequently used criteria in judging quality, but the frequency of use of a particular criterion differed across the products and also between the two cities (Tables 25 and 26).

Table 25. *Proportion of households according to criteria used for judging quality of dairy products by households in Dhaka city*

Product consumed	Freshness	Purity	Good flavour	Good taste	High fat content	Low fat content
Raw fresh milk	88.0	34.0	8.0	87.0	2.0	2.0
Pasteurized milk	16.3	22.0	6.4	52.0	3.3	0.0
NPP fresh milk	41.0	9.4	8.3	27.0	10.0	4.3
UHT milk	11.0	8.0	12.0	52.0	7.0	10.0
Fermented milk	6.0	9.0	5.0	74.0	1.0	5.0
Skimmed milk	6.4	0.0	6.3	62.0	15.0	10.3
Milk powder full cream	9.4	8.0	4.2	64.0	11.0	3.4
Milk powder half cream	7.0	5.4	6.0	60.3	5.3	16.0
Yoghurt	12.0	8.0	6.4	70.0	1.4	2.2
Cheese/paneer	23.3	35.0	10.0	25.3	6.4	0.0
Butter/ghee	12.0	11.1	8.4	61.2	7.3	0.0
Cream	9.2	9.3	10.0	55.2	10.0	6.3
Ice-cream	10.0	4.0	7.0	77.0	1.0	1.0
Sweets	14.0	4.5	6.5	73.0	1.0	1.0

Source: Field survey.

Table 26. *Proportion of households according to criteria used for judging quality of dairy products by households in Mymensingh city*

Product consumed	Freshness	Purity	Good flavour	Good taste	High fat content	Low fat content
Raw fresh milk	25.0	14.0	1.4	55.1	1.3	3.2
Pasteurized milk	5.0	4.0	2.0	82.0	6.0	1.0
NPP fresh milk	5.0	4.0	2.0	82.0	6.0	1.0
UHT milk	5.0	4.0	2.0	82.0	6.0	1.0
Fermented milk	5.0	4.0	2.0	82.0	6.0	1.0
Skimmed milk	5.0	4.0	2.0	82.0	6.0	1.0
Milk powder full cream	1.0	4.0	16.0	77.0	1.0	1.0
Milk powder half cream	4.3	16.2	16.0	61.3	0.2	2.0
Tinned condensed milk	0.0	1.3	1.2	96.2	1.3	0.0
Yoghurt	5.2	2.3	2.4	90.1	0.0	0.0
Cheese	23.0	0.0	0.0	54.0	23.0	0.0
Butter/ghee	2.0	10.6	27.4	51.0	8.0	1.0
Cream	0.0	0.0	0.0	100.0	0.0	0.0
Ice-cream	2.0	1.0	2.0	95.0	0.0	0.0
Sweets	4.1	1.4	2.3	92.2	0.0	0.0

Source: Field survey.

For example, freshness, good taste and purity were considered important for judging quality of raw fresh milk by a much larger proportion of households in Dhaka than in Mymensingh. For pasteurized milk, a much larger proportion used good taste as a criteria of quality in Mymensingh than in Dhaka. Overall, good taste was the most widely used quality criterion for most products in both the cities.

Respondents who purchased a variety of dairy products recently were asked to rate their degree of satisfaction with the quality of their purchased products. Responses were classified into three satisfaction levels—high, medium and low. Not satisfied at all was not put as an option, as during the pretest of the questionnaire it appeared that a decision to purchase would not be made if the purchaser was totally dissatisfied with the quality based on the criteria in his/her mind. It appears that the majority of purchasers for most of the products were highly satisfied, good proportions were moderately satisfied while a small proportion were just satisfied (Table 27).

5.1.5 Quantity, price and total value of consumption

Respondent households were asked to give actual or estimated consumption of various milk and milk products at home and, separately, away from home during the 30 days prior to the survey (i.e. during April–May 2006). Estimated per capita consumption at home and unit prices paid are summarized in Table 28. Per capita per month consumption of all milk and milk products averaged 5.3 kg liquid milk equivalent (LME) in Mymensingh and 9.5 kg in Dhaka. In Mymensingh, most of the consumption volume was in the form of raw fresh

milk and a small amount of pasteurized milk. In Dhaka most of the consumption also was in the form of liquid milk, of which pasteurized milk had a larger share than was the case in Mymensingh. The level of consumption of all the other milk products was also higher in Dhaka.

Table 27. *Proportion of households according to the level of satisfaction with the quality of the purchases of various dairy products in the two cities*

Product purchased	Mymensingh			Dhaka			All		
	H	M	L	H	M	L	H	M	L
Raw fresh milk	59	32	9	54	22	24	56.6	25.5	17.9
Pasteurized milk	44	39	17	35	39	26	37	39	24
Packed fresh milk	59	41	0	50	25	25	50.4	25.3	24.3
UHT milk	33	48	19	30	44	26	30	45	25
Fermented milk	6	55.4	38.6	28	50	22	25	52	23
Skimmed milk	23	77	0	17	57	26	19.4	58.3	22.3
Milk powder full cream	67.5	25.5	7	41	35	24	48	33	19
Milk powder half cream	88	11	2	40	45	15	51	37	12
Tinned condensed milk	25	62	13	37.3	39.4	23.3	35	44	21
Yoghurt	76	15	9	43	33	24	53	28	19
Cheese/paneer	77	23	0	13.7	47.6	38.7	21	46	33
Butter/ghee	63	24	13	47	22	31	51	23	26
Cream	23	23	54	53	33	14	45	33	22
Ice-cream	87	9	4	45	34	21	57	27	16
Sweets	67	24	9	42.6	32.5	24.9	50	30	20

H = High, M = Medium, L = Low.

Unit prices of raw fresh milk, yoghurt, ice-cream, lassi and ghee were found to be lower in Mymensingh city than in Dhaka city. The probable reason could be that nearly all these items except a portion of ice-cream were locally produced in surrounding areas of Mymensingh so were less costly to produce and market. On the other hand, pasteurized milk, skimmed milk, powdered milk, cheese, butter and chocolate milk were processed in and around Metropolitan Dhaka and were relatively cheaper there than in Mymensingh.

Total values of milk and milk products consumed at home per capita per month by households in Dhaka and Mymensingh averaged BDT 884 and 538 respectively (Table 29). An additional BDT 79 and 30 respectively was spent on consumption of dairy products away from home. In Mymensingh, most of the consumption away from home was in the form of ice-cream while in Dhaka about 40% of the expenditure was in the form of ice-cream and about half was in the form of sweets, lassi and chocolate milk. This difference between the two cities in the level and pattern of consumption away from home was most likely associated with differences in the average level of income and associated food habit or life style.

Table 28. *Milk and milk products consumed at home by the households in last 30 days*

Product consumed	Average quantity consumed per capita (kg LME)			Price (BDT per kg actual product)		
	Mymensingh	Dhaka	All	Mymensingh	Dhaka	All
Raw fresh milk	4.0	3.3	3.6	23.30	27.60	26.00
Pasteurized milk	1.8	2.6	2.4	41.60	31.70	33.40
UHT milk	0.1	0.7	0.7	33.30	41.50	41.20
Fermented milk	0.1	0.7	0.7	11.80	19.30	19.00
Skimmed milk	0.4	0.6	0.5	80.10	60.00	76.10
Milk powder full cream	0.2	0.3	0.2	348.40	356.60	354.40
Milk powder half cream	0.2	0.3	0.3	504.00	342.10	371.90
Tinned condensed milk	0.1	0.2	0.2	30.20	36.50	35.80
Yoghurt	0.5	0.8	0.7	80.30	100.60	95.40
Cheese	0.0	0.2	0.2	250.00	246.00	246.40
Butter	0.01	0.1	0.1	280.00	337.00	334.20
Ghee	0.1	0.1	0.1	339.7	375.60	370.80
Cream	0.0	0.1	0.1	na	304.00	304.00
Ice-cream (milk based)	0.2	0.6	0.5	85.3	96.30	92.60
Sweets (milk based)	0.5	0.7	0.7	96.5	120.30	113.30
Chocolate milk	0.1	0.4	0.4	73.0	64.40	64.90
Lassi	0.2	0.5	0.5	52.2	55.00	54.60
Total liquid milk equivalent	5.3	9.5	8.1			

Source: Field survey.

Liquid milk and half cream powdered milk was most commonly consumed as a drink and to some extent mixing with other food items and mixing with tea/coffee/hot drink (Table 30). On the other hand, full cream powdered milk was less frequently used for drinking.

Table 29. *Total value of consumption of milk and milk products at home and away from home by the households in the last 30 days*

Product consumed	Total value of consumption at home (BDT/capita per month)			Total value of consumption outside home (BDT/capita per month)		
	Mymensingh	Dhaka	All	Mymensingh	Dhaka	All
Raw fresh milk	93.70	91.50	93.00	0.0	0.0	0.0
Pasteurized milk	76.50	81.60	81.70	0.0	0.60	0.40
UHT milk	4.90	29.40	28.10	0.0	0.50	0.30
Fermented milk	1.50	13.10	12.40	0.0	1.40	1.00
Skimmed milk	34.50	37.50	36.10	0.0	0.0	0.0
Milk powder full cream	63.80	97.70	88.50	0.0	0.20	0.10
Milk powder half cream	88.20	97.70	97.80	0.0	0.0	0.0
Tinned condensed milk	4.00	6.70	6.30	0.0	0.0	0.0
Yoghurt	42.30	75.60	66.20	0.50	3.00	2.20
Cheese	9.30	52.30	44.10	0.0	0.20	0.10
Butter	6.80	35.70	32.80	0.0	0.0	0.0
Ghee	22.70	48.70	44.80	0.0	2.20	1.40
Cream		23.00	18.70	0.30	1.20	0.90
Ice-cream (milk based)	19.30	55.50	44.20	26.50	29.90	28.70
Sweets (milk based)	50.50	84.70	73.60	0.50	13.60	9.20
Chocolate milk	10.90	25.90	25.10	0.70	10.50	7.20
Lassi	9.10	27.60	24.90	1.90	15.30	10.80
All items	538.00	884.00	818.30	30.30	79.10	62.70

Source: Field survey.

Table 30. *Proportion of households according to form of consuming different dairy products in Dhaka and Mymensingh cities*

Milk and milk products	Drinking/eating directly	Mixed with other food items	Mixed with non-dairy item (tea, coffee)
Raw fresh milk	70	19	11
Pasteurized milk	66	21	13
UHT milk	84	7	9
Milk powder full cream	45	29	26
Milk powder half cream	81	11	8
Tinned condensed milk	6	9	85
Yoghurt	86	11	3
Cheese	60	25	15

Source: Field survey.

5.2 Meat and eggs

5.2.1 Sources of recent purchases

Local wet market and retail or grocery shops were the most common sources of purchase of most meat and eggs (Table 31). Supermarkets were used by very few households. As mentioned earlier, Mymensingh features well-organized grocery shops which are well patronized.

The overwhelming majority of households in both cities—more in Mymensingh than in Dhaka—mentioned proximity to home as the main reason for choice of outlet for purchase (Table 32). Lower price and familiarity with the seller (perhaps involving trust) were also reasons for choice of outlet for a good proportion of the households in Dhaka, and for a smaller proportion in Mymensingh.

5.2.2 Quality criteria for recent purchases

Most respondents reported that they judged the quality of meat at the time of purchase primarily on the basis of freshness (assessed by various indicators such as smell or flavour in case of meat) as there were few other verifiable indicators of quality. Earlier, in response to questions on preferences for types of meat based on several quality criteria, households indicated preferences by rating those criteria. But it appears that under the prevailing marketing practices where there was no product grading, standardization or labelling of meat and eggs, observed freshness was the only criterion used by most households at the time of purchase.

Asked about the extent of satisfaction on a scale of three levels—high, medium and low—about the quality of their recent purchases of various meats and eggs, majority were highly satisfied with respect to most products, a good proportion were medium satisfied and a few reported low level of satisfaction (Table 33). The degree of satisfaction was less in the case of beef from Indian cattle, sheep meat and local chicken (village chicken reared under (semi) scavenging conditions).

Table 31. *Proportion of purchasing households according to sources of recent purchase of meat and eggs in Mymensingh and Dhaka cities*

Product type	Home delivery by producer			Home delivery by trader/vendor			Local market			Street vender			Retail/grocery shop			Supermarket		
	Mymen-singh	Dhaka	All	Mymen-singh	Dhaka	All	Mymen-singh	Dhaka	All	Mymen-singh	Dhaka	All	Mymen-singh	Dhaka	All	Mymen-singh	Dhaka	All
Farm hen egg	6	13	11	5	3	4	58	39	45	5	2	3	21	42	36	4	1	2
Local hen egg	13	8	10	4	14	11	57	28	38	5	2	3	15	45	35	2	2	2
Duck egg	12	20	17	3	13	9	54	31	39	8	3	5	22	30	27	1	3	2
Local beef	3	2	2	1	1	1	88	90	89	0	1	1	0	2	1	6	4	5
Indian beef	0	0	1	2	2	6	86	13	61	0	1	2	0	0	1	13	8	10
Goat meat	2	1	1	0	0	0	87	88	87	7	2	3	0	2	2	5	7	6
Sheep meat	0	29	11	0	0	0	54	71	67	0	0	0	0	0	0	23	0	11
Local chicken	5	2	3	2	1	1	88	87	87	1	2	2	0	1	1	3	7	6
Live broiler	2	0	1	3	2	2	91	84	86	0	1	1	0	1	0	3	12	10
Dressed broiler	0	0	0	0	0	0	77	95	94	0	3	2	0	1	1	18	2	2
Frozen broiler	0	0	8	0	0	0	100	0	92	0	0	0	0	0	0	0	0	0
Live duck	13	6	10	3	6	4	78	74	76	0	6	3	0	2	1	0	6	3

Source: Field survey.

Table 32. *Proportion of households according to reason for choosing specific outlets for recent purchase of meat and eggs in the two cities*

Product purchased	Known seller			Lower price			Near home		
	Mymen-singh	Dhaka	All	Mymen-singh	Dhaka	All	Mymen-singh	Dhaka	All
Farm hen egg	4	26	19	4	4	4	92	70	77
Local hen egg	6	14	11	2	13	10	93	73	79
Duck egg	5	24	17	1	8	6	94	68	77
Local beef	10	22	19	7	10	9	83	68	72
Indian beef	10	48	38	5	17	14	85	36	48
Goat meat	9	16	13	1	5	4	90	79	83
Sheep meat	0	29	10	18	29	20	77	43	70
Local chicken	7	25	19	7	6	6	87	69	74
Local broiler	4	23	17	4	9	7	92	68	76
Dressed broiler	0	9	9	0	6	6	100	85	86
Frozen broiler	0	100	8	0	0	0	100	0	92
Duck	8	22	15	13	10	11	79	68	74

Source: Field survey.

Table 33. *Proportion of households according to level of satisfaction with the quality of recently purchased meat and eggs in different cities*

	Dhaka			Mymensingh			All		
	H	M	L	H	M	L	H	M	L
Farm hen egg	41	38	21	71	23	6	51	34	16
Local hen egg	45	34	21	92	4	4	61	24	15
Duck egg	43	38	20	72	23	4	54	32	14
Local beef	41	29	30	82	10	8	52	24	24
Indian beef	44	45	11	64	33	2	48	43	9
Goat	51	25	24	69	27	4	57	26	18
Sheep	43	43	0	23	77	0	33	67	0
Local chicken	50	26	24	97	1	2	65	18	17
Local broiler	27	55	18	67	25	9	40	45	15
Dressed broiler	16	47	37	100	0	0	19	45	35
Frozen broiler	100	0	0	83	19	0	85	15	0
Duck	52	30	18	59	34	7	56	32	12

H = high, M = medium, L = low.

5.2.3 Value of consumption

Respondents were asked to report actual or estimated quantities of consumption of different types of meat and eggs at home and outside home during 30 days prior to the survey in May–June 2006. While some items were purchased by weight, some (live chickens, other

birds, eggs) were purchased by number. Thus, only the value of consumption is reported for all products (Table 34). Households in Mymensingh spent more on local egg and duck egg than did those in Metropolitan Dhaka. On the other hand, the households in Metropolitan Dhaka spent more on farm eggs. Total expenditure on meat in Dhaka was 42% higher than that in Mymensingh. Households in Dhaka spent more on beef and on chicken than those in Mymensingh. Per capita expenditure on mutton/lamb consumption in the two cities was similar.

Table 34. *Value of consumption at home and outside home on meat and eggs in the 30 days prior to the survey (BDT/caput per month) by the sample households in Mymensingh and Dhaka*

Products	Mymensingh	Dhaka	All
Farm egg	40.36	59.55	53.11
Local egg	25.75	22.48	23.58
Duck egg	21.47	19.93	20.45
Total egg	87.58	101.96	97.14
Beef of local cattle breed	84.26	137.66	119.75
Beef of exotic breed or Indian cattle	26.84	40.73	36.07
Total beef	111.11	178.39	155.81
Mutton (chevon)	47.99	50.67	49.77
Sheep meat (mutton)	22.31	23.74	23.26
Total mutton/lamb	70.30	74.41	73.03
Local chicken	86.59	137.97	120.77
Live broiler	62.21	69.52	67.07
Dressed broiler	22.89	32.98	29.60
Frozen broiler	23.63	23.22	23.36
Total chicken	195.59	263.70	240.89
Duck meat	22.70	24.58	23.95
Other	49.06	81.95	70.91
Total meat	403.05	574.23	516.92
Total meat and eggs	490.63	676.19	614.06

Source: Field survey.

6 Elasticity of demand for livestock products

6.1 Total household expenditure on food and non-food items

In order to put the demand (expenditure) for animal products within the context of overall household budget or expenditure, respondents were asked to report actual or estimated expenditure on all food and non-food items during the 30 days prior to the survey. Food expenditure accounted for 56% of overall household expenditure for the entire sample (Table 35). For low, medium and high income household groups, share of food expenditure in total household expenditure was respectively 58%, 49% and 39% (Table 36). The sample average can be compared with the national household expenditure survey which found that food expenditure accounted for 53.8% of total consumption expenditure nationally and 45.2% in urban areas (BBS 2007, 36). However, the 2005 survey by BBS found that meat and eggs and milk/milk products respectively accounted for 10.6% and 4.4% of total food expenditure in urban areas, while our survey arrived at the corresponding figures of 22.3 and 32.0% (Table 35). There could be three reasons for such divergence from the BBS survey. First, in the current survey, very detailed data on livestock products were collected. For example, milk and milk products included all types of liquid and powdered milk, sweets, yoghurt, ghee, ice-cream etc., and both consumption at home and away from home were included. The BBS survey did not go into such details, so numerous items might not have been included or reported under 'milk and milk products'. Second, our survey covered only Dhaka and Mymensingh, the capital and an additional advanced city: so the sample had some bias towards higher income households. Lastly, the survey data was for a specific month rather than a full year, so there was the possibility of some deviation from the national level average.

Another feature of the current survey was that the share of expenditure on animal products within food expenditure increased as income level increased, but the share of expenditure on animal products in the overall household expenditure declined. However, higher income households still spent higher absolute amounts on animal products compared to lower income groups. We will see later the implications for these expenditure patterns on the estimated characteristics of demand.

Table 35. *Estimated per capita per month expenditure on food and non-food items in the two cities*

Item	Mymensingh			Dhaka			All		
	Mean expenditure	% of total food expenditure	% of total expenditure	Mean expenditure	% of total food expenditure	% of total expenditure	Mean expenditure	% of total food expenditure	% of total expenditure
Cereals	341.00	15.3	8.8	258.20	8.8	4.8	285.90	10.4	5.8
Pulses	48.10	2.2	1.2	51.40	1.7	1.0	50.30	1.8	1.0
Vegetables	113.60	5.1	2.9	137.60	4.7	2.6	129.50	4.7	2.6
Fruits	72.00	3.2	1.9	136.60	4.6	2.5	114.90	4.2	2.3
Edible oils	60.60	2.7	1.6	70.70	2.4	1.3	67.30	2.4	1.4
Spices	52.40	2.4	1.4	88.10	3	1.6	76.10	2.8	1.5
Sugar	44.40	2	1.1	51.10	1.7	1.0	48.90	1.8	1.0
Tea	14.80	0.7	0.4	17.40	0.6	0.3	16.50	0.6	0.3
Other foods	89.90	4.0	2.3	137.30	4.7	2.6	121.40	4.4	2.5
Total non-livestock foods	836.80	37.6	21.7	948.40	32.3	17.6	910.80	33.1	18.5
Dairy items	568.30	25.5	14.7	963.10	32.8	17.9	881.00	32.0	17.9
Egg	87.58	3.9	2.3	101.96	3.5	1.9	97.14	3.5	2.0
Meat	403.05	18.1	10.4	574.23	19.5	10.7	516.92	18.8	10.5
Fish	329.60	14.8	8.5	351.50	12	6.5	344.10	12.5	7.0
Total animal products	1388.53	62.4	36.0	1990.79	67.7	37.0	1839.16	66.9	37.5
Total foods	2225.33	100	57.6	2939.19	100	54.7	2749.96	100	56.0
Total non-food expenditure	1636.80	–	42.4	2436.69	–	45.3	2160.49	–	44.0
Total expenditure	3862.13	–	100.0	5375.88	–	100.0	4910.45	–	100.0

– Not applicable.
Source: Field survey.

Table 36. *Estimated per capita per month expenditure (BDT) on food and non-food items by income groups*

	Low income			Medium income			High income			All households		
	Mean expenditure	% of total food expenditure	% of total expenditure	Mean expenditure	% of total food expenditure	% of total expenditure	Mean expenditure	% of total food expenditure	% of total expenditure	Mean expenditure	% of total food expenditure	% of total expenditure
Cereals	244.58	19.2	10.9	247.70	13.0	6.4	267.44	10.1	4.0	285.90	10.4	5.8
Pulses	37.25	2.9	1.7	45.92	2.4	1.2	55.46	2.1	0.8	50.30	1.8	1.0
Vegetables	65.97	5.2	2.9	96.08	5.0	2.5	108.47	4.1	1.6	129.50	4.7	2.6
Fruits	49.6	3.9	2.2	122.92	6.4	3.2	180.34	6.8	2.7	114.90	4.2	2.3
Edible oils	50.69	4.0	2.3	67.06	3.5	1.7	84.09	3.2	1.2	67.30	2.4	1.4
Spices	50.70	4.0	2.3	73.20	3.8	1.9	104.62	4.0	1.5	76.10	2.8	1.5
Sugar	29.90	2.3	1.3	44.42	2.3	1.1	50.63	1.9	0.7	48.90	1.8	1.0
Tea	10.37	0.8	0.5	17.72	0.9	0.5	23.01	0.9	0.3	16.50	0.6	0.3
Other foods	71.92	5.6	3.2	118.26	6.2	3.0	195.75	7.4	2.9	121.40	4.4	2.5
Total non-livestock foods	610.98	47.9	27.2	833.28	43.7	21.4	1069.81	40.4	15.8	910.80	33.1	18.5
Dairy items	216.10	17.0	9.6	327.41	17.2	8.4	517.65	19.6	7.6	881.00	32.0	17.9
Egg	47.04	3.7	2.1	69.50	3.6	1.8	85.46	3.2	1.3	97.14	3.5	2.0
Meat	199.97	15.7	8.9	363.80	19.1	9.3	552.08	20.9	8.2	516.92	18.8	10.5
Fish	200.69	15.7	8.9	314.75	16.5	8.1	421.22	15.9	6.2	344.10	12.5	7.0
Total animal products	663.8	52.1	29.6	1075.46	56.3	27.6	1576.41	59.6	23.3	1839.16	66.9	37.5
Total foods	1274.78	100.0	56.8	1908.74	100.0	49.0	2646.22	100.0	39.1	2749.96	100	56.0
Total non-foods	970.79		43.2	1985.71		51.0	4123.45		60.9	2160.49	–	44.0
Total expenditure	2245.57		100.0	3894.45		100.0	6769.67		100.0	4910.45	–	100.0

Source: Field survey.

49

6.2   Estimation of demand elasticities

6.2.1   Specification of the Almost Ideal Demand System (AIDS) model

Working (1943) and Leser (1963) specified a demand model to estimate the income–consumption relationship and to establish how this relationship changes with household income. Deaton and Muellbauer (1980) extended the Working–Lesser model through the addition of price variables. Since accurate income measures and data are difficult to collect, total expenditure is often used as a proxy for income. To mitigate potential heteroskedasticity problems, the model is also estimated in share form (Deaton and Muellbauer 1980; Delgado and Courbois 1998). This model, generally known as the Almost Ideal Demand System (AIDS) model, has been widely used as a framework for estimating price and income elasticities when expenditure or budget share data are available (see for example, Deaton and Muellbauer 1980; Huang and David 1993; Fan et al. 1994; Halbrendt et al. 1994; Fan et al. 1995; Wu et al. 1995; Gao et al. 1996; Cai et al. 1998; Delgado and Courbois 1998; Han and Wahl 1998; Huang and Rozelle 1998; Huang and Bouis 2001).

The basic share equation for the AIDS model can be specified for the present study as:

$$w_i = \alpha_0 + \sum_j \gamma_{ij} \ln p_j + \beta_i \ln(X/P) \qquad\qquad (1)$$

where w_i is the share of food commodity group i in total expenditure, p_j is the price of food commodity j, X is the total expenditure within the food commodity demand system, and P is an overall price index. This expression is a linear approximation of the translog price index. As in most empirical work using the AIDS, P is approximated by the Stone price index:

$$\ln P = \sum_j w_i \ln p_i \qquad\qquad (2)$$

In equation 1, intercept α_0 is the budget share when all prices and real expenditures are normalized to 1, which means that one share equation in the system is dropped for estimation purposes. Parameter γ_{ij} is the change in the ith budget share with respect to a percentage change in the jth price holding real expenditure constant, α_i represents the change in the ith budget share with respect to a percentage change in real income or expenditure with prices held constant. Equation 1 can be estimated, imposing the adding up, homogeneity and symmetry restrictions, which are essential properties of the AIDS model. Hazell and Roell (1983) showed that when the demand equations are estimated in the share form as above, the following adding up restrictions are automatically imposed:

$$\sum_{i=1}^{n} \alpha_i = 1, \quad \sum_{i=1}^{n} \gamma_{ij} = 0 \quad \text{and} \sum_{i=1}^{n} \beta_i = 0$$

Following Greene and Alston (1990), conditional uncompensated price elasticities (η_{ij}) and conditional expenditure elasticities (e_i) from LA-AIDS model are given by:

$$\eta_{ij} = -\delta_{ij} + \gamma_{ij}/w_i - \beta_i w_j/w_i \qquad (3)$$

and

$$e_i = 1 + \beta_i/w_i \qquad (4)$$

where δ_{ij} is equal to one when $i = j$, and zero otherwise. Note that the β_is in equation 3 will be equal to zero only if preferences are homothetic (Deaton and Muellbauer 1980).

Fan et al. (1994) modified the AIDS model to incorporate consumer habit formation over time and Huang and Bouis (2001) allowed food consumption behaviour to change geographically by introducing time and regional dummies. In order to incorporate characteristics of the consumer household to account for changes in purchase and consumption behaviour as we did in hedonic model, the AIDS model in equation 1 can be extended to:

$$w_i = \alpha_0 + \sum_j \gamma_{ij} \ln p_j + \beta_i \ln(X/P) + \sum_k \alpha_k \ln Z + \alpha_2 D + u_i \qquad (5)$$

where Z is a vector of personal characteristics of the household, and D is a city dummy, X and P are as defined earlier and u_i is a random error term. The Z variables permit demand to vary by household head's demographic characteristics such as age, education, family size that usually affect purchase and consumption. The expenditure share in equation 5 can be rewritten for empirical estimation as:

$$w_i = \alpha_0 + \sum_j \gamma_{ij} \ln p_j + \beta_i \ln X - \beta_i \ln P + \sum_k \alpha_k \ln Z + \alpha_2 D + u_i \qquad (6)$$

An interest in this study was to assess the effect of quality and safety perceptions on the demand for dairy products and meat. Inclusion of such a demand shifter in the AIDS model was considered useful by Alston et al. (2001). Piggott and Marsh (2004) accommodated three indices accounting for beef safety, pork safety and poultry safety. In this study, perception on quality and safety as reflected in the preference ratings for different dairy products and meat according to their various attributes were regarded as a household characteristic that affected purchase and consumption behaviour like any other demographic characteristic. Therefore, in the expenditure share equations specified above, indices of quality and safety perceptions that usually affected purchase and consumption of livestock products were included in the vector Z along with other independent variables in equation 6.

Indices accounting for the household head's perceptions on quality and safety of livestock products were constructed on the basis of their preference rating elucidated for different

products discussed in Section 3. The index for commodity i with respect to its attribute k = 1,….n can be defined as:

$$Z_k = \sum_j X_{ik}/N \qquad\qquad (7)$$

where Z_k = index of household head's perception on quality and safety for *i* livestock products and X_{ik} = household head's score given for kth attribute of ith commodity, N = grand total scores assigned for all n attributes of ith commodity.

In this study we constructed quality and safety perception indices separately for dairy products, and meat and eggs. For measuring quality and safety perception index of dairy products we considered 15 milk products and 7 attributes for each product assuming that knowledge and preference for quality and safety about these products would give a good representation of the household's preference for quality and safety attributes of products in general. The products considered were raw fresh milk, pasteurized, UHT, fermented milk, full and half cream powdered milk, condensed milk, yoghurt, cheese, butter, ghee, ice-cream, sweets, chocolate milk and lassi. And the ratings of eight attributes considered were taste, nutritive value, health risk, hygieneness, shelf life, availability of product, handling convenience and price.[5]

To construct a quality and safety perception index for meat and eggs, we considered beef, mutton, and chicken and eggs. The product attributes considered for beef and mutton were breed, sex and age of animal, natural and artificial feeding systems, fat content, different cuts, colour of meat, appearance of meat, hygiene of display location and certification by a food authority. The attributes for chicken were local and crossbreeds, sex of bird, age of bird, feeding system, cuts, and appearance (live and frozen). Three types of eggs were considered: local hen egg, farm hen egg and duck egg. The product attributes considered were taste, nutritive value, health risk, hygieneness, shelf life, availability of product, handling convenience and price.

Each of the estimated share equations represented a group of commodities so each sample household had positive purchase values except in the case of some equations representing a specific individual commodity like liquid milk and pasteurized milk or a commodity group with few commodities such as beef and mutton. However, even in such cases zero purchase samples were 7–10 out of 900, which were excluded from the relevant equations (see Appendix A). This small size of the zero purchase samples did not appear to affect the regression estimates.

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5. Whether inclusion of rating on product price was appropriate for construction of the quality index might be a question. Rating on price in the present context was expected to reflect a product's quality and safety as in the case of ratings on other product attributes, so it was assumed that a composite index of quality could be constructed incorporating ratings on all the attributes including price.

In case of time series data, usually problem of heteroskedasticity may arise. We have estimated share equations using cross-section data. No apparent heteroskedasticity problem was observed from plots of residuals versus predicted values and plots of residuals vs. some of the independent variables, so no formal rigorous test for heteroskedasticity was conducted.

6.2.2 Results and discussion

The specified share equations were estimated with and without the quality index as a variable to test whether the inclusion of the quality index was appropriate. For goodness of fit, the R^2 and F values for various estimated share equations that included the quality index variable are shown in Table 37.

Table 37. *Value of R^2 of different budget share equations of LA-AIDS model*

Share equation	Sample size	Value of R^2	F value	Significant quality index variable(s)
Food share in total household expenditure	900	0.27	7.25*	Dairy
Animal product share in total food expenditure	893	0.42	33.32**	Both dairy and meat
Meat share in total animal product expenditure	890	0.52	17.01**	Meat
Beef and mutton share in total meat expenditure	890	0.32	18.87**	Dairy
Chicken and eggs share in total meat expenditure	892	0.31	19.38**	Both dairy and meat
Dairy share in total animal product expenditure	892	0.54	25.64**	Both dairy and meat
Liquid milk share in total dairy expenditure	892	0.36	4.20*	Both dairy and meat
Powder milk share in total dairy expenditure	890	0.36	6.32*	Both dairy and meat
Fish share in total food expenditure	890	0.52	5.10*	Meat
Cereals share in total food expenditure	900	0.74	55.75**	Dairy and meat
Pulses share in total food expenditure	900	0.33	5.48**	Dairy
Vegetables share in total food expenditure	900	0.46	20.59**	Meat
Fruits share in total food expenditure	900	0.41	9.20**	Dairy
Edible oil share in total food expenditure	900	0.62	28.51**	None
Spices share in total food expenditure	900	0.42	9.80**	Dairy
Sugar share in total food expenditure	900	0.29	4.15**	Dairy

** and * indicate statistically significant at 1 and 5% respectively.
Source: Appendix tables A1–A7.

The table also shows if the coefficient of any of the two quality index variables—dairy and meat—was statistically significant. R^2 varied from 0.24 to 0.74 and these were statistically significant at least at 5% level. These are reasonably good figures for cross-sectional data. Secondly, inclusion of the quality and safety indices for dairy and meat products as explanatory variables improved the value of R^2 to varying degrees for most equations, had no effect in a few cases and marginally reduced the value of R^2 for only one equation. Moreover, out of 15 equations, in 5 cases the coefficient of both the quality index variables were significant, in 9 cases either of the two was significant and in only 1 case neither was significant at 5% level. Thus it can be reasonably asserted that perception of quality and safety of a food product can be used as a household demographic characteristic, along with other socioeconomic characteristics, to explain purchase and expenditure pattern within the limit of the household budget.

Expenditure elasticities of different food items estimated from the budget share equations (calculated at mean of data) are shown in Table 38. The expenditure elasticitiy of an item measures the percentage increase in the weight of that item due to one percent increase in total expenditure on the group of which the item is a part. Thus the expenditure elasticity of 1.02 for food suggest that, other things including relative prices of commodities remaining unchanged, the relative share of food in total household expenditure increases in approximately the same proportion as the real total household expenditure increases, i.e. the demand for food is unitary elastic in the major urban areas of Bangladesh. However, although overall expenditure elasticity of food is unitary, there are possibilities of substitution between food groups and between individual food items.

Table 38. *Estimated expenditure elasticities of different food items*

Product	Expenditure elasticity
Food	1.02
Animal products	1.32
Meat	1.36
Beef and mutton	1.05
Chicken and eggs	1.06
Milk	0.95
Liquid milk	1.04
Powdered milk	0.93
Fish	0.80
Cereals	0.52
Pulses	1.00
Vegetables	0.70
Fruits	1.26
Edible oils	0.65
Spices	0.98
Sugar	1.25

Source: Field survey.

Among the various food items, the demand for animal products, fruits and sugar are expenditure elastic, i.e. other things remaining the same, the relative shares of these items in total food expenditure increase as real expenditure on food increases. However, among the animal products, only demand for meat appears to be expenditure elastic while demand for dairy products appear to be approximately unitary elastic, i.e. other things remaining the same, the relative shares of these items in total food expenditure increase in approximately the same proportion as the real total food expenditure increases. Demand for pulses, which is a source of protein for poor people, also appear to be unitary elastic. On the other hand, expenditure elasticity of demand for cereals, vegetables, edible oil and fish are inelastic, i.e. other things remaining the same, the relative shares of these items in total food expenditure decline as the real total food expenditure increases. These figures seem plausible for urban consumers in Bangladesh. The greatest decline in the share of food expenditure occurs in case of cereals because as total real expenditure on food increase, the absolute value of expenditure on cereals does not increase much as the need for cereals is satiated. Similar is the case of other daily necessities like vegetables and edible oil, and to some extent for fish as most Bangladeshi consumers irrespective of level of overall food expenditure try to include fish in the daily menu. Hence, if total food expenditure increases, consumers may increase expenditure on meat as a source of protein with or without reducing expenditure on fish (see below).

These results can be compared with findings from other studies in Bangladesh and elsewhere in the developing countries. Hossain and Bose (2000) estimated the income elasticity of demand for milk in Bangladesh in 1995–96 as 1.62 compared to 1.19 for meat and eggs, and these were projected to be 0.65 and 0.63 respectively in 2020. Based on national level aggregate data for 64 developing countries for the period 1970–95, Delgado and Courbois (1998) found expenditure elasticity of 1.36 for milk, 0.65 and 0.27 respectively for beef and chicken meat, and 1.10 for pork and mutton. In a more recent study in China, Cai et al. (1998) and Ma and Rae (2003) found expenditure elasticity for ruminant meat ranging from 1.10 for low income urban group to 0.71 for high urban income group, which are closer to our estimates.

The own- and cross-price elasticities of various food items are shown in Table 39. The bold figures in the diagonal are own price elasticities which measure the change in demand for a product in response to relative price changes of that product. As expected, other things remaining the same, price rise for a particular item is associated with decrease in demand for that item. The demand for meat, dairy products, pulses and fruits appear to be unitary elastic with respect to their own price. This means that, other things being equal, the consumption changes in direct proportion to the price change, but in the opposite direction. Demand for cereals and vegetables are marginally price elastic while demand for fish, spices and

sugar are highly price elastic and demand for edible oil is highly price inelastic. Normally cereals and vegetables are considered as necessities so are expected to be price inelastic but in this study, these two items appeared marginally price elastic while meat and dairy products appeared to be close to unitary elastic. Perhaps this is because the sample is exclusively composed of urban households whose food habit within budget is slightly different from rural households. Delgado and Courbois (1998) in the aforementioned cross-country study found own price elasticity of –0.86 for milk, which is close to the estimate for milk in this study, but they found –0.14 to –0.39 for different types of meat, which are quite the opposite compared to the estimates in this study. However, differences in the nature of sample units and data—national aggregate in Delgado–Courbois case and individual urban households in the current study—and the difference in the reference period and location (in some countries meat features more importantly in the diet than others) may partly explain these differences in the estimates.

The cross-price elasticity of an item measures the change in demand for that item in response to relative price changes of another product. As expected, other things remaining the same, price rise for a particular item is associated with decrease or increase in demand for other item(s) in varying degrees. The demand for meat, milk and fish appears to be highly sensitive to the change in prices of cereals—a one percent increase in the price of cereals decreases demand for meat by one percent, demand for milk by 1.8% and demand for fish by 1.3%. Thus, given the low average income of Bangladesh households, given budget constraint, a rise in the price of cereal, the basic staple, induces a decrease in the demand for protein commodities. In general, most of the other cross-price elasticities are found to be less than unity with either negative or positive sign, indicating substitution and complementary relationship (respectively) between the items concerned. In a few cases the values are close to zero implying no demand relationship between the two products.

Table 39. *Estimated own and cross price elasticities of different food items*

	Meat	Milk	Fish	Cereals	Pulses	Vegetables	Fruits	Edible oils	Spices	Sugar
Meat	-0.952	-0.397	-0.571	-1.008	-0.342	-0.416	-0.115	-0.712	-0.116	-0.147
Milk	-0.533	-0.896	-1.315	-1.779	-2.069	0.070	0.206	1.585	-0.504	0.879
Fish	-0.639	-0.734	-1.761	-1.325	-0.676	-0.644	-0.283	-0.669	-0.377	-0.173
Cereals	-0.205	0.066	-0.093	-1.229	-0.040	-0.277	0.009	-0.084	-0.008	-0.059
Pulses	-0.033	-0.013	-0.020	-0.026	-1.033	0.000	-0.033	-0.013	0.000	-0.052
Vegetables	0.025	0.061	-0.011	0.010	-0.662	-1.154	-0.057	0.040	0.103	-0.018
Fruits	0.116	-0.090	0.080	-0.118	0.201	0.282	-0.956	-0.007	0.122	-0.306
Edible oils	0.131	0.047	0.009	0.004	0.022	0.086	-0.039	-0.554	-0.049	0.052
Spices	0.089	-0.216	0.222	0.060	0.032	0.111	-0.081	-0.468	-1.401	-0.248
Sugar	-0.171	-0.202	-0.256	-0.364	-0.281	-0.089	0.027	-0.343	-0.090	-1.595

Source: Field survey.

7   Summary and conclusion

Demand for animal products has been increasing rapidly in Bangladesh due to urbanization and increases in per capita income. There are rudimentary indications that demand for improved food quality and safety has also been increasing and that consumers were willing to pay higher prices for such attributes of products. However, there is little empirical evidence on the criteria and indicators of quality and safety that consumers use in their buying decisions, or that suppliers use in differentiating products to promote sales, or the extent to which consumers are willing to pay for such attributes. The present study attempts to bridge that knowledge gap.

A detailed survey was conducted in 2006 among 900 households selected through a multi-stage stratified sampling procedure from Dhaka and Mymensingh cities to collect information on consumer preference expressed through rating of different dairy products, meat and eggs according to their alternative uses and their attributes reflecting quality and safety as well as household expenditure on food and non-food items. Although some degree of differentiation for quality and safety might prevail among both rural and urban consumers, it was assumed that the differentiation would be sharper in the urban areas, so given available time and resources, the survey was focused in urban areas.

Preferences for dairy products

Among various products considered, raw fresh milk, pasteurized milk and full and half cream powdered milk were the major dairy products consumed by urban consumers. Raw fresh milk was regularly consumed by about 58% of the households, pasteurized milk by 37%, and powdered milk by about 55% of the households, with or without raw or pasteurized milk. Less frequent consumption was prevalent among another 25–35% of the households. Other dairy products were consumed by a smaller proportion of households.

Milk and milk products were consumed in different ways, e.g. direct drinking or eating, mixing with other food, mixing with tea/coffee/hot drinks, for making yoghurt, or for baking. Respondents reporting consumption of products were asked to rate their preference for each product on a scale of 1–10 in terms of each use option, as well as an overall rating taking into account all uses. Lower rating indicated lower preference and vice versa. The results indicated that the degree of preference for a product varied according to use option. With respect to a particular use option, the degree of preference for different products also varied between the two cities; this was true even for products which are close substitutes such as raw milk, pasteurized milk and powdered milk.

Respondents were also asked to rate each product in terms of the following attributes: taste, nutritive value, health risk, hygiene, shelf life, availability, handling convenience, and price, as well as an overall preference rating taking into account all the attributes. The results showed that the degree of preferences for a particular product varied in terms of different attributes, and with respect to a particular attribute. The degree of preference varied between different products, even for close substitutes.

The overall rating values of the different dairy products, especially such major dairy products as raw, pasteurized and powdered milk, according to different uses and different attributes mentioned above were almost similar even though these ratings were done independently during the same interview session without cross referring to one another. Overall, taking into account all use options and all attributes, the order of preference was raw fresh milk, pasteurized milk, full cream powdered milk and half cream powdered milk. This was further confirmed by the use of a logistic regression model that analysed preference ordering based on preference rating. Therefore, the ratings done on the basis of use options and on the basis of attributes should be considered as highly consistent and representative of consumer perceptions about the characteristics of these products and their market and use values.

Consumers were also asked to rate preferences for four major forms of milk—raw fresh, pasteurized, full and half cream powder—based on a number of other factors that reflect quality and safety of dairy products (e.g. breed of cow, fat content, colour and flavour, source of supply, packaging, brand and labelling where applicable). For raw fresh milk, consumers preferred milk from local cows, with high fat content, creamy colour with good flavour, supplied directly from/by producers themselves. In case of pasteurized and powdered milk, full cream milk with creamy colour and good flavour received the highest rating. Products packed in certain material with labelling were also strongly preferred to non-packed products or those using alternative packaging material and those without labelling. There was also more preference for Milk Vita brand of pasteurized milk than for other brands. In the case of powdered milk, Nestle, Dano and Red Cow were the most preferred brands.

Preferences for meat and eggs

Among the major types of meat consumed in Bangladesh, urban consumers most preferred chicken followed by beef, goat meat, buffalo meat and sheep meat. Respondents were asked to rate various meat products in terms of a number of attributes: e.g. breed (local, exotic, Indian), age and sex, feeding system (natural, commercial), fat content on the carcass (high, low), various cuts (hind leg, foreleg, mixed cuts, rib, boneless etc.), certification by a health authority, hygiene of the display location in the shop. For beef, the meat of local breeds, young bulls, naturally produced animals and moderate fat content was most preferred. For

goat meat, naturally fed male animals were preferred. For both beef and goat meat, fresh meat certified by a health authority and sold in a hygienic butcher shop were found to be the most preferred attributes.

Preference rating for live chicken was about twice the rating given to dressed frozen chicken but the rapidly expanding commercial broiler industry has also created a general acceptance of broilers. When buying broliers, consumers' preference was to buy them live and get them slaughtered at home or in the shop in their presence. Differences in preferences between male and female chicken and between young and older chicken appeared minor, although chicken from natural production systems was preferred to commercially raised chicken.

Respondents were also asked to rate preferences for three types of eggs (local hen egg, farm hen egg and duck egg) in terms of a number of attributes such as taste, nutritive value, health risk, hygiene, shelf life, availability, handling convenience, price and overall rating taking into account all the attributes. Local hen eggs were slightly more preferred, although only in terms of taste and overall attributes and farm eggs were most preferred in terms of nearly all the other attributes. Duck eggs were least preferred in terms of a number of attributes. In terms of price, farm eggs were rated slightly higher than the other two types, indicating that consumers considered farm egg price in relation to its attributes more acceptable than was the case for the other two.

Effect of attributes on perceived prices of products

For the livestock products examined, respondents rated each product in terms of different physical attributes as well as in terms of prevailing price of the product: the analysis presented price as an attribute. The rating for the price attribute was assumed to implicitly encompass the ratings for all the other attributes. As such, the rating of a product in terms of its prevailing price could be treated as the respondents' willingness to pay that level of price for that product given the ratings on the other attributes of that product. In order to test this relationship, a hedonic or implicit price model was fitted for major milk products (raw milk, pasteurized milk, full and half cream powdered milk) and beef, mutton and chicken meat. For each product, the dependent variable was the respondent's rating on prevailing price and the independent variables were ratings on relevant attributes of the product and relevant socio-economic characteristics of the respondents. It was hypothesized that at the margin, respondents' rating on price is affected by his/her ratings on the attributes.

Results show that, for all four forms of milk, among various product attributes perception on taste appeared to be the most important factor significantly affecting prices. The results implied that higher rating on taste was accompanied by a significantly higher rating on price of a form of milk. Perception on nutritive value was found to affect significantly prices of

raw fresh, pasteurized and full cream powdered milk. Perception on health risk was found to affect significantly prices of all forms of milk except half cream powdered milk. Perception on shelf life and handling convenience were also found to contribute significantly to prices of pasteurized and full cream powdered milk. Respondents in Dhaka were willing to pay higher prices for these products compared to those in Mymensingh. Among the socio-economic factors, only age of the household head had a significant (negative) effect on rating of the price of half cream powdered milk as older household heads gave lower rating on the price of this product. This implied that older household heads had lower preference for half cream powdered milk. Also significantly lower rating for price was identified on a grocery shop as a source of supply of this product. The reason perhaps reflected a general perception that products sold at grocery shops were not always trustworthy.

Rating for price of beef significantly increased along with higher ratings for local breed animal, mature bull as the animal type, natural as well as artificial as systems of feeding, medium fat content of the carcass, boneless cut, and whitish colour of meat (indicating meat from younger animals). On the other hand, rating for price significantly declined along with increased rating for cow as the animal type and red colour of the meat indicating meat of older animal.

In the case of mutton, rating for price significantly increased along with higher ratings for high fat content in carcass, foreleg and hind leg as cuts, fresh/presence of blood as appearance of meat, and significantly decreased along with higher rating for neck/hump/buttock as a cut. Also respondents in Dhaka city were willing to pay a significantly higher price for mutton than in Mymensingh. Rating for price of chicken meat significantly increased along with higher ratings for cross/exotic chicken, male chicken, leg as cut, frozen chicken and with greater age of household head.

Characteristics of most recent purchases of products

Information on most recent purchases of various dairy products revealed that home delivery by producer was the most widely used source of raw fresh milk, grocery shop was the most common source for pasteurized milk and local traditional market and grocery shops were the most widely used source for powdered milk and other products.

Per capita per month total household expenditure on food items was found to be about 56% of total household expenditure. Of the total household expenditure, about 30% was spent on animal products—10.5% on meat, 2% on eggs and 17.9% on dairy products. Another 7% was spent on fish. The share of expenditure on animal products was somewhat higher than comparable estimates (e.g. BBS in its 2005 household expenditure survey). Reasons for the difference might be the smaller sample size in this study, the somewhat purposive nature of

the sample (particularly ignoring seasonal effects), some bias toward the wealthier consumer by virtue of sampling in and within large cities.

Estimated characteristics of demand

Expenditure and price elasticities were estimated by using an Almost Ideal Demand System (AIDS) demand model. Along with other variables, an index of quality and safety for dairy products and another for meat and eggs derived from the preference ratings of respondents given on various attributes of these products were included as independent variables. These indices were assumed to serve as demand shifters reflecting aggregate demand for quality and safety. Inclusion of the demand shifter increased the explanatory power of most of the budget share equations implying that such indices derived from preference ratings could be used as proxies for demand for quality and safety reflected in budget shares or purchase decisions.

Estimation from the best fit AIDS models showed that animal products in general, and meat in particular, were highly expenditure elastic in urban Bangladesh although some of the specific meat and dairy items showed nearly unitary elasticity, which might imply that a steady rise in demand for such products would accompany further income growth. High own-price elasticities of fish, cereals and vegetables implied that, given budget constraint, high prices of these products would significantly reduce expenditure and consumption of these items; and high cross price elasticities between cereals, milk and fish implied that a rise in the price of basic staple, would adversely affect the consumption of protein goods.

Discussion and conclusions

This study is the first attempt to comprehensively characterize and quantify Bangladeshi urban demand for animal products with a focus on quality and safety. Based on a survey methodology, successive analyses present statements of preference based on ratings, identified quality criteria, stated sources of supply and recent purchasing behaviour both at home and away from home, and econometric analysis of relationships between price ratings and quality ratings across attributes, so as to generate willingness to pay for those attributes. Although targeted at urban populations, considerable variation between locations was identified.

Demand for animal products in Bangladesh follows patterns familiar to many developing countries in that it employs informal markets, has an income-sensitive character and varies by location. Its characteristics with reference to food quality and safety are familiar from studies of developed countries as well, in that consumers seek out, can identify, and are willing to pay for quality and safety. Some of the attributes considered by consumers represented

quality and safety criteria, although the distinction between quality and safety was not always clear. Some attributes such as freshness represented quality and some attributes such as certification of a health authority represented safety while others like purity might represent both. A similar situation prevails in the informal market in other developing countries where official grades and standards are either absent or poorly defined.

The findings about preference, prices and expenditure patterns on dairy products and meat have implications for producers, processors and retailers as the supply chains connecting consumers and producers are getting longer. They also have implications for policy. For example, long term growth in the dairy sector has been very small and past policies on tax, tariff and import of dairy products did not have any significant impact on the growth of the sector (Staal et al. 2008; Jabbar 2010). Part of the reason was that government policies on import of dairy products (especially powdered milk, the main imported product) and policies on tax and tariff on imported and domestically processed products were not prepared on the basis of empirical evidence on the nature of consumer demand for the products and the nature of response of domestic producers, traders and processors to government policies and market prices, so domestic producers failed to take advantage of the increasing demand for quantity as well as quality to trigger rapid growth in the dairy sector. Differences in ratings for raw, pasteurized and powdered milk—the most widely consumed dairy products—according to their various uses and attributes imply that these products are not substitutes across the board. This combined with the finding that ratings on prices of these products were significantly influenced by their ratings on quality and safety attributes like taste, nutritive value, health risk and shelf life and handling convenience imply that relative shares of consumer purchases of these products will depend on how the supply chains of these products respond to and handle desired quality and safety attributes on the one hand and prices on the other. Imported powdered milk constitutes a significant share of the dairy market, and domestically processed milk still constitutes a small share of the market but has been increasing rapidly in the urban areas. If the increased demand is to be used as an opportunity to transform the dairy sector in an increasingly open market conditions, it is imperative that appropriate policies have to be formulated and actors in the supply chains have to respond to those policies keeping in view the desires of the consumers.

In the case of meat, especially beef, naturally fed local breed bulls with medium fat appeared to be the most preferred product profile. But supply of such beef has become rare in the market with the dominance of high fat beef of artificially fattened imported Indian cattle. Majority of import of live cattle from India occurs illegally or informally, which allows the large and expanding urban beef market to be a dumping ground for culled Indian cattle. If consumer preference is to be used as a vehicle to foster growth of the domestic livestock sector, appropriate policy actions need to be made to formalize and rationalize live cattle

import from India. Since male off-springs of dairy cattle is a source of draught and beef cattle, policies to support dairy and beef cattle production also need to be harmonized.

Demand led transformation of the livestock sector also brings into the picture the issue of grades and standards defining quality and safety. In Bangladesh, official grades and standards for animal products are virtually non-existent or very poorly and partially defined in some cases. Enforcement of those standards are even poorer. This was vividly shown, for example, during a crisis created in the milk market due to melamine contamination. Following a scare created by discovery of melamine in some brands of imported powder milk in October 2008, some consumers of powder milk quickly shifted to raw milk and to pasteurized milk to a lesser extent creating extra demand for these products so raw milk price suddenly jumped by about 75% on an already increasing price trend triggered by price rise in the global market. This situation lasted for about six months and then raw milk price fell suddenly to its original six months earlier level, remained there for about three months, then fell again to the June 2006 level as in the case of global powder milk prices. Informal traders in Dhaka made supernormal profit during the melamine crisis through unscrupulous means. Dairy processors also made money at the expense of both producers and consumers showing serious callousness about food safety in their purchasing and handling of raw milk. Dairy processors and traders failed to appreciate that the dairy industry cannot prosper without taking producers and consumers with them (see Box 1). Lack of appropriate official standards and their enforcement remains a hindrance to properly link production and consumption through processing and marketing chains as a vehicle to transform the dairy sector. In case of meat, the situation is even worse and requires proper response.

Box 1 Milk quality and safety: Melamine contamination and artificial milk production

In October 2008, following the discovery of melamine contaminated milk in China, there was serious public concern in Bangladesh about quality of imported powdered milk. Laboratory tests found different levels of melamine in a number of brands imported from different countries. But test results also varied between different laboratories so lack of consensus about test results delayed policy action on the suspected brands, which created public outrage and concern. Powdered milk traders continued to sell suspected brands even after a High Court ruling, in response to a public interest writ petition, ordered to stop trading of suspected brands. It took several more days for law enforcing agencies to come out to enforce the court order which allowed the traders to hide much of the stocks.

Liquid milk traders, especially traditional gowalas, took advantage of this uncertainty and increased milk price. Moreover, they also increased milk supply by mixing increased quantities of powdered milk with liquid milk, and selling those as fresh cow milk. Since

water and powder milk adulteration is a fairly common practice, consumers concern increased as they suspected that the melamine contaminated powdered milk would end up in the market through the traditional liquid milk sellers.

To make the situation worse, The Daily Prothom Alo, a popular daily newspaper, reported (on 1–2 November 2008) that on 31 October 2008, their investigation in Pabna and Sirajgonj districts, the main milk shed for Dhaka city, revealed that traditional milk traders have been producing artificial milk using chemicals and they reportedly have been supplying that milk to BRAC, Pran, and Akij dairies for processing and selling as pasteurized milk. The paper also published picture of a trader's artificial milk production factory. This practice has emerged in response to inadequate supply of fresh milk in relation to demand of the processing plants. The process of making artificial milk apparently runs like this: traders separate cream and solid (sana) from milk purchased from producers, then in the remaining milk-water (normally called ghoal) they mix iron cutting oil at the rate of two drops per litre, which makes the colour of milk-water fully white like full milk. Then they add cream, powdered milk, sugar, salt, sodium carbonate and milk essence in appropriate proportion to prepare artificial milk. Further, peroxide and formalin are added to extend shelf life for delivery to milk collection points of processors.

After the above news paper report, public health and law enforcing authorities have reportedly identified and captured several staff/agents of BRAC, Pran, Aftab and Akij dairies and several milk traders with artificially prepared milk and/or materials and equipment for preparation of such milk, and imposed financial penalty at varying rates. While this quick response was commendable, it was disappointing to see that the management authorities of the relevant dairies did not take responsibility for failing to maintain food safety norms and to protect the health of ordinary consumers. The artificial milk issue had subsided for a while but another newspaper, The Daily Star, reported on 25 February 2009 arrest of a milk trader in Jhenidah district with fake milk manufacturing equipment and raw materials which he has been using to regularly supply fake milk to the local BRAC purchase centre. The BRAC purchase centre staff reported to the law enforcers, when questioned, that they were unaware about the practice and could not detect the adulteration with their normal testing procedure. So quality control of milk along the supply chains remains a major concern.

Source: Jabbar (2010).

How to define quality and safety standards and enforce them is yet another practical problem. Defining standards based on developed country public health norms will be fruitless because neither producers nor the processing industry and other actors in the informal market chain may be able to comply with those standards under current system of production and marketing. The government institutions responsible for enforcement of

standards also do not have the technical skills and organizational infrastructure to enforce those standards. On the other hand, the study revealed that consumers differentiated dairy products and meat and eggs on the basis of a number of product-specific attributes, and their preferences for a product varied depending on those attributes. Moreover, consumers' preferences for products in terms of different attributes were also reflected in their willingness to pay different prices of those products.

It can be reasonably assumed that with economic development, consumer demand for standardized and graded products with quality and safety assurance will increase. Estimation of demand and expenditure elasticities revealed that although further income increases will tend to raise consumption of animal products, producers and food industry actors must supply the growing market at low cost. Own-price elasticities were found to be high enough to discourage high-priced marketing efforts. Therefore establishment of standards and grades will become necessary to meet consumer demand on the one hand and facilitate producers and market agents to respond to consumer demand on the other. The informal criteria and indicators or product attributes that consumers and market agents use to differentiate quality and safety might be considered as starting point for definition of official grades and standards. Then gradual improvement of such grades and standards may be possible with efforts from all the actors in the supply chain from producers to consumers.

As demand for quality and safety increase gradually along with economic development, periodic updating will lead to establishment of standards that reflect both evolving consumer demand and the requirements of public health, hygiene and nutrition. The distinction between quality and safety standards is also likely to evolve along with more transmission of knowledge and information on standards. Complementary regulations may be formulated and enforced at producer level and at market intermediary levels to ensure delivery of standard quality and safe products to consumers because lack of adequate transmission of information will lead to unequal distribution of benefits from better standards, especially smallholder producers are likely to loose most from any information asymmetry.

Whether smallholders will have any comparative advantage in supplying an expanding market requiring more homogenous and better quality and safer products need to be studied regularly along with studies on consumer demand because of the dynamic nature of the emerging and evolving market, the industry and the sector. Applied studies of developing country demand may benefit from the current study's use of indices of demographic variables that further characterize the little-studied developing countries' consumer demand.

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Appendices: Estimated parameters of budget share equations for selected food groups using an Almost Ideal Demand System (AIDS) model

Table A1. Estimated parameters of equations showing shares of food in total household expenditure, and shares of animal products and sigh in total food expenditure

Variables	Food share in total household expenditure	Animal products share in total food expenditure	Fish share in total food expenditure
Constant	0.477	−0.665**	0.379**
	(0.249)	(0.143)	(0.117)
Price of meat (LNP1)	−0.011	0.027**	−0.024**
	(0.017)	(0.010)	(0.008)
Price of dairy product (LNP2)	0.013	0.004	−00.026**
	(0.011)	(0.006)	(0.005)
Price of fish (LNP4)	−0.002	−0.007	0.064**
	(0.012)	(0.007)	(0.006)
Price of cereals (LNP5)	0.010	−0.034**	−0.046**
	(0.026)	(0.015)	(0.012)
Price of pulses (LNP6)	−0.022	0.000	−0.023
	(0.031)	(0.018)	(0.015)
Price of vegetables (LNP7)	0.048*	0.013	−0.021*
	(0.023)	(0.013)	(0.011)
Price of fruits (LNP8)	0.008	0.002	−0.010*
	(0.011)	(0.006)	(0.005)
Price of edible oils (LNP9)	0.005	0.031	−0.024
	(0.031)	(0.018)	(0.015)
Price of spices (LNP10)	0.012	−0.002	−0.014**
	(0.012)	(0.007)	(0.006)
Price of sugar (LNP11)	−0.040	0.000	−0.007
	(0.030)	(0.017)	(0.014)
Total expenditure on food (LNX)	0.008	0.086**	−00.006
	(0.014)	(0.008)	(0.007)
Natural log of household head's age (Lnage)	0.006	−0.011	0.001
	(0.016)	(0.009)	(0.008)
Natural log of household head's education (Lnedu)	−0.002	0.004**	0.0000856
	(0.002)	(0.001)	(0.001)
Natural log of household's family size (Lnfsiz)	−0.017	0.001	−0.010
	(0.018)	(0.010)	(0.008)
Children below 6 yrs (yes = 1)	0.015**	0.001	0.001
	(0.008)	(0.005)	(0.004)
Dummy for district (Dhaka = 1)	0.012	0.026)**	−0.010
	(0.014)	(0.008)	(0.007)
Safety and quality index for dairy product (Safd)	−0.023*	0.019**	−0.006
	(0.014)	(0.008)	(0.006)
Safety and quality index for meat (Safm)	−0.008	0.014*	−0.023**
	(0.016)	(0.009)	(0.008)
Total safety index (TSafindex)	−0.025*	0.038**	–
	(0.019)	(0.011)	
Stone price index (STI)	0.27	0.42	−0.070**
			(0.009)
R²	0.42	0.65	0.52
F-value	7.25*	33.32**	17.01**

* Significant at 5% level. ** Significant at 1% level.

Table A2. Estimated parameters of equations showing shares of meat and dairy products in total expenditure on animal products

Independent variables	Meat share in total expenditure on animal products	Dairy share in total expenditure on animal products
Constant	−0.235	0.105
	(0.130)	(0.115)
Price of meat (LNP1)	0.013	0.010
	(0.009)	(0.008)
Price of dairy product (LNP2)	−0.002	0.017**
	(0.006)	(0.005)
Price of fish (LNP4)	−0.034**	−0.025**
	(0.006)	(0.005)
Price of cereals (LNP5)	−0.062**	−0.030**
	(0.014)	(0.012)
Price of pulses (LNP6)	0.009	−0.037**
	(0.016)	(0.014)
Price of vegetables (LNP7)	−0.010	0.002
	(0.012)	(0.011)
Price of fruits (LNP8)	0.001	0.003
	(0.006)	(005)
Price of edible oils (LNP9)	0.011	0.028**
	(0.016)	(0.014)
Price of spices (LNP10)	0.000	−0.–0.009
	(0.006)	(0.005)
Price of sugar (LNP11)	−0.011	0.016
	(0.016)	(0.014)
Total expenditure on food (LNX)	0.074**	−0.011**
	(0.007)	(006)
Natural log of household head's age (Lnage)	0.001	−0.020
	(0.009)	(0.008)
Natural log of household head's education (Lnedu)	0.002	0.002
	(0.001)	(0.001)
Natural log of household's family size (Lnfsiz)	0.021**	−0.008
	(0.009)	(0.008)
Children below 6 yrs (yes = 1)	0.0000212	0.002
	(0.004)	(0.004)
Dummy for district (Dhaka = 1)	0.003	0.031**
	(0.008)	(0.007)
Safety and quality index for dairy product (Safd)	0.010	0.017**
	(0.007)	(0.006)
Safety and quality index for meat (Safm)	0.019*	−0.019**
	(0.009)	(0.008)
Stone price index (STI)	−0.035**	−0.077**
	(0.010)	(0.009)
R^2	0.52	0.54
F-value	18.87**	19.38**

Table A3. Estimated parameters of equations showing shares of liquid and powder milk in total dairy expenditure

Independent variables	Liquid milk share in total dairy expenditure	Powder milk share in total dairy expenditure
Constant	2.156	–0.202
	(0.351)	(0.-0.102)
Price of meat (LNP1)	–0.028	–0.176
	(0.024)	(–1.318)
Price of dairy product (LNP2)	–0.281**	0.304**
	(0.015)	(0.141)
Price of fish (LNP4)	0.028	0.043
	(017)	(017)
Price of cereals (LNP5)	–0.090**	–0.008
	(0.037)	(0.001)
Price of pulses (LNP6)	0.093*	0.090
	(0.044)	(0.013)
Price of vegetables (LNP7)	–0.056	–0.019
	(033)	(–0.004)
Price of fruits (LNP8)	–0.022	–0.066
	(0.016)	(0.026)
Price of edible oils (LNP9)	–0.058	–0.012
	(0.044)	(0.002)
Price of spices (LNP10)	–0.013	–0.119
	(0.017)	(0.044)
Price of sugar (LNP11)	–0.038	–0.115
	(0.042)	(0.016)
Total expenditure on food (LNX)	–0.013	–0.116
	(0.020)	(0.051)
Natural log of household head's age (Lnage)	–0.010	–0.026
	(0.023)	(0.006)
Natural log of household head's education (Lnedu)	0.004	0.002
	(0.003)	(0.006)
Natural log of household's family size (Lnfsiz)	0.002	0.026
	(0.025)	(0.007)
No. of children below 6 (Childdummy)	0.003	–0.039
	(0.011)	(–0.022)
Dummy for district (Dhaka = 1)	–0.049*	–0.206*
	(0.020)	(–0.083)
Safety and quality index for dairy product (Safd)	0.037*	0.119*
	(0.020)	(0.036)
Safety and quality index for meat (Safm)	0.045*	0.025
	(0.023)	(0.032)
Stone price index (STI)	0.095**	–0.040
	(0.027)	(–0.013)
R^2	0.36	0.26
F-value	25.64**	4.2*

* Significant at 5% level. ** Significant at 1% level.

Table A4. Estimated parameters of equations showing shares of beef and chicken in total expenditure on meat

Variables	Beef and mutton share in total meat expenditure	Chicken and egg share in total meat expenditure
Constant	1.536**	0.633
	(0.413)	(0.411)
Price of meat (LNP1)	–0.074**	–0.118**
	(0.028)	(0.028)
Price of dairy product (LNP2)	0.015	–0.027
	(0.018)	(0.018)
Price of fish (LNP4)	–0.007	0.015
	(0.020)	(0.020)
Price of cereals (LNP5)	–0.074	–0.004
	(0.044)	(0.043)
Price of pulses (LNP6)	0.012	–0.008
	(0.051)	(0.051)
Price of vegetables (LNP7)	–0.026	0.084**
	(0.038)	(0.038)
Price of fruits (LNP8)	–0.028	0.029
	(0.019)	(0.019)
Price of edible oils (LNP9)	–0.084*	0.087
	(0.052)	(0.052)
Price of spices (LNP10)	–0.006	–0.006
	(0.020)	(0.019)
Price of sugar (LNP11)	–0.046	0.031
	(0.049)	(0.049)
Total expenditure on food (LNX)	–0.038	0.034
	(0.027)	(0.027)
Natural log of household head's age (Lnage)	–0.015	0.016
	(0.003)	(0.003)
Natural log of household head's education (Lnedu)	0.030	–00.036**
	(0.029)	(0.029)
Natural log of household's family size (Lnfsiz)	0.001	–0.007
	(0.013)	(0.013)
Children below 6 yrs (yes = 1)	0.096**	–0.074
	(0.023)	(0.023)
Dummy for district (Dhaka = 1)	–0.026	0.044
	(0.024)	(0.024)
Safety and quality index for dairy product (Safd)	0.131**	–0.046*
	(0.027)	(0.027)
Safety and quality index for meat (Safm)	0.007	–0.014*
	(0.032)	(0.032)
Total safety index (TSafindex)	0.022	–0.030
	(0.023)	(0.023)
Stone price index (STI)	0.32	0.31
R^2	6.32*	5.10*
F-value		

* Significant at 5% level. ** Significant at 1% level.

Table A5. Estimated parameters of equations showing shares of cereals and pulses in total food expenditure

Variables	Cereal share in total food expenditure	Pulses share in total food expenditure
Constant	0.948** (0.106)	0.023 (0.053)
Price of meat (LNP1)	–0.046** (0.007)	–0.005 (0.004)
Price of dairy product (LNP2)	–0.001 (0.005)	–0.002 (0.002)
Price of fish (LNP4)	–0.014** (0.005)	–0.003 (0.002)
Price of cereals (LNP5)	0.118** (0.011)	–0.005 (0.006)
Price of pulses (LNP6)	–0.015 (0.013)	0.036** (0.007)
Price of vegetables (LNP7)	–0.044** (0.010)	0.000 (0.005)
Price of fruits (LNP8)	–0.002 (0.005)	–0.004* (0.002)
Price of edible oils (LNP9)	–0.017 (0.013)	–0.002 (0.007)
Price of spices (LNP10)	–0.003** (0.005)	0.000 (0.003)
Price of sugar (LNP11)	–0.011 (0.013)	–0.008 (0.006)
Total expenditure on food (LNX)	–0.070** (0.006)	0.001 (0.003)
Natural log of household head's age (Lnage)	0.012** (0.007)	–0.002 (0.004)
Natural log of household head's education (Lnedu)	–0.003** (0.001)	–0.001** (0.000)
Natural log of household's family size (Lnfsiz)	0.010 (0.007)	0.001 (0.004)
Children below 6 yrs (yes = 1)	–0.006** (003)	0.003* (0.002)
Dummy for district (Dhaka = 1)	0.005 (0.006)	–0.004 (0.003)
Safety and quality index for dairy product (Safd)	–0.033** (0.006)	–0.005* (0.003)
Safety and quality index for meat (Safm)	0.022** (0.007)	–0.002 (0.004)
Total safety index (TSafindex)	–	–
Stone price index (STI)	0.025** (0.008)	0.004 (0.004)
R^2	0.74	0.33
F-value	55.75**	5.48**

* Significant at 5% level. ** Significant at 1% level.

Table A6. Estimated parameters of equations showing shares of vegetables and fruits in total food expenditure

Variables	Vegetable share in total food expenditure	Fruits share in total food expenditure
Constant	0.136** (0.047)	–0.110* (0.068)
Price of meat (LNP1)	–0.010** (0.003)	0.010* (0.005)
Price of dairy product (LNP2)	–0.002 (0.002)	–0.005 (0.003)
Price of fish (LNP4)	–0.003 (0.002)	0.005 (0.003)
Price of cereals (LNP5)	–0.004 (0.005)	–0.006 (0.007)
Price of pulses (LNP6)	0.022** (0.006)	0.015 (0.009)
Price of vegetables (LNP7)	0.044** (0.004)	0.019* (0.006)
Price of fruits (LNP8)	0.001 (0.002)	0.004 (0.003)
Price of edible oils (LNP9)	–0.001 (0.006)	0.000 (0.009)
Price of spices (LNP10)	0.002 (0.002)	0.009** (0.003)
Price of sugar (LNP11)	–0.001 (0.006)	–0.021** (0.008)
Total expenditure on food (LNX)	–0.028** (0.002)	0.010** (0.003)
Natural log of household head's age (Lnage)	0.004 (0.003)	0.006 (0.005)
Natural log of household head's education (Lnedu)	–0.0000473 (0.000)	0.001 (0.001)
Natural log of household's family size (Lnfsiz)	–0.014** (0.003)	–0.013** (0.005)
Children below 6 yrs (yes = 1)	–0.001 (0.002)	0.001 (0.002)
Dummy for district (Dhaka = 1)	–0.011** (0.003)	–0.005 (0.004)
Safety and quality index for dairy product (Safd)	0.001 (0.003)	0.019** (0.004)
Safety and quality index for meat (Safm)	–0.015** (0.003)	9.92E-005 (0.005)
Total safety index (TSafindex)	–	–
Stone price index (STI)	–	–
R^2	0.56	0.41
F-value	20.59**	9.20**

* Significant at 5% level. ** Significant at 1% level.

Table A7. Estimated parameters of equations showing shares of edible oil, spices and sugar in total food expenditure

Variables	Edible oil share in total food expenditure	Spices share in total food expenditure	Sugar share in total food expenditure
Constant	0.025 (0.019)	0.116** (0.040)	–0.168** (0.067)
Price of meat (LNP1)	0.002 (0.001)	0.001 (0.002)	–0.001 (0.004)
Price of dairy product (LNP2)	0.000 (0.001)	–0.003 (002)	–0.002 (0.003)
Price of fish (LNP4)	–0.001 (0.001)	0.002 (0.005)	–0.004 (0.003)
Price of cereals (LNP5)	–0.001 (0.002)	0.001 (0.004)	–0.007 (0.007)
Price of pulses (LNP6)	–0.001 (0.002)	0.003 (0.002)	–0.006 (0.008)
Price of vegetables (LNP7)	0.004** (0.002)	–0.003 (0.005)	–0.002 (0.006)
Price of fruits (LNP8)	–0.001 (0.001)	0.017** (0.002)	0.002 (0.003)
Price of edible oils (LNP9)	0.023** (0.002)	–0.016** (0.005)	–0.008 (0.009)
Price of spices (LNP10)	–0.002 (0.001)	–0.008* (0.004)	–0.002 (0.003)
Price of sugar (LNP11)	0.003 (0.002)	0.007** (0.003)	0.053** (0.008)
Total expenditure on food (LNX)	–0.014** (0.001)	–0.012** (0.002)	0.009** (0.003)
Natural log of household head's age (Lnage)	0.005 (0.001)	–0.001 (0.003)	0.001 (0.005)
Natural log of household head's education (Lnedu)	0.000 (0.000)	–0.001** (0.000)	9.05E-005 (0.000)
Natural log of household's family size (Lnfsiz)	–0.005** (0.001)	–0.007** (0.003)	0.013** (0.005)
Children below 6 yrs (yes = 1)	–0.001** (0.001)	–0.003** (0.001)	0.003 (0.002)
Dummy for district (Dhaka = 1)	–0.004** (0.001)	0.004 (0.003)	–0.002 (0.004)
Safety and quality index for dairy product (Safd)	–0.001 (0.001)	0.004* (0.002)	–0.011** (0.004)
Safety and quality index for meat (Safm)	0.000 (0.001)	0.003 (0.003)	0.006 (0.005)
Total safety index (TSafindex)	–	–	
Stone price index (STI)	–	–	
R^2	0.62	0.42	0.29
F-value	28.51**	9.80**	4.15**

* Significant at 5% level. ** Significant at 1% level.