Investigating Consumers' Preference on Fresh Vegetables in Bangladesh: Best-Worst Scaling Approach

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Abstract

Safety vegetables are nutritionally essential for our good health, but we are daily fighting against to take "Safe and Fresh Vegetables" for "sake of "Good Health" due to contamination, adulterations and pesticides residues effects. The aim of the study was to examine the consumers' preference for food quality and safety attributes of fresh vegetables by using quality and safety attributes of fresh vegetables using the best-worst scaling technique. The balanced incomplete block design procedure was employed to obtain a total 180 sample from Dhaka and Mymensingh city of Bangladesh. The data were collected through survey monkey software by using the pre-determined structured questionnaire and analyzed by the MaxDiff scaling and multinomial mixed logit regression model. The results revealed that fresh vegetable attributes were a combination of size, appearance, texture, freshness, and flavor as well as nutritional ingredients and safety aspects that determine their value to the consumer. The fresh vegetables contained vitamins, minerals and dietary fiber that satisfied consumer demand and helped to keep healthy and protect from diseases. The researchers found that nutritional value, purity, freshness, shelf life and safety are the most important attributes of fresh vegetables and variety, size, content, colour are the least important for the consumers. The study concludes that demand for can be significantly stimulated in the study area when these most important attributes have been considered by producers, processors, and marketers.

Keywords: Fresh Vegetables; Consumers 'preferences; Food safety; Products attributes; BWS

Introduction

Bangladesh is the 3rd position in global vegetable production, but it remained in the lower position in intake. The total vegetables production is 3.73 million but demand annually 13.25 million metric tonnes in Bangladesh (FAO, 2015). According to the World Health Organization (WHO), a healthy individual should take 220 grams of vegetable daily of which Bangladesh is intake only 70 percent of need. Vegetables are the main sources of essential vitamins such as A, C, niacin, riboflavin and thiamin, minerals such as calcium and iron and dietary fiber. They added to eat of crucial nutrients from other foods by making the more taste and dietary fiber necessary for digestion and maintaining health curing nutritional disorders [1]. Vegetables are not only minimizing the malnutrition but also maximize the economic returns.

Farmers are widely using toxic chemicals for vegetables production and pesticides uses to fight against pests. That's why vegetables are adulterated by various harmful chemicals and pesticides. On the other hand, traders are using toxic artificial ingredient and colors to extend its appearance and shelf life. Using chemical preservatives without concern for the health of the consumer is rampant. Now a day, food adulteration is becoming a "Silent Killer" in Bangladesh. Because, vegetables are contaminated by toxic chemicals and pesticides like carbide, formalin, heavy metal, chemical, textile colors, artificial sweeteners, DDT, urea and so on pose a serious threat to public health especially damaging vital organs like liver, kidney, pancreas etc. It is very difficult to find fresh and adulteration free vegetables in the market. For this reason, the worldwide fresh vegetables market has growing rapidly in recent years to a multi-billion-dollar sector, largely driven by increasing population growth, urbanization and changing consumption pattern as a result increasing consumer demand for healthy, freshly prepared convenient vegetables [2]. The quality of fresh vegetable includes a combination of attributes like appearance, texture and flavor, as well as nutritional and safety aspects that determine their value to the consumer. But challenge for producers, traders and retailers in

market is to predict consumer preferences for vegetables, because consumers represent the essential demand for vegetables and this demand is always not stable. Moreover, several studies [3,4] have been undertaken to determine consumer preferences for vegetable attributes and respective willingness to pay for various characteristics, thereby providing vegetables with desirable attributes to consumers and keeping the market fresh and alive. Furthermore, the lack of food safety, food security, nutrition and profitability are a problem no inherent to nature but with unjust societal systems and institutions. Lusk and Briggeman [5] also argued that understanding why consumers prefer a given attribute is important to determine the presence of market failure and therefore the need for public policy intervention. That's why, researchers set the objective of study is to elicit fresh vegetables attribute preferences among quality conscious consumers in Dhaka city and Mymensingh city of Bangladesh.

Theoretical framework of Best-Worst Scaling (BWS)

Best-Worst Scaling (BWS) is also called Maximum Difference Scaling (MaxDiff.) which is based on random utility theory (Thurstone, 1927; Cohen 2003) [6-8]. It is defined as a choice-based measurement approach that reconciles the need for question parsimony with the advantage of choice tasks that force individuals to make choices. BWS be a way to overcome some key shortcomings of common rating approaches (e.g. ties among items, response style bias, and standardization difficulties [9]. The BWS is superior to other methods, such as rating scales, because it forces respondents to discriminate between items, so results obtained from BWS are easy to interpret [10]. Unlike the rating scale, the BWS can also be used to compare both the intra and inter attributes. It builds on a body of items. The BWS approach effectively permits respondents to evaluate all pair-wise combinations of alternatives presented in a particular subset leading to the assumption that their "Best" and "Worst" choices represent the maximum difference in utility between all attributes. A respondent gets presented a series of sets and is asked to choose one best item and one worst item in each set. BWS assumes everyone has a latent scale of "utility" or "importance", and the scale value of objects will determine a person's choice over these objects. This scale value consists of two parts: one systematic part which can be understood as "intrinsic", and one random error component. Therefore, the probability of a certain project chosen as the best given other K options can be expressed as:

$$P(U = best \setminus A, B, C.....) = P(S_A > S_K = P[(V_A + \varepsilon_K)]$$

in which, and represent the scale value, the systematic component of the scale value and the error term respectively. McFadden further developed the conditional logit model under the independently and identical distribution assumption of the error terms, and the choice probability can be expressed as below [6,8].

$$P(A = best \setminus A, B, C.....K) = \exp(V_A) / \sum_{i=1}^{k} \exp(V_k)$$

Compared with other designs there are several advantages of BWS. It is suggested that choosing the "best" and the "worst" from a set of options can generate relatively consistent results compared to the ranking task and it offers more information than simply choosing the "best". Besides, when attributes under evaluation have multiple levels, BWS approach enables a comparison of all attribute levels on a single scale by setting only one level as reference [8,11].

BWS Design is to Estimates of Consumers' Rank of Preferences

The BWS is widely used for collecting data to analyze the consumers' preferences and becoming popular over time. It forces respondents to discriminate between scaled items and uses an underlying scale ratio of measurement [12]. This BWS method is consistent with consumer utility maximization. Based on this method, respondents are presented a set of items and they are demanded to indicate which one is the best and which is the worst [12]. For instance, the BWS was applied to investigate the relative importance consumers place on food values and to study preferences for sustainable farming practices [13]. Furthermore, efficient estimates can be obtained when repeated choices are made by the same respondent, which is the case in this present study [14]. Finally, the BWS method is gaining more popularity as a better alternative to the rating system and measuring value [15]. Therefore, the BWS method reported above fit well in this present study related to consumers' preferences for quality and safety attributes of fresh vegetables. This is captured by the difference between the most preferred and least preferred items chosen from the set, when consumers are making a purchase decision. This can be mathematically represented as in this equation:

$$U_{ij} = V_{ij} + \varepsilon_{ij}$$

Where,

U_{ij} is the utility for consumer i choosing vegetables having attribute, V_{ij} and ε_{ij} are the deterministic component and the error term of utility, respectively.

BWS was used to determine values which consumers placed on quality and safety. Thus, the balanced incomplete block design (BIBD) method was used to design the questionnaire administered to respondents. In total 15 (fifteen) attributes of vegetables have been considered in the study (Table 1). Fifteen blocks or questions and eight attributes were randomly assigned to each. This questionnaire was used to collect data from Dhaka and Mymensingh City such as city market, shops, open vendor where vegetables are sold to consumers [16-19]. For each question are asked to choose which option of vegetables attributes they most preferred and which one they least preferred. A sample question for this study based on best-worst scaling method is presented in Table 2.

Table 1: The list of most important attributes of fresh vegetables.

Attributes	Characteristics/Descriptions
Nutrient content	The amount of nutrient content in the vegetables. Is the intervention expected to provide good value for money? Vitamin A, B, C, E, polyphenolics, carotenoids, glucosinolates
Color	Color is derived from the natural pigments in vegetables many of which changes as the plant proceeds through maturation and ripening. The nature color of vegetables ranges from white to yellowish
Taste	Taste is a important attributes of vegetable combination of sweet, sour, salty, bitter, and umami. When preparing vegetables consumer think about it taste. The extent of which the consumption of vegetables is appealing to senses.
Labeling	The extent to which the vegetables can be easily identified and traced back
Nutritive value	A consumer expects fresh vegetables to be good sources of dietary fiber and many vitamins and minerals. The amount and type of nutrient, and vitamins are considered during the purchasing the vegetables.
Purity	The extent to which the vegetables is produced without additives
Safety/health risks	The extent to which consumption of vegetables will not cause illness
Hygiene/cleanliness	The extent to which the vegetables meets some basic sanitary standard
Shelf life	How long the vegetables can be kept before undergoing spoilage
Origin/traceability	The extent to which the identities and locations of producers and processors are known
Quality	Does the intervention address a particular need for indigenous Queenslanders?

Table 2: A Sample Questions for Best-Worst Scaling.

Most preferred	Attributes	Least preferred
☐	Taste	☐
	(Taste is the flavor of vegetables to recognize different by the consumer with appealing their senses)	
☐	Freshness	☐
	(Freshness is aging of vegetables that reflects its color, firmness, and smell before reaching to the consumers)	
☐	Color	☐
	(Vegetable color is very important for consumers. It comes from three main types of pigment: carotenoids, which give orange and yellow colors: flavonoids which provide blue, red and cream colors; and chlorophyll, which makes green that contain antioxidants, phytonutrients, and nutrients)	
☐	Variety	☐
	(Vegetables are available in many varieties in the country that classified two groups biological and families. It good for health because it contain rich vitamins, minerals and fiber and fight against the inflammation or reduce the risk of disease)	
☐	Label	☐
	(The name was given to the vegetables to know its traceability. Vegetable labels selection based in custom, handmade pieces from field and markets)	
☐	Nutritive value	☐

	(The extent to which vegetables meets your food requirement)	
☐	Shelf life	☐
	(Shelf life is the length of time that a vegetable may be stored without become unfit for use. Consumer want to know during the purchasing, how long the vegetables withstands before undergoing spoilage)	
☐	Pesticides free	☐
	(Pesticide free vegetables indicate farmers don't use any synthetic herbicides, insecticides or fungicides in their production. The extent to which vegetables can treat certain diseases)	

Materials and Methods

The study was conducted in Dhaka and Mymensingh City of Bangladesh because of large number of urban populations, quality conscious consumers live in the cities that's why a considerable amount of the fresh vegetables are comes here from all over the country. The balanced incomplete block design technique was used to obtain a total 180 sample (100 Dhaka City consumers and 80 Mymensingh City). Survey Monkey software was used to collect by pre-determine structured questionnaire and interviewed in F2F due to lack of reached respondents by e-mail, phone and internet facilities of Bangladeshi people. Descriptive statistics, BWS/MaxDiff and multinomial mixed logit regression model were used to analyze the collected data.

Results and Discussion

Demographics characteristics of survey consumers

The demographic profiles of respondents are illustrated in the Table 3. Among the total respondents about 63.50% were male and 36.50% were female. The ages were grouped into five categories and found that the highest (40.67%) age group under 30-40 years old and followed by 50-60 years old (25.34%), 40-50 years old (14.48%) and above 60 years old (2.25%) which is indicated most of the young respondents involved in household buying activities. As for matrials status about 83.89% were married, 12.22% were unmarried and 3.89% were unknown about the marital information as per survey questionnaire in the study areas. About 24.30% were employed in Government sectors, 57.30% were in private sectors, 7.50% were unemployed and 4.10% were retired. The result found that 5.21% of respondents' income was below BDT 20000 per month, 18.81% was in BDT 20000-40000, 25.46% was BDT 40000-60000, 25.46% was BDT 60000-80000, 19.82% was in BDT 80000-100000 and 12.4% was BDT 100000 and above, respectfully. The household size was 1-10 member with a relatively high share of respondent 37.78% were 4-5 persons per family, 25.00% was 2-3 persons per family, 22.78 % was 6-7 persons per family, 5.00% was 8-9 persons per family, 4.44% were about 10 persons and 0.56% were more than 10 persons per family and 4.44% was living alone. The Table 3 also showed that about 52.22% of the respondent had graduate education. This was followed by 20.00% had postgraduate, 17.78 % had higher secondary education, 6.67% had secondary education. This implies that most of the respondents attained certain level of formal education, which would facilitate understanding of improved selection method of fresh vegetable of the respondents more receptive to advisory services [20-25].

Table 3: Frequency Distribution of the Survey Consumers' Demographic Characteristics.

Sources: Field survey data 2019.

Demographic attributes (N=180)	Categories	Number of Respondents	Percentage (%)
Geographical Region	Dhaka City	100	55.56%
	Mymensingh City	80	44.44%
Age	Less than 30 years	26	14.48%
	30 years to 40 years	73	40.67%
	40 years to 50 years	31	17.26%
	50 years to 60 years	46	25.34%
	Above 60 years	4	2.25%
Gender	Male	114	63.50%
	Female	66	36.50%
Marital Status	Married	151	83.89%
	Single	22	12.22%

	Unknown	7	3.89%
Employment Status	Government Sector	44	24.30%
	Private Sector	103	57.30%
	Unemployed	14	7.50%
	Retiree	7	4.10%
	Others	12	6.80%
Monthly income	Less than BDT20000	9	5.21%
	BDT 20000-40000	34	18.81%
	BDT 40000-60000	46	25.46%
	BDT 60000-80000	36	19.82%
	BDT 80000-100000	33	18.30%
	BDT 100000 or More	22	12.40%
Education	Illiterate	5	2.78%
	Class five to ten	1	0.56%
	SSC	12	6.67%
	HSC	32	17.78%
	Graduate	94	52.22%
	Postgraduate	36	20.00%
Household size	1 person	8	4.44%
	2–3 persons	45	25.00%
	4–5 persons	68	37.78%
	6–7 persons	41	22.78%
	8–9 persons	9	5.00%
	10 persons	8	4.44%
	More than 10 persons	1	0.56%

Multinomial Mixed Logit (MML) model Estimates of Vegetables Attribute

Table 4: MML model estimates of vegetables attribute.

SD: standard deviation; SE: standard errors. ** and * are statistically significant levels at 1% and 5%, respectively. Zero values reported by Statistical Application Software (SAS) were used as basis for comparison.

Characteristics	Parameters	Overall	Dhaka City	Mymensingh City			
		Value	SE	Value	SE	Value	SE
Nutrient content	Mean	-0.550**	0.093	-0.609**	0.142	-0.567**	0.136
	SD	1.330**	0.118	1.620**	0.198	1.342**	0.168
Color	Mean	0.061	0.084	0.087	0.134	0.049	0.122
	SD	0.989**	0.122	1.252**	0.189	1.040*	0.175
Taste	Mean	-0.06	0.085	-0.133	0.136	-0.003	0.125
	SD	0.710**	0.142	1.043**	0.197	0.693**	0.205
Labeling	Mean	0.021	0.09	0.155	0.137	-0.104	0.132
	SD	0.035	10.06	0.407	0.39	0.057	1.241
Nutritive value	Mean	0.925**	0.082	1.113**	0.157	0.880**	0.121
	SD	0.065	0.74	0.238	0.574	0.019	1.018
Safety	Mean	0.199*	0.083	0.323*	0.145	0.103	0.121
	SD	0.548**	0.165	1.107**	0.195	0.294	0.361
Hygiene	Mean	0.766	0	0.985**	0.144	0.65	0

	SD	0.433*	0.201	0.976**	0.213	0.459	0.251
Shelf life	Mean	0.511**	0.095	0.509**	0.168	0.567**	0.139
	SD	0.987**	0.149	1.278**	0.229	1.026**	0.207
Freshness	Mean	0.347**	0.081	0.359**	0.139	0.376**	0.126
	SD	0.802**	0.132	0.900**	0.206	1.155**	0.174
Quality	Mean	-0.274*	0.09	-0.333*	0.147	-0.248	0.134
	SD	0.653**	0.152	1.063**	0.205	0.821**	0.194
Varieties	Mean	-1.382**	0.113	1.440**	0.163	-1.528**	0.169
	SD	1.080**	0.162	1.179**	0.254	1.091**	0.223
Pesticides free	Mean	-0.115	0.09	-0.327*	0.14	0.06	0.13
	SD	1.567**	0.113	1.913**	0.194	1.580**	0.166
Loglikelihood at convergence		-8,473		-4,934		-4,227	0
Loglikelihood at zero		-,0047.5		-5,278.50		-4,506	
Pseudo-R2		0.058		0.06		0.056	
N individuals		180		100		80	

The Table 4 shows that parameter estimates from the MML model. The coefficients with positive sign indicate that attributes are preferred, while coefficients with negative signs indicate that attributes are not preferred by consumers. The results found that nutritive value, shelf life, availability, purity and safety are positive and statistically significant, implying that consumers preferred to have vegetables products with these attributes. It also shows that varieties, nutrient content, packaging and handling convenience were negative and statistically significant, indicating consumers significantly discounted vegetables products having these attributes and standard deviation regardless of location (Dhaka city or Mymensingh city) for nutrient content, color, shelf life, purity, safety, hygiene, availability, handling convenience, type of animals, origin, food miles and therapeutic value were statistically significant, implying that these parameters indeed randomly vary over the population.

Relative Important of Consumers' Perceptions of on Fresh Vegetables

The relative importance of 15 (fifteen) attributes of vegetables is estimated by using MML model (Table 5). Researchers found that nutritive value, on average, is the most important vegetable attributes and significantly more important than hygiene, shelf life, availability, purity and safety are the next most important. Table 5 summarizes the results of simple count analysis. The relative importance of each variable is indicated by its B-W score, and the standard deviation suggests the degree of heterogeneity of consumers' perceptions on fresh vegetable attributes for food safety. The result shows that "standardization" "freshness" "physical appearance" and "traceability" are substantially more highly valued than the rest of the attributes, while "audit during sales life as long as possible" and "cold chain with pesticide and chemical used when asked by consumers" are underrated by most respondents. Most consumers are inclined to hold more positive attitudes towards "physical appearance to traceability", "hormone" and "fertilizer residue", and understate the importance of "fertilizer residue" and "pesticide residue costs with producers". Nevertheless, consumer' perceptions on the importance of vegetable attributes, such as "hormone", "fertilizer residue" and "pesticide residue life as long as possible" tend to diverge as reflected by the large standard deviations of their B-W scores, which also suggests the need to further exp lore respondent heterogeneity [26-30].

Table 5: Estimated Relative Important of Consumers' Perceptions of on Fresh Vegetables.

Source: Field survey data 2019.

Rank	Variables	Best	Worst	B-W	Mean	SD
	Variable Names	Variable Definitions				
1	Standardization	Thinking that there is standardization for issues like length, color for fresh vegetables (Berdegue et al., 2005)	768	31	737	2.583	1.071

2	Freshness	Paying attention to consuming vegetables in their fresh form (Bond et al, 2009)	748	43	705	2.475	1.098
3	Size	Crushed fresh vegetables having adverse effects on the purchasing decision (Kays, 1999; Oraman and Unakıtan, 2010)	432	160	272	0.954	1.413
4	Traceability	Not being able to ensure traceability during the production and marketing of vegetables (Liao et al., 2011)	392	184	208	0.729	1.224
5	Hormone	Consumer opinion regarding the use of hormones by farmers (Smith and Reithmuller, 1999; Oraman and Unakıtan, 2010)	348	237	112	0.396	1.557
7	Pesticide residue	Consumer opinion that there is pesticide residue on the vegetables (Safefood, 2007; Oraman and Unakıtan, 2010)	102	485	-383	-1.341	1.368
8	Audit during production	Consumers thinking that the audits at the farms are sufficient (Safefood, 2007)	80	723	-643	-2.259	1.521
9	Audit during sales	Consumers thinking that the audits during sales are sufficient (Bal et al., 2006; Safefood, 2007)	22	771	-750	-2.628	0.963
10	Varieties	Vegetables are available in many varieties and can be classified into biological groups or 'families',	160	424	-264	-0.927	1.539

BWS for Consumers Preferences

Table 6 showed that the average BWS scores with high scores corresponding to attributes that were like and the low scores corresponding to attributes that were disliked. The scores reflect some expected patterns which provide some evidences that our consumers appropriately read and interpreted the questionnaire. BWS scores also support quantitative comparison between levels within an attribute, and even across attributes something that is not possible with traditional likert-scale ratings. The Table 6 shows that the average best-worst scaling (BWS) score were -0.806 for food borne pathogens, -0.698 for heavy metals, -0.452 for pesticide residues, 0.415 for food additives, .060 for naturally occurring toxins and -0.340 for veterinary residues of food safety attributes. The average best-worst scaling (BWS) score of nutrition attributes were fat (0.040), calories (0.554), fiber (0.541), vitamins (0.253), sodium (-0.523), and mineral (0.323). Under the value attributes of fresh vegetables, the BWS scores were purity (-0.250), compositional integrity (0.216), appearance (-0.343), taste (0.251), convenience of preparation (-0.542) and size (-0.351). The average best-worst scaling (BWS) scores of production process attributes were genetic modification (-0.351), environmental impact (0.560) and pesticide use (0.140).

Table 6: BWS Scores of Quality Attributes of Fresh Vegetables.

Note: Parentheses indicated Standard Error.

Source: Field survey data 2019.

Quality Attribute	Level of Quality Attributes	Average BWS Score
Vegetables safety attributes	Food borne pathogens	-.806 (.050)
	Heavy metals	-.698 (.059)
	Pesticides residues	-.452 (.074)
	Food additives	. 415 (.073)
	Naturally occurring toxins	.060 (.049)
Nutrition attributes	Fat	.040 (.068)
	Calories	.554 (.053)
	Fiber	.541 (.043)
	Vitamins	.253 (.035)
	Sodium	-.523 (.053)
	Mineral	.323 (.027)
Value attributes	Purity	-.250 (.054)
	Compositional integrity	.216 (.041)
	Appearance	-.343 (.067)
	Taste	.251 (.047)
	Convenience of preparation	-.542 (.073)
	Size	-.115 (.035)
Attributes of production process	Genetic modification	-.351 (.054)
	Environmental impact	.560 (.057)
	Pesticide use	.140 (.041)

Conclusion

BWS was used to identify the fresh vegetables attribute preference among the quality conscious consumers in the selected areas of Bangladesh. BIBD method was used to design the questionnaires and 180 consumers were purposively sampled and interviewed. The results found that nutritive value, shelf life, availability, safety and purity are the most important attributes, whereas verity, nutrient content, handling convenience and food miles are the least important attributes. This indicates that consumers place a high preference for nutritive value, shelf life, availability, safety and purity attributes of fresh vegetables. It implies that consumers are more concerned about vegetables with these attributes and this can significantly stimulate demand. The output also helps people along the value chain of vegetables to provide consumers with desirable attributes of vegetables, thereby enhance not only the profitability of their business, but also improve the overall welfare of consumers. The BWS technique, however, appropriate in ranking order of importance, had never been used in ranking choice of fresh vegetable purchase. Finally, the study created future direction for ranking of choice setting of consumer behavior analysis to researchers, academician and policymaker in context of Bangladesh as well as developing countries.

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