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How Do Quality Attributes of Banana Vary by Market Segments? A Hedonic Pricing Analysis

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ABSTRACT

Background: Bananas are the second most produced and consumed fruit in Bangladesh, but mostly by poor consumers. The purpose of this study is to identify the important quality attributes of bananas.

Methods: In total, 200 respondents were physically interviewed from three regions of Bangladesh using a self-administered, semi-structured questionnaire from September to October 2020. The study applies hedonic pricing model to estimate the marginal implicit price of those attributes of bananas.

Result: The results show that poor consumers buy and consume more bananas (62% more) than other income levels. Results also indicate that variety is the most influential attribute for banana purchase decisions, *i.e*., consumers pay 12% more for sagar bananas. Consumers also pay more for size, color, damage-free and wrinkle-free bananas and less for hard flesh and an extra stick. The study concludes that banana sellers may make more money if marketing plans are developed for each of the consumer market segments.

Key words: Banana, Marginal implicit price, Market segments, Quality attributes.

Abbreviations: BBS, Bp test, FAO, WHO.

INTRODUCTION

Regular intake of high-nutrient fruits is essential for healthy (Polsky and Garriguet, 2020; Liu, 2003) and an active lifestyle (Sidhu and Zafar, 2018) as they are rich in vitamins and minerals (Better Health Channel, 2018; Slavin and Lloyd, 2012). It helps not only to prevent non-communicable ailments (Ruthsatz and Candeias, 2020) but also lowers the risk of chronic diseases such as stroke, cardiovascular disease, hypertension and type 2 diabetes *etc.* (Liu *et al.,* 2000; Bazzano, 2006; Health Canada, 2019; Li *et al.,* 2014). The World Health Organization (WHO) estimated that cardiovascular disease alone will claim the lives of around 18 million people globally (Singla *et al*., 2022). Thus, the FAO and WHO recommend that adults consume at least 400g of fruits and vegetables each day, particularly if they are elderly (WHO, 2003).

Bangladesh has a per capita fruit consumption of only 35.78 g/day, while poor consumers intake just 15.19 g/day (BBS 2017), which is far below India's 57.69 kg/person and worth noting as China and Canada which have the highest fruit consumption worldwide at 97.93 kg/person (FAO, 2021a). This clearly shows that Bangladesh consumes less fruit per person than other nations, particularly bananas, which are declining at a rate of 0.64% per capita while global consumption is rising at a rate of 0.22% (FAO, 2021 b). This is because the price difference between bananas and other fruits sold in the market is the main factor driving underprivileged consumers to purchase bananas.

Although Bangladeshis only consume 27.62 kg of fruit year on average, they rely heavily on bananas to prevent malnutrition, making them the second most nutritious food in the country in terms of kilocalories per decimal over the year (Fiedler, 2014). Bangladesh produces bananas only for domestic consumption (BBS, 2018), ranking 14th globally (Hossain, 2014) among 112 countries where bananas are cultivated (UNICEF and WHO, 2017). Even in 2016-2017, the total banana production of Bangladesh was 0.8 million tons (BBS, 2018; FAO, 2021b), representing 20% of total fruit production and a market share of 36% (Fonsah *et al.,* 2017).

The purpose of the study, therefore, is to identify the implicit price of banana quality attributes. The study will overcome the knowledge gap of the consumers to purchase bananas, which may overcome the health and environmental risks (Ikhajiagbe *et al.,* 2021). Therefore, the study postulates three specific objectives namely; (a) To identify which quality attributes of banana, pay off the most, (b) To find out the buying behaviour of the different

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income-level consumer groups and (c) To calculate the marginal price of the quality attributes.

The study is important since bananas contain several bioactive compounds that may provide several health benefits (Singh *et al.,* 2016; Sidhu and Zafar, 2018) and the consumption of bananas improves human health because bananas contain iron, fiber, vitamins and minerals (Choo and Aziz 2010; Kumar *et al.,* 2012; Evans *et al.,* 2020; Sora *et al.,* 2023; Kukreja and Sharma, 2024). Bananas also contain several essential nutrients (Prodhan *et al.,* 2017) and various antioxidants (Someya *et al.,* 2002; Kanazawa and Sakakibara 2000) that protect against coronary heart disease (Hertog *et al.,* 1993). The only solid food given to the infant is banana (Hossain 2014; Hossain *et al.,* 2016). Nigerians eat bananas as a filling snack at home and while traveling (Emerole *et al.,* 2013). The mixture of rice and ripe banana is one of the traditional and delicious foods in Bangladesh (Hossain 2014). Often referred to as the "fruit of the wise men" in India, bananas are currently regarded as one of the most significant fruit crops in the world (Saravanapandeeswari and Vanitha, 2018; Hazarika *et al.,* 2021).

Literature on the hedonic pricing of bananas is not very strong (Basan 2017; Mugisha *et al.,* 2008), though consumer preferences for banana purchase decisions prevail a lot. While Sporleder *et al.,* 2014 demonstrated that trust plays a significant influence in customer choices; Basan (2017) observed that consumers, particularly high-income consumers in the Philippines, evaluate quality qualities and pay a price premium for bananas. The study added that low- and middle-income consumers accept bananas with or without blemishes. Banana size, taste, flavor (Ayinde *et al.* 2008), sweetness, color, flavor (Opara *et al.,* 2007) and texture (Mugisha *et al.,* 2008) which are also important for banana purchase and consumption decisions. The German consumers added that bananas with yellow-green colors are preferred over bananas with brown color (Symmank *et al.,* 2018). On the other hand, consumers from Uganda concluded that they were willing to pay a 70-98% price premium for genetically modified bananas (Kikulwe *et al.,* 2010). To the authors' knowledge, the study of banana quality attributes in developing countries like Bangladesh does not exist. Therefore, the study confirmed that banana retailers may benefit if they consider the quality attributes of bananas in their selling strategies.

The next section explains the study's materials and methods, then moves on to results and discussion and finally conclusion.

MATERIALS AND METHODS

The hedonic price model is a popular method of identifying the implicit price of a product's quality attributes. The model was applied following the study of Waugh (1928) which first identified the price of vegetables (asparagus, tomatoes and cucumbers) based on some quality attributes, *i.e.,* size, color and variety *etc.* The theory was later formally introduced by Court (1941) and Tinbergen (1951, 1956).

Lancaster (1966) used the model to make consumer choice decisions. He said "A product is a collection of quality attributes for which consumers buy the product and maximize its utility, subject to a budget constraint". The following is the typical hedonic price model for calculating the implicit price of a product's quality attributes (Lancaster, 1966).

$$p = f(z_k) \qquad ...(1)$$

$$\text{Subject to : } \max U(x, z) \qquad \forall\, y = b + mx$$

Where,

p = Price of a product as the function of its quality attributes.

Z_k= Vector of quality attributes.

x = Consumer utility is the function of a numeraire good.

z = Purchase of the differentiated good.

Where,

y = Total income of the consumer is assumed to choose a bundle of goods.

Based on the above stated standard hedonic price model, the following augmented model was used to calculate the implicit price of the banana quality attributes.

$$\log(p) = \alpha + \beta.\log(q) + \gamma.\text{variety}_i + \delta.\text{size}_i + \vartheta\sum z_k + u_k \qquad ...(2)$$

Here, log (p) = Logarithm of banana price.

log (q) = Logarithm of quantity, a consumer purchase at a time.

α = Average price of banana if all things being equal.

β, γ, δ and ϑ = Indicate the estimated values of the parameters of quantity, variety (sagar or others), size (grade I or II) and the rest of the quality attributes such as color, wrinkle-free, damage-free, ripeness, traceability, chemical-free, hard flesh.

U_k= Unobserved banana quality attributes which are assumed as null for this study.

The regressors variables are measured by dummy variable except quantity purchased (in continuous form). The semi-log functional form of robust regression models were applied to find out the value of the estimated parameters.

At first, the parameters were estimated using the full sample. Later, the parameters were estimated for different consumer groups by income, banana variety and size. All the variables are interpreted following Halvorsen and Palmquist (1980). The validity of the model was tested by the Breusch-Pagan/ Cook-Weisberg (*bp*) test.

Field work

In total, 200 samples were collected from three different regions (Barishal, Khulna and Dhaka) of Bangladesh during the period of September-October 2020. The sampling areas are illustrated in the following Fig 1.

The samples were collected randomly using a semi-structured questionnaire. Before that, the questionnaire was pre-tested among 15 banana consumers and according to the pre-test, the questionnaire was finalized

for this study. The questionnaire was divided into three sections: general inquiries about buying bananas, examination of banana quality qualities and customer demographics questions. The following Table 1 presents the demographic profile of the respondents.

Table 1 shows that 70% of the total respondents are from Barishal division and the remaining are from Khulna (14%) and Dhaka (16%). The adult age group has the greatest number of respondents. The reason is that the respondents are mostly from other occupations namely; students, drivers and housewives, *etc.* (52% of the total respondents). Around 18% of respondents are self-employed or business owners, with the remainder working in the private (23%) and government (7%) sectors. The table also shows that the maximum number of respondents' income is low due to other occupation categories and represents at least 62% of the total respondents. The result is opposite to the study of Rasoli *et al.* (2021), where they found that there is a positive relationship between income and purchase of food products.

The table also shows that the average monthly expenditure on fruits is BDT. 2,760 and the average monthly expenditure on bananas is BDT. 304. The findings are consistent because people spent less money on fruits because the majority of their money was spent on necessities such as rice, fish, lentils and so on. The following Table 2 presents the summary statistics of the variables included in the hedonic price models.

Table 2 shows that consumers purchase at least seven bananas at a time. The price per stick banana is almost 6 BDT. The findings suggest that yellow bananas, which are ripe and have a sweet taste, are the main reason why consumers buy them. Consumers are less concerned about banana traceability because maximum people in Bangladesh are unaware of this attribute. Similar results are revealed in the estimation of the hedonic price models, where it is seen that traceability is not significantly important to the decision to purchase bananas for this study (see Table 3 and 4). However, consumers consider size and wrinkle-free in some context.

RESULTS AND DISCUSSION

Eight regression models in total were estimated to determine the significance of quality attributes affecting consumer choices for bananas in Bangladesh. Table 3 below shows the estimated parameters of the choice to buy bananas for various consumer income categories, encompassing the entire sample size.

The first model shows the consumer purchase decision for the full sample size. The latter three models show the purchase decisions of low-, middle- and high-income consumers. The table shows that all the models are valid since the F-statistics are significant at 1-10% levels. The R-squared values illustrate how price variations are caused by several banana quality parameters. For example, the price of bananas would change by 42% if the variables included in the full sample size model changed by 100%. The result shows that quantity, variety, size, color, damage-free and hard flesh are significantly important for banana purchase decisions. P-values indicate that ripeness, wrinkle-freeness, traceability and chemical-freeness are not significant factors in any situation when it



Fig 1: Sampling areas of the study.

Table 1: Demographic profile of the respondents.

Criteria	Frequency	Percentage
Area		
Barishal division	139	0.70
Khulna division	28	0.14
Dhaka division	33	0.16
Age (years)		
Young if age is less than 21	12	0.06
Adult if age is 21-30	138	0.69
Parenthood if age is 31-40	24	0.12
Post-parenthood if age is more than 40	26	0.13
Occupation		
Govt. service	14	0.07
Private service	46	0.23
Self-employed/Businessman	37	0.18
Others	103	0.52
Monthly Income (BDT)		
Low if income is less than 20,000	123	0.62
Middle if income is 20,000-40,000	55	0.27
High if income is more than 40,000	22	0.11
Monthly expenditure on fruits (BDT)	200	2,760
Monthly expenditure on banana (BDT)	200	304

Source: Authors' own estimation.

comes to banana buying decisions. However, the results may be different if a large number of sample sizes or more areas are considered in the scope of future research.

The results infer that consumers pay more for banana variety, size, color and damage-freeness while pay less for an extra stick and banana's hard flesh for full sample size. The results are in line with the study of Hossain and Badiuzzaman (2021) especially in the case of Guava for size, color and Hog plum for quantity. The results are also consistent with the study of Hossain *et al.* (2022) with respect to the parameters explanation of color and extra stick of banana. Consumers pay at least 12% more if the

Table 2: Summary statistics of the variables included in the hedonic price models (Sample size, n = 200).

Variable	Description	$\overline{X}$	σ	Min	Max
Price	Price per stick banana in BDT	5.79	1.55	3	10
Quantity	Number of banana sticks purchase at a time	7.32	5.59	1	25
Variety	Sagar banana =1 and 0, otherwise	0.32	0.47	0	1
Size	Size ≥ 4 inches and 0, otherwise	0.56	0.50	0	1
Color	Yellow color =1 and 0, otherwise	0.92	0.27	0	1
Wrinkle free	Wrinkle free =1 and 0, otherwise	0.52	0.50	0	1
Damage free	Damage free =1 and 0, otherwise	0.74	0.44	0	1
Ripeness	Ripen =1 and 0, otherwise	0.90	0.30	0	1
Traceability	Traceability =1 and 0, otherwise	0.05	0.22	0	1
Chemical free	Chemical free =1 and 0, otherwise	0.21	0.40	0	1
Hard flesh	Hard flesh =1 and 0, otherwise	0.26	0.44	0	1

Source: Authors' own estimation, field survey (September-October 2020).

Table 3: Estimated parameters of the variables for hedonic price models by income groups.

Variable	Full sample	Low-income	Middle-income	High-income
	β ($\sigma\overline{\chi}$)	β ($\sigma\overline{\chi}$)	β ($\sigma\overline{\chi}$)	β ($\sigma\overline{\chi}$)
Logquantity	-0.055***	-0.040*	-0.121***	0.073
	(0.017)	(0.021)	(0.042)	(0.143)
Variety	0.124***	0.120***	0.087***	0.132*
	(0.014)	(0.018)	(0.031)	(0.072)
Size	0.066***	0.056***	0.081**	0.004
	(0.013)	(0.015)	(0.034)	(0.066)
Color	0.041*	0.045	0.073	-0.045
	(0.023)	(0.027)	(0.052)	(0.090)
Wrinkle free	-0.010	0.000	-0.010	-0.074
	(0.013)	(0.016)	(0.030)	(0.071)
Damage free	0.028*	0.023	0.086**	-0.010
	(0.015)	(0.016)	(0.039)	(0.079)
Ripeness	0.030	0.009	0.063	0.073
	(0.021)	(0.025)	(0.040)	(0.155)
Traceability	-0.013	0.032	-0.022	-0.114
	(0.029)	(0.034)	(0.064)	(0.120)
Chemical free	0.004	0.004	0.014	0.043
	(0.016)	(0.019)	(0.034)	(0.082)
Hard flesh	-0.032**	-0.018	-0.064*	-0.085
	(0.016)	(0.020)	(0.032)	(0.067)
Constant	0.638***	0.648***	0.600***	0.681**
	(0.035)	(0.041)	(0.084)	(0.277)
Observations	200	123	55	22
F-statistics	13.70***	8.25***	6.07***	1.54*
R-squared	0.420	0.424	0.580	0.583

Note: The dependent variable is price in logarithm. β and $\sigma\chi$ refer to the parameter estimated for the exogenous variables and robust standard errors in parentheses. Source: Author estimations (2020). */**/*** indicate the variable significance at 10%, 5% and 1% level.

banana is *sagar*, *ceteris paribus*. On the other hand, consumers pay least for an additional stick, discounted by at least 5% if other things remain constant. Consumers also pay less for hard flesh by at least 3%, ceteris paribus.

Similar results prevail in middle-income consumers, with the exception of the color attribute. High-income consumers consider only the variety of banana and are willing to pay 13% more for this attribute. Poor consumers purchased bananas more than the other two income groups' consumers; at least 62% of the total respondents (Table 1). Consumers are willing to pay more for size and variety and less for quantity. The similar results in the case of size and less for quantity are observed in the study of Hossain *et al.,* 2021 for hog plum purchase decision in the southern part of Bangladesh. The following table 4 illustrates poor consumers' buying decisions of bananas by their variety and grade.

The results show that all models are valid in terms of the p-values of F-statistics (Table 4). With the exception of ripeness, traceability and chemical freedom, the models adequately predicted the price fluctuations of bananas. For example, at least 84% of the variation in banana price can be explained by changes in each of the independent variables included in the grade II model.

The results show that poor consumer buying decisions vary by banana variety and its grade. Consumers make different purchasing decisions for different banana varieties, such as *sagar* banana, which considers only a single attribute, namely, quantity, whereas other banana varieties, such as *sabri*, *champa* and so on, consider more attributes such as size and color. The price premium for the size of *sabri, champa* and so on is consistent with the study of Sarder *et al.* (2020).

The poor have different options when it comes to banana size. When making purchasing decisions for both grades of banana, consumers consider variety. The differences between grades I and II are observed in terms of wrinkle-free, damage-free and hard flesh. For example, consumers pay at least 27% more if the grade I banana is *sagar*, *ceteris paribus*. Consumers also prefer grade I bananas for their hard flesh quality and are willing to pay 3% more for it, whereas grade II bananas are preferred if they are wrinkle- and damage-free. Consumers pay 14% more if the grade II banana lacks wrinkle and pay 13%

Table 4: Estimated parameters for different poor consumer subgroups.

Variable	Sagar	Others	Grade I	Grade II
	β ($\sigma\bar{\chi}$)	β ($\sigma\bar{\chi}$)	β ($\sigma\bar{\chi}$)	β ($\sigma\bar{\chi}$)
Logquantity	-0.115*	-0.017	-0.003	-0.092
	(0.058)	(0.026)	(0.019)	(0.097)
Variety	-	-	0.084***	0.277**
			(0.016)	(0.107)
Size	0.062	0.051***	-	-
	(0.046)	(0.016)		
Color	-	0.043*	0.029	-0.008
		(0.024)	(0.022)	(0.109)
Wrinkle free	0.000	0.000	0.006	0.142*
	(0.044)	(0.019)	(0.013)	(0.074)
Damage free	0.032	0.019	-0.010	0.130*
	(0.045)	(0.020)	(0.014)	(0.068)
Ripeness	0.074	-0.007	-0.020	0.088
	(0.064)	(0.017)	(0.022)	(0.094)
Traceability	0.066	-0.013	-0.022	-
	(0.070)	(0.020)	(0.027)	
Chemical free	0.041	-0.002	-0.016	-0.096
	(0.067)	(0.015)	(0.017)	(0.064)
Hard flesh	0.019	-0.035	0.030*	-0.076
	(0.050)	(0.025)	(0.017)	(0.083)
Constant	0.783***	0.664***	0.718***	0.718***
	(0.088)	(0.037)	(0.033)	(0.150)
Observations	31	92	107	16
F-statistics	1.40*	1.72*	5.95***	4.86**
R-squared	0.337	0.224	0.340	0.847

Note: The dependent variable is price in logarithm. β and $\sigma\bar{\chi}$ refer to the parameter estimated for the exogenous variables and robust standard errors in parentheses. Source: Author estimations (2020). */**/*** indicate the variable significance at 10%, 5% and 1% level.

more for damage-free bananas, *ceteris paribus*. However, according to the respondents, the color of the banana-yellow in Bangladesh-generally reflected its ripeness. The results show that poor consumers purchase mostly other types of bananas due to their lower price. The results also show that consumers purchase grade I bananas due to their quality attributes rather than the grade II bananas.

The results aforementioned reveal that variety is the most important attribute for banana purchase decisions due to its availability all over the country. The result is consistent with the study of Emerole *et al*. (2013). Size and quantity are the second-most important attributes for the purchase decision of a banana, followed by damage-free, hard flesh, color and wrinkle-free. In Nigeria, size is one of the most important factors in banana purchasing decisions, while color is the least important (Ayinde *et al*. 2008). Poor consumers pay 27% more for sagar banana when its size is equal or more than 4 inches. Similar results were identified in the study of Basan (2017). In addition, the study revealed that consumers pay more for damage-free bananas. The study further revealed that color (yellow) positively influences the price of bananas (Mugisha *et al*. 2008) which is opposite to the study of Basan (2017). Basan also discovered that the price of bananas in the Philippines is adversely affected by green and green-yellow bananas.

Policy implications

The study suggests that the actors involved in the fruit supply chain can consider the factors influencing consumers purchase decisions. For example, the producer may consider the variety and the size of the banana to maximize their profits. The reason is that the majority of the banana growers have low-to-medium knowledge of banana cultivation technology (Thorat *et al.,* 2014) and lack modern agricultural practices for producing quality bananas (Fonsah *et al.,* 2017). Therefore, the knowledge of farmers about the modern cultivation technique should be improved and it should be encouraged for them to adopt the new technology to produce more bananas (Hossain *et al.,* 2015; Thorat *et al.,* 2014; Basan, 2017) so that they can earn more profits from this fruit business.

The *aratdars* may consider the storage and transport facilities of bananas so that the fruit cannot be damaged. Therefore, the farmers are not willing to produce more bananas due to lack of proper storage facilities (Kamal *et al.,* 2014). Similar findings were found by Ni *et al.* (2020), who also claimed that freshness has a major role in determining bananas market price. Retailers may take into account a number of attributes in order to divide the market into distinct customer groups and ascertain their needs. Finally, the government may monitor to discourage the use of any chemical for the protection of human health, sustainable environmental development through agricultural extension officers. The further research may be improved the quality of bananas with the coordination and integration between university, Bangladesh Agricultural Research Institute (BARI) or extension officials and research agencies.

CONCLUSION

Quality bananas are necessary since the poor consumers' health may be worsening because they do not have access to alternatives in the Bangladeshi fruit market at the same price. Therefore, the aim of the study is to identify the implicit price of the banana attributes.

The study found that banana variety is the most important attribute for consumers purchase decisions. Size, variety, color, damage-freeness, wrinkle-freeness all increase the price of bananas, while hard flesh and quantity decrease the price. The findings show that poor consumers prefer other types of bananas due to their lower price and grade I for quality attributes. The study also revealed that poor consumers pay more for *sagar* variety and sizes of 4 inches or more, while paying less for an extra stick. The lack of damage and hard flesh of bananas distinguishes middle-income consumers from poor consumers. High-income consumers consider only the *sagar* variety for their purchase decision and pay 13% more. Consumer's value other varieties quality attributes more than *sagar's*. The results further revealed that consumers consider more attributes for a grade II banana than a grade I banana due to the latter's lower quality.

The implication of the study is that actors involved in the banana supply chain may benefit from this study, considering the factors important for banana purchase decisions. The banana's quality may be ensured if proper transport and storage facilities are improved. Therefore, the role of *aratdars* is highly important for selling bananas. The retailers also consider these factors to sell the bananas according to the consumers' needs and preferences. The distinguished authority, such as BARI may supervise the production system to control the use of any residues for the production and distribution of bananas.

The contingent valuation method may be applied to rank the banana attributes. The study only shows the price variation of banana due to its quality attributes, lacks the consumption patterns of different regions. The study may be different if a larger sample size would be considered, a future scope of the research.

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Disclaimers

The views and conclusions expressed in this article are solely those of the authors and do not necessarily represent the views of their affiliated institutions. The authors are responsible for the accuracy and completeness of the information provided, but do not accept any liability for any direct or indirect losses resulting from the use of this content.

Conflict of interest

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REFERENCES

Ayinde, O.E. Adewumi, M.O. and Folorunsho, W.O. (2008). Consumer preference of banana (*Musa spp.*) in Kwara State, Nigeria. In IV International Symposium on Banana: International Conference on Banana and Plantain in Africa: Harnessing International. **879:** 89-93.

Basan, R.J.P. (2017). Consumer preference of table banana quality by income groups in the philippines: Hedonic price analysis. *Asian Journal of Agriculture and Development*. **13:** 21-34.

Bazzano, L.A. (2006). The high cost of not consuming fruits and vegetables. Journal of the American Dietetic Association. **106(9):** 1364-1368.

BBS (Bangladesh Bureau of Statistics). (2017). Preliminary report on household income and expenditure survey 2016.

BBS (Bangladesh Bureau of Statistics). (2018). Yearbook of Agricultural Statistics-2017. Statistics and Information Division, Ministry of Planning, Government of the People's Republic of Bangladesh, 29th Series, April 2018.

Better Health Channel. (2018). Fruit and Vegetables. Available from https://www.betterhealth.vic.gov.au/health/healthyliving/fruit-and-vegetables?viewAsPdf=true/accessed 2 March 2021.

Choo, C.L. and Aziz, N.A.A. (2010). Effects of banana flour and β-glucan on the nutritional and sensory evaluation of noodles. *Food Chemistry*. **119(1)**: 34-40.

Court, L.M. (1941). Entrepreneurial and consumer demand theories for commodity spectra: Part I. *Econometrica: Journal of the Econometric Society*. pp. 135-162. doi: https://doi.org/10.2307/1906875.

Emerole, C.O. Osondu, K.C. Anyiro, C.O. and Orji, O.A. (2013). Trade enhancement characteristics of dessert banana fruits and estimates of transaction costs in okigwe metropolis, imo state nigeria. *International Journal of Food and Agricultural Economics*. **1:** 141-150.

Evans, E. A. Ballen, F. H. and Siddiq, M. (2020). Banana Production, Global trade, Consumption trends, Postharvest handling and Processing. Handbook of Banana Production, Postharvest Science. *Processing Technology and Nutrition*. pp. 1-18.

FAO (Food and Agriculture Organization of the United Nations). (2021a). Fruits-Excluding Wine-food Supply quantity (kg/capita/yr). Available from http://www.fao.org/faostat/en/#data/FBS/; accessed 15 April 2021.

FAO (Food and Agriculture Organization of the United Nations). (2021 b). Banana Consumption per Capita in Bangladesh. Available from http://www.fao.org/faostat/en/#data/FBS; accessed 20 April 2021.

Fonsah, E.G. Manower, T. Hussain, A. Chattapadhya, S. Islam, S. Islam, M.S. Uddin, M.J. Amin, A.S. and Amin, B. (2017). Factors affecting banana agricultural value chain in Bangladesh. *Journal of Food Distribution Research*. **48(1):** 22-32.

Fiedler, J.L. (2014). Food crop production, Nutrient availability and Nutrient intakes in Bangladesh: Exploring the Agriculture-Nutrition Nexus with the 2010 Household Income and Expenditure Survey. *Food and Nutrition Bulletin*. **35(4):** 487-508.

Halvorsen, R. and Palmquist, R. (1980). The interpretation of dummy variables in semilogarithmic equations. *American Economic Review*. **70(3):** 474-475.

Hazarika, M. Sarma, R. and Phukon, K. K. (2021). An analysis on area production and productivity of banana in Assam. *Agricultural Science Digest*. **41(2):** 334-337. doi: 10.18805/ag.D-5219.

Health Canada. (2019). Canada's dietary guidelines for health professionals and policy makers. Available from https://www.canada.ca/en/health-canada.html/, accessed 8 March 2021.

Hertog, M.G. Feskens, E.J. Kromhout, D. Hollman, P.C.H. and Katan, M.B. (1993). Dietary antioxidant flavonoids and risk of coronary heart disease: the zutphen elderly study. *The Lancet*. **342(8878):** 1007-1011.

Hossain, A. and Badiuzzaman. (2021). Hedonic prices for the fruit market in Bangladesh: Lessons from guava and hog plum purchase decisions. *Journal of Retailing and Consumer Services*. **62:** 102636.

Hossain, A. Hoq, M.S. and Mandal, A.K. (2021). Hedonic price analysis for hog plum purchase decision in southern part of Bangladesh. *Bangladesh Journal of Agricultural Research*. **46(1):** 107-116.

Hossain, A. Islam, I. and Deba Nath, S. (2022). Does quality matter for fruit purchase decisions? A hedonic analysis. *Journal of International Food and Agribusiness Marketing*. pp. 1-18.

Hossain, M.F. (2014). A study of banana production in Bangladesh: area, yield and major constraints. *Journal of Agricultural and Biological Science*. **9(6):** 206-210.

Hossain, M.M. Abdulla, F. and Majumder, A.K. (2016). Forecasting of banana production in Bangladesh. *American Journal of Agricultural and Biological Sciences*. **11(2):** 93-99.

Hossain, M.M. Alam, M.A. and Uddin, M.K. (2015). Application of stochastic frontier production function on small banana growers of kushtia district in Bangladesh. *Journal of Statistics Applications and Probability*. **4(2):** 337.

Ikhajiagbe, B. Ogochukwu, O.F. and Ogwu, M.C. (2021). Shelf life, fruit quality and safety of banana (Musa species) ripened through traditional ripening techniques in Nigeria. *International Journal of Fruit Science*. **21(1):** 66-81.

Kamal, M.S. Ali, M.A. and Alam, M.F. (2014). Socio-economic status and problems of banana growers in Bangladesh. *International Journal of Natural and Social Sciences*. **1(2):** 91-99.

Kanazawa, K. and Sakakibara, H. (2000). High content of dopamine, a strong antioxidant, in cavendish banana. *Journal of Agricultural and Food Chemistry*. **48(3):** 844-848.

Kikulwe, E. Birol, E. Falck-Zepeda, J. and Wesseler, J. (2010). Rural consumers preferences for banana attributes in Uganda: Is there a market for GM staples. Choice experiments in developing countries: Implementation, challenges and implications. Cheltenham, UK: Edward-Elgar Publishing.

Kukreja, N. and Sharma, P. (2024). Composition and pharmacological benefits of banana blossom: A brief review. *Agricultural Reviews*. **46(5):** 766-773. doi: 10.18805/ag.R-2697.

Kumar, K.S. Bhowmik, D. Duraivel, S. and Umadevi, M. (2012). Traditional and medicinal uses of banana. *Journal of Pharmacognosy and Phytochemistry*. **1(3):** 51-63.

Lancaster, K.J. (1966). A new approach to consumer theory. *Journal of Political Economy*. **7(2):** 132-157.

Li, M. Fan, Y. Zhang, X. Hou, W. and Tang, Z. (2014). Fruit and vegetable intake and risk of type 2 diabetes mellitus: meta-analysis of prospective cohort studies. *BMJ Open*. **4(11):** e005497. doi: 10.1136/bmjopen-2014-005497.

Liu, R.H. (2003). Health benefits of fruit and vegetables are from additive and synergistic combinations of phytochemicals. *The American Journal of Clinical Nutrition*. **78(3):** 517S-520S.

Liu, S., Manson, J.E., Lee, I.M., Cole, S.R., Hennekens, C.H., Willett, W.C. and Buring, J.E. (2000). Fruit and vegetable intake and risk of cardiovascular disease: The Women's Health Study. *The American Journal of Clinical Nutrition*. **72(4):** 922-928.

Mugisha, J., Akankwasa, K., Tushemereirwe, W. and Ragama, P. (2008). Urban consumer willingness to pay for introduced dessert bananas in Uganda. *African Crop Science Journal*. **16(4).**

Ni, J. Gao, J. Deng, L. and Han, Z. (2020). Monitoring the Change Process of Banana Freshness by GoogLeNet. IEEE Access.

Opara, L.U. Al Said, F.A. and Al Abri, A. (2007). Assessment of what the consumer values in fresh fruit quality: Case study of Oman. *New Zealand Journal of Crop and Horticultural Science*. **35(2):** 235-243.

Polsky, J.Y. and Garriguet, D. (2020). Change in vegetable and fruit consumption in Canada between 2004 and 2015. *Health Reports*. **31(4):** 3-12.

Prodhan, A.S. Sarker, M.N.I. Sultana, A. and Islam, M.S. (2017). Knowledge, adoption and attitude on banana cultivation technology of the banana growers of Bangladesh. International *Journal of Horticultural Science and Ornamental Plants*. **3(1):** 47-52.

Rasoli, S.R. Siddayya and Kinduzi, M.O. (2021). Socio-economic factors influencing consumers online purchase behavior of food products in Bangalore city. *Bhartiya Krishi Anusandhan Patrika*. **36(2):** 120-125. doi: 10.18805/BKAP316.

Ruthsatz, M. and Candeias, V. (2020). Non-communicable disease prevention, nutrition and aging. *Acta Bio Medica: Atenei Parmensis*. **91(2):** 379.

Saravanapandeeswari, V. and Vanitha, B. (2018). Growth of area, production and productivity of banana (*Musa Paradisiaca*) cultivation in Theni district, Tamil Nadu- An analysis by component elements. *Indian Journal of Agricultural Research*. **52(2):** 107-110. doi: 10.18805/IJARe.A-4971.

Sarder, M.M. Hossain, A. and Tripura, K. (2020). Retail strategies of apple in a developing country: A hedonic price analysis. Journal of the Patuakhali Science and Technology University. **10(1,2):** 127-142.

Sidhu, J.S. and Zafar, T.A. (2018). Bioactive compounds in banana fruits and their health benefits. *Food Quality and Safety*. **2(4):** 183-188.

Singh, B., Singh, J.P., Kaur, A. and Singh, N. (2016). Bioactive compounds in banana and their associated health benefits-A review. *Food Chemistry*. **206:** 1-11.

Singla, P., Dhillon, P.K. and Madhu. (2022). Foods for specific health use (FOSHU): A mini review. *Agricultural Reviews*. **46(1):** 94-101. doi: 10.18805/ag.R-2512.

Slavin, J.L. and Lloyd, B. (2012). Health benefits of fruits and vegetables. *Advances in Nutrition*. **3(4):** 506-516.

Someya, S., Yoshiki, Y. and Okubo, K. (2002). Antioxidant compounds from bananas (*Musa cavendish*). *Food Chemistry*. **79(3):** 351-354.

Sora, S.A. and Jibat Guji, M. (2023). Evaluation of banana (*Musa* spps.) for growth, yield and disease reaction at teppi, Southwestern Ethiopia. *International Journal of Fruit Science*. **23(1):** 62-69.

Sporleder, E.M. Kayser, M. Friedrich, N. and Theuvsen, L. (2014). Consumer preferences for sustainably produced bananas: a discrete choice experiment. *International Food and Agribusiness Management Review*. **17:** 59-82.

Symmank, C., Zahn, S. and Rohm, H. (2018). Visually suboptimal bananas: How ripeness affects consumer expectation and perception. *Appetite*. **120:** 472-481.

Thorat, G. Sharma, S.K. Singh, G. and Mishra, R. (2014). Knowledge, adoption and attitude of the banana growers about the banana cultivation technology. *Indian Res. J. Genet. and Biotech*. **6(4):** 666-669.

Tinbergen, J. (1951). Some remarks on the distribution of labour incomes. *International Economic Papers*. **1:** 195-207.

Tinbergen, J. (1956). On the theory of income distribution. *Weltwirt-Schaftliches Archiv*. pp. 155-175.

UNICEF and World Health Organization. (2017). The state of food security and nutrition in the world 2017: Building Resilience for Peace and Food Security.

Waugh, F.V. (1928). Quality factors influencing vegetable prices. Journal of Farm Economics. **10(2):** 185-196.

WHO (World Health Organization) (2003). Diet, Nutrition and the prevention of chronic disease. *World Health Organ Tech Rep Ser*. **916:** (i-viii).