# A study on consumer awareness, perception and willingness to pay for biofortified products in Delhi, India

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*Malnutrition, which can perpetuate a cycle of poverty and ill health, will disproportionately impact people. Biofortification is an initiative to ensure improved nutritional outcomes in developing countries, where approaches to food supplements and commercially marketed fortified foods are limited. A primary survey was carried out in and around the National Capital Territory (NCT) of Delhi, India. A total of 134 respondents from urban and 123 respondents from rural areas were interviewed. The results revealed that the majority of respondents in urban areas (72%) presumed that biofortified products were higher in micronutrients than those in rural areas (49%). The findings reveal that age and gender negatively impact consumer awareness of biofortification, while education, food habits and income exert a positive and significant impact. The policy implications drawn should enable the development of consumer-based food products by creating a niche market and using an appropriate marketing channel to increase consumer acceptance and WTP.*

**Keywords:** Biofortification, consumer awareness, malnutrition, perception, willingness to pay.

MALNUTRITION is a condition that occurs when a person's body receives insufficient nutrients due to the lack of proper nutrition. This could be due to inadequate diet, unbalanced diet, problems with absorption or digestive issues[1]. As a result, an estimated 155 million children are stunted, 52 million are wasted, and 41 million are obese and undernutrition has caused 45% of deaths among children under the age of five years worldwide[2]. According to the United Nations Children's Fund (UNICEF), 'malnutrition' is a broad term commonly used as an alternative to undernutrition. This global burden is highly skewed by age and region, with childhood malnutrition being one of the most serious health issues in developing countries[3]. Of the total mortality burden, vitamin A deficiency affects 93%, iron deficiency anaemia affects 68%, and zinc deficiency affects all children under the age of five year with the total disease burden (mortality and morbidity) accounting for 94%, 57% and 100% respectively[4]. Although the global burden of micronutrient deficiencies had reduced by more than half in many countries between 1990 and 2010, it continues to be a major public health issue and one of the leading causes of death and disability, particularly in Sub-Saharan Africa[5]. Malnutrition in all forms is most common in Asia and Africa. In 2016, Asia and Africa accounted for 56% and 38% of all stunted children, as well as 49% and 24% of all overweight, and 69% and 29% of wasted children under the age of five respectively[6]. In India, 195 million people are malnourished[7].

The following strategies are commonly used to address micronutrient malnutrition: (a) Dietary diversification by consuming a wide variety of foods with different nutrients, based primarily on the types of food already available to the population, with only minor modifications to a consumer's choice of foods, such as increasing the variety and quantity of micronutrient-rich foods, including animal-source foods[8]. However, this is not always attainable in developing countries[9], because high-income consumers have access to improved nutrition[10], while poor people lack the purchasing power[11]. (b) Fortification is the process of intentionally increasing the number of essential micronutrients in the food to improve its nutritional quality and provide public health benefits with minimal risk to health[12]. Fortified foods are expensive due to the additional processing costs and must be consumed regularly[13]. (c) Supplementation, defined as the provision of relatively large doses of micronutrients in the form of capsules, syrups, or pills[14], is generally reported to be the quickest way to control micronutrient deficiency in individuals or populations that have been identified as deficient[12]. However, it has little impact due to underfunding, logistical issues, mismanagement and lack of compliance[15]. (d) Biofortification is the practice of selectively breeding essential food crops to contain higher levels of crucial micronutrients like iron,

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zinc, vitamin A and iodine. This biofortification approach differs from conventional fortification by increasing the nutrient content of crops during plant growth, as opposed to artificially adding these nutrients during food processing[2]. This, in turn, involves replacing staple food crops that constitute a significant portion of daily caloric intake in rural regions with biofortified crops, thereby enhancing nutrient content in daily caloric intake[16] and reducing malnutrition. In contrast to commercial fortification and supplementation, biofortification of staple food crops bred to be rich in micronutrients is likely to be a cost-effective public health intervention[11], and an effective technique for combating micronutrient malnutrition[17].

According to the substantial literature on consumer acceptance behaviour for quality attributes such as biofortified iron beans[18], better quality ripened pears[19], maize fortified with minerals and vitamins[20] and golden rice[21], consumers were willing to pay higher premium prices than for products with normal attributes. A study revealed that the increased intake of micronutrients by biofortified crops would improve the health status of deficient individuals[22]. However, the success of biofortification is determined by several factors, including how widely biofortified staples are adopted by farmers and accepted by consumers, as well as their cost-effectiveness[23]. Since it has almost no effect on the change in colour or appearance of the product, improved premium for biofortified products is achieved by international branding, providing information on nutritional aspects and other sensory characteristics[24]. It was observed that providing nutritional information increased consumer acceptance and willingness to pay (WTP) for orange maize in Zambia[11] and Ghana[20].

Since the dietary patterns and choices of consumers are typically based on foods rather than nutrients, the nutrient content alone is unlikely to be a reasonable justification for their acceptance, and in some cases, it may affect cooking, storage or sensory qualities, all of which have an impact on their acceptance[25]. The present study provides an in-depth evaluation to elicit information about consumer acceptance, perceptions, food purchasing behaviour and WTP for biofortified products.

## Materials and methods

### *Study location*

To gain better understanding, primary data were collected from both urban and rural areas. Urban consumers from the National Capital Territory (NCT) area, Delhi, India. The areas with the largest shopping complexes were listed for the study, and four regions were selected, each with one shopping mall. The rural consumers were purposefully chosen from the Baghpat district, Uttar Pradesh (UP) where ICAR-Indian Agricultural Research Institute (IARI) designated specific project villages as part of the Agri-nutri smart village (A2N) model within the research project 'Enhancing Nutritional Security and Gender Empowerment' of the Division of Agricultural Extension, ICAR-IARI, this initiative implemented various interventions with the objective of increasing awareness regarding nutrition and agriculture. The villages of Basi, Sunehra and Lahchauda in the Kekra block, Baghpat district, UP, were mainly chosen for the study, where many newly released varieties have been demonstrated, including PM-30 (a biofortified mustard variety with health benefits on account of low erucic acid), which is the focus of this study.

### *Sample*

The data were collected over three months, from January to March 2019. The survey in urban areas was carried out so that at least 15 respondents who were aware of biofortified varieties were contacted in each region, so there were a total of at least 60 respondents who were aware of biofortification from the four study regions. The survey in rural areas was carried out in each village so that at least 20 respondents were aware of biofortification. In total, 134 respondents from the urban and 123 respondents from the rural areas were interviewed. The survey had a total sample size of 257 respondents.

### *Data analysis*

A pre-tested schedule was used to perform face-to-face interviews. There were two sections of the schedule. The first section had questions related to perception, understanding and other socio-demographic variables, while the second section had questions about biofortified products.

### *Knowledge index*

This was calculated for each respondent based on their awareness regarding biofortification. The awareness scores were assessed by assigning a value of one to the correct answer and zero otherwise[26]. A total of six questions were asked, with each respondent receiving a score ranging from 0 to 6. The scores were categorized into four: not aware (0), slightly aware (index < mean – 1/2 standard deviation), moderately aware (mean – 1/2 standard deviation < index < mean + 1/2 standard deviation) and completely aware (index > mean + 1/2 standard deviation).

### *Information sources*

The respondents were given a list of sources to specify, including radio, newspaper, television, internet, journals, articles, exhibitions, training, friends, relatives and others, and asked to tick as many as they could so that the sources from which they had received information about biofortification

could be evaluated and compared for both urban and rural areas.

### *Perception of biofortified products*

This is important to evaluate because perceptions regarding health benefits, taste, convenience and other attributes influence the decision to purchase goods as well as the quantity consumed[27]. We used a Likert scale (1–5) to analyse the responses and present them in the form of percentages using a bar chart since the data on perception are qualitative, and the response spectrum of each statement is a linear scale that shows the degree to which respondents agree or disagree with the statement.

### *Consumers' food purchasing behaviour*

The study gathered three types of information about respondents' purchasing behaviour. They were first questioned about their frequency of buying newly arrived food items in the market (always/often/sometimes/rarely/never), their purchasing behaviour regarding biofortified products if they were made available in the supermarket (yes/no) and their opinion on the need for promotion and advertising of biofortified products for wider acceptance (yes/no). Then the percentage of respondents 'corresponding to each closed-ended category provided within the above brackets for each question were tabulated'.

To understand who is responsible for taking decisions on the purchase of food items, the respondents were asked to specify the decision-makers among five categories (husband/wife/children/elders/servants/and others). To identify the major factors that influence food purchase, each respondent was asked to rate five product characteristics based on their significance in influencing their food purchase: price, taste, nutrition, brand and additional healthy ingredients. For each characteristic, the percentage preference was determined using a five-point Likert scale: not at all important (1), slightly important (2), moderately important (3), important (4) and very important (5).

## Statistical analysis

### *Determinants of consumers awareness of biofortification*

Consumer awareness regarding biofortification is influenced not only by perception but by a multitude of socio-economic and demographic factors. Awareness regarding biofortification can be modelled as a choice between two alternatives: aware and not aware. Using the statistical package STATA, the binary logit estimates and marginal effects were determined to quantify the instantaneous effects of changes in an independent variable on the predicted probability of being aware while keeping other independent variables constant. The logit model postulates that $Pi$ is a function of an index variable $Zi$, which is equivalent to the logarithm of the odds ratio, i.e. the ratio of the probability that a consumer is aware to the probability that he is not aware. This can be calculated as a linear function of explanatory variables ($Xki$). Mathematically,

$$Pi = F(Zi) = F(Xi) = 1/(1 + e - Zi),$$

$$Zi = \ln\left\{\frac{Pi}{1-Pi}\right\} = \alpha + \sum_{k=1}^{M} \beta k Xki,$$

where $i = 1, 2 \ldots, N$, with $N$ being the total number of respondents, $X$ is the explanatory variable (age in years, gender, years of education, occupation, monthly income, household size, location, food habits and decision-makers in purchasing food items), $k = 1, 2\ldots, M$, with $M$ being the total number of explanatory variables, $\alpha$ the constant and $\beta$ is an unknown parameter.

### *Willingness to pay for biofortified products*

Initial bids were tested for randomness to determine whether the bids were represented equally in the data on average. The price test checks whether, on average, the proportion of no responses also increases as the bid value increases. The contingent valuation method estimated how much consumers will pay for each product attribute. A respondent was confronted with two bids, the first of which asked if they were willing to pay a specific amount for a product, and the second bid was made based on the first response. A second bid with a higher amount was offered if the respondent answered 'yes' and with a lower amount if the answer was 'no'. Based on the responses, WTP was determined using the double-bound contingent valuation method (CVM).

### *Determinants of WTP*

WTP was determined for each respondent and then regressed on the explanatory variables in the study, which include age, gender, years of education, occupation, monthly income, household size, location, and food habits to estimate their influence.

## Results

### *Decision-making and awareness level of respondents*

In the study areas, 44.78% of urban and 49.59% of rural respondents were aware of biofortification. Salaried jobs and non-agricultural enterprises were the major occupations of

**Table 1.** Respondents' level of awareness

| Statements | Right answers | Correctly aware (%) | | |
|---|---|---|---|---|
| | | Urban ($n$ = 60) | Rural ($n$ = 61) | Pooled ($n$ = 121) |
| In biofortification, the nutritional quality of food crops is improved during plant growth through agronomic practices | Yes | 38.33 | 83.61 | 61.16 |
| In biofortification, the nutritional quality of food crops is improved during plant growth through conventional plant breeding | Yes | 61.67 | 81.97 | 71.90 |
| In biofortification, the nutritional quality of food crops is improved during plant growth through modern biotechnology or genetic engineering | Yes | 81.67 | 63.93 | 72.73 |
| In biofortification, any of the above or all of the above techniques are followed for improving the nutritional value of crops | Yes | 78.33 | 62.30 | 70.25 |
| Biofortification is a commercial approach in which specific micronutrients are added to food products physically during processing | No | 60.00 | 68.85 | 64.46 |
| In biofortification, relatively large doses of micronutrients are supplied in the form of capsules, syrups or pills | No | 42.00 | 47.00 | 44.50 |

**Table 2.** Determinants of awareness (marginal effects after logit)

| Variable | d$y$/d$x$ (Urban) | d$y$/d$x$ (Rural) | d$y$/d$x$ (Total) |
|---|---|---|---|
| Age | –0.015* (0.009) | –0.008* (0.005) | –0.011*** (0.004) |
| Gender | –0.224** (0.107) | –0.413*** (0.125) | –0.312*** (0.078) |
| Household size | 0.005 (0.066) | 0.006 (0.022) | 0.005 (0.020) |
| Education | 0.057*** (0.022) | 0.050*** (0.016) | 0.047*** (0.011) |
| Food habits | –0.002 (0.107) | –0.028 (0.258) | 0.033*** (0.010) |
| Income | 0.007*** (0.003) | 0.035*** (0.011) | 0.008*** (0.003) |
| Decision maker – husband | –0.074 (0.239) | 0.110 (0.138) | 0.093 (0.119) |
| Decision maker – children | 0.246 (0.409) | 0.028 (0.297) | 0.088 (0.236) |
| Decision maker – elders | –0.142 (0.132) | –0.175 (0.245) | –0.138 (0.116) |
| Location | – | – | –0.213 (0.215) |
| log likelihood | –61.09 | –56.01 | –118.65 |
| Pseudo $R^2$ | 0.308 | 0.3430 | 0.3206 |
| $X^2$ ($p$-value) | 54.39 (0.000) | 58.49 (0.000) | 111.99 (0.000) |
| No. of observations | 129 | 123 | 253 |

Note: Standard errors are given in parenthesis. Statistical significance levels: ***1%; **5%; *10%. The derivative d$y$/d$x$ represents the marginal effect of a one-unit change in an independent variable on the probability of the dependent variable being in a particular category.

urban respondents, while agriculture and wage employment were most common in rural areas. The findings revealed that 74% of wives in urban areas and 56% of husbands in rural areas were the key decision-makers in purchasing food items. With regard to information sources in the urban setting, social media was found to be the most common, followed by newspapers and television. In the rural setting, it was training followed by relatives, exhibitions and friends.

Those who were aware of biofortification were asked further in-depth questions to gauge their extent of awareness. Table 1 shows that 70% of respondents understood clearly that in biofortification, the nutritional quality of food crops is improved during plant growth using any of the practices mentioned, including agronomic practices, modern biotechnology or genetic engineering, and conventional plant breeding methods. However, 64% of the respondents had the misconception that biofortification entails physically adding micronutrients to food products during processing, and 45% perceived that biofortification entails providing nutrients by tablets, syrups or pills.

The knowledge index also revealed that the majority of respondents in rural and urban areas were moderately aware, while about 11% of rural respondents and 18% of urban respondents received a score of zero, suggesting that they were unaware of biofortification despite maintaining that they were.

Binary logit was used to analyse the factors influencing consumer awareness of biofortification (Table 2). The age of the consumers had a negative and significant effect on their awareness, which indicates that younger age groups are more likely to be aware of biofortification. The marginal effect results showed that increasing a respondent's age by one year reduced the probability of them being aware of biofortification by 1.1%. Male respondents were found to be 31% less cognizant than female respondents on average, suggesting that gender had a negative and significant influence on awareness. Also, consumer awareness was significantly influenced by factors such as education and income. In both urban and rural areas, an increase in one unit of education (number of years of schooling) and income

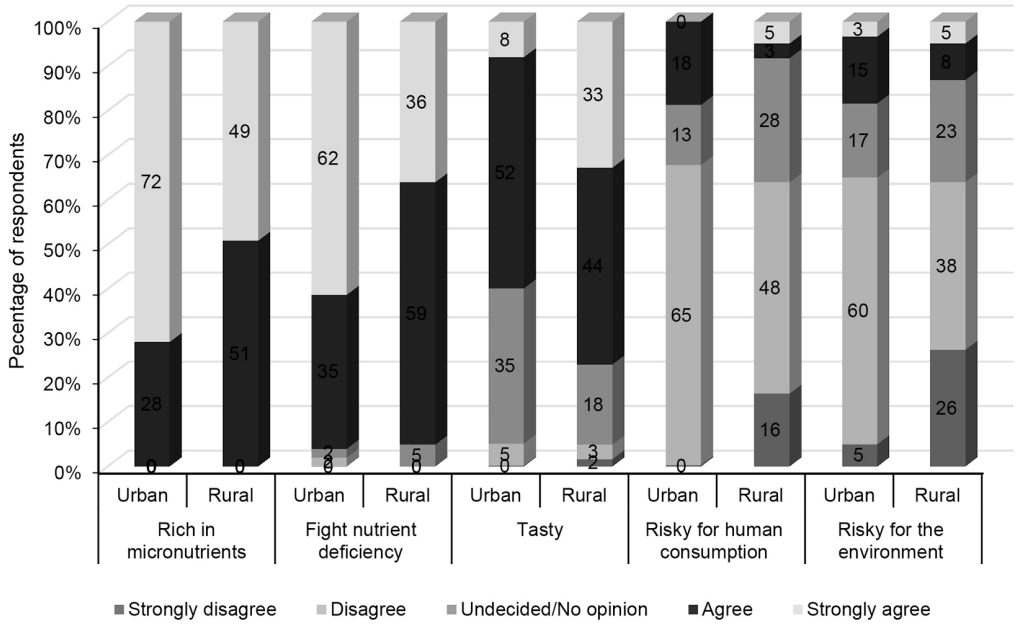


**Figure 1.** Perception scores.

increased the probability of being aware by 4.7% and 0.8% respectively, while household size, food habits and decision-makers (one who influences food purchase) did not influence awareness. In the pooled data, however, food habits became a significant factor influencing awareness, while location was found to be an insignificant factor, implying no significant difference in the awareness levels between urban and rural consumers.

### *Consumers' perception of biofortified products*

When given a Likert scale ranging from strongly disagree to strongly agree (Figure 1), nearly three-fourths of respondents in urban areas strongly agreed that biofortified products were rich in micronutrients, while half of the rural consumers perceived the same. Similarly, almost all respondents agreed or strongly agreed with the statement that biofortified foods can aid in the fight against nutrient deficiency, especially in low-income communities and rural areas. With regard to taste, more than half of the respondents agreed that biofortified products would be tasty and also disagreed that biofortified foods are risky for both human consumption and the environment.

### *Consumers' food purchasing behaviour*

When considering purchasing new food products that have just arrived in the market, it was found that more urban respondents rated 'always' and 'often' to purchase newly arrived food products than the rural respondents, while in both regions, nearly an equal percentage of respondents rated 'sometimes' and 'rarely' to the purchase of new products. More so, it was found that more rural respondents rated 'never' to newly arrived products than urban respondents. As a result, urban respondents were more likely than rural respondents to purchase newly arrived goods.

Thereafter, respondents were asked about their purchasing behaviour of biofortified products. The results revealed that 83% of urban and 59% of rural respondents would purchase a biofortified product once it becomes available in the market. When enquired about the need for product promotion and advertising, 86% of urban and 90% of rural respondents mentioned that biofortified products should be advertised and promoted.

To identify the most important factors that influence food purchase, the respondents were asked to rank the product characteristics according to their level of importance before purchasing, ranging from not at all important to very important (Figure 2). The majority of the respondents in both regions ranked taste/flavour as very important, while rural respondents ranked price as being more important than the urban respondents, who were more conscious of nutritional information and ranked it as very important while purchasing food items. More than half of respondents in both study areas ranked the brand name of a product as very important to them when purchasing it, whereas urban respondents ranked the availability of additional health information in the product as more important to them.

### *WTP, influencing factors and their determinants*

The respondents' WTP was analysed through a double-bound CVM. There were six randomly allocated initial

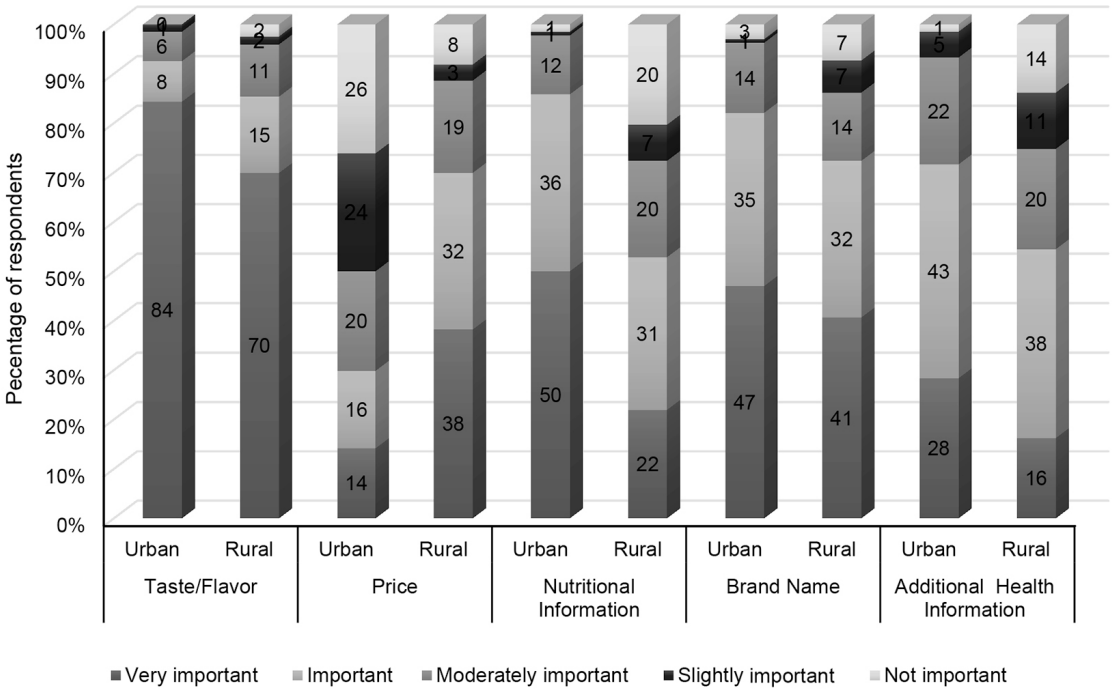


**Figure 2.** Factors influencing food purchase.

**Table 3.** Coefficient estimates for double-bound contingent valuation model and willingness to pay (WTP) with and without control variables

| Variables | Urban | Rural | Pooled |
|---|---|---|---|
| Age | 0.103 (0.196) | 0.170 (0.200) | 0.137 (0.136) |
| Gender | 3.887 (3.694) | –10.958* (6.242) | –1.893 (3.396) |
| Income | 0.177*** (0.072) | 0.802*** (0.331) | 0.000*** (0.000) |
| Household size | 0.096 (1.943) | –0.330 (0.889) | 0.179 (0.695) |
| Food habits | 15.000*** (3.662) | 5.662 (8.219) | 13.496*** (3.843) |
| Awareness | –0.542 (4.149) | 0.776 (6.055) | 2.160 (3.625) |
| Education | 1.031** (0.485) | 0.548 (0.582) | 0.528 (0.366) |
| Location | – | – | 6.967 (5.312) |
| Constant | 99.934*** (13.492) | 104.299*** (13.008) | 98.825*** (8.532) |
| log likelihood | –120.587 | –150.56263 | –278.037 |
| $X^2$ ($p$-value) | 36.81 (0.000) | 12.97 (0.073) | 43.16 (0.000) |
| No. of observations | 134 | 123 | 257 |
| WTP with no control variables | 135.87*** (2.029) | 126.96*** (2.559) | 131.90*** (1.658) |
| WTP with control variables | 136.49*** (1.773) | 127.25*** (2.425) | 132.60*** (1.532) |

Note: Standard errors are given in parenthesis. Statistical significance levels: ***1%; **5%; *10%.

bids for a litre of biofortified mustard oil, ranging from INR 100 to 150, based on a 10% difference in the average market price of normal mustard oil taken at 100 INR/litre. The randomness test for the initial bid revealed an equal representation ranging from 22 to 23 frequencies per bid. The price test results verified that when a lower initial bid was quoted, a larger number of respondents were willing to pay. As the initial bid price increased, a smaller number of respondents were willing to pay.

Table 3 shows the results of WTP analysis with control variables. In the urban study areas, variables like income, education and food habits, while in the rural study areas, variables like gender and income were found to be significant. As in the case of pooled data, only income and food habits were found to be significant.

The consumers' responses were analysed using STATA's Doubleb command, which directly gives WTP for biofortified mustard oil (Table 3). The respondents in both urban and rural areas were willing to pay INR 135.87 and INR 126.96 respectively, which is 35.87% and 27% more than the prevailing price of normal mustard oil. In total, the pooled WTP for biofortified oil accounted for INR 131.91. WTP estimates increased marginally after introducing the control variables to the model, with urban and rural respondents willing to pay INR 136.49 and INR 127.25 respectively, for the pooled respondents, which includes both

urban and rural respondents, the WTP increased by INR 132.58, representing a 32.58% increment over the price of normal mustard oil.

WTP for each respondent was estimated using STATA's Predict command, for which multiple linear regression was employed to identify determinants of predicted WTP. As WTP is predicted from the model, the regression model is highly significant, and the $R^2$ value of 1 indicates that the variation in WTP is completely explained by the model (Table 3).

## Discussion and conclusion

The present study considers the respondents' awareness regarding biofortification. The knowledge scores reveal that awareness of biofortification is slightly higher in rural respondents, which may be due to institutional training in health and nutrition programmes. However, it is to be noted that since the rural samples have been taken from the ICAR-IARI-adopted villages, the results cannot be generalized. As consumers want products that have traceability information and an assurance of good quality[28], the information sources play an important role. In this study, it was found that the main sources of information of urban respondents were the internet, newspapers and television, while for rural respondents, they were training, relatives, exhibitions and friends. So, training programmes by Government institutions and other non-profit organizations can help supplement media sources in rural areas in disseminating information. In addition, mobile phones and the internet should be considered, since they are widely used by urban consumers.

Although the explained variance of the binary logit model is rather low (Table 4), exploring the sign and impact of some of the important determinants of awareness is useful. In this study, age and gender negatively affected awareness. In this study, age and gender had a negative impact on awareness, while education, food habits, and income exerted a positive impact. This variation holds significant implications for the development of programmes targeting the enhancement of consumer awareness, as it was observed that awareness levels varied for each respondent. Consumers can decide whether or not to choose a specific type of food depending on their perceptions, knowledge of health benefits, or other psychological factors[27,29]. The majority of respondents in this study strongly agreed that biofortified products are rich in micronutrients, and almost all the respondents agreed that biofortified foods can aid in the fight against nutrient deficiency. This indicates that consumers show keen interest in the nutrition attributes of food products, considering them important for their choice of food[30].

**Table 4.** Determinants of WTP

| Variables | Urban | Rural | Total | Standard error | $P > \|z\|$ |
|---|---|---|---|---|---|
| Age | 0.103 | 0.170 | 0.137 | 0.000 | 0.000 |
| Gender | 3.887 | –10.958 | –1.893 | 0.000 | 0.000 |
| Income | 0.177 | 0.802 | 0.249 | 0.000 | 0.000 |
| Household size | 0.096 | –0.330 | 0.179 | 0.000 | 0.000 |
| Food habits | 15.000 | 5.662 | 13.496 | 0.000 | 0.000 |
| Awareness | –0.542 | 0.776 | 2.160 | 0.000 | 0.000 |
| Education | 1.031 | 0.548 | 0.528 | 0.000 | 0.000 |
| Location | – | – | 6.967 | 0.000 | 0.000 |
| Constant | 99.934 | 104.299 | 98.825 | 0.000 | 0.000 |
| Number of observations | 134 | 123 | 257 | | |
| Probability > $F$ | 0.000 | 0.000 | 0.000 | | |
| $R^2$ | 1.00 | 1.000 | 1.000 | | |
| Adjusted $R^2$ | 1.000 | 1.000 | 1.000 | | |

The factors that influence food intake fall into the categories of food characteristics, individual characteristics, or economic and social environment characteristics when it comes to food purchasing behaviour[31]. In the present study, taste/flavour was ranked as very important by the respondents, confirming previous findings that consumers value taste and other associated varietal attributes more than the nutritional quality of a product[19,32,33]. Also, the majority of rural respondents rated price as very significant since the economic and social environment reflects external influences on food acceptability, such as product price, ability to pay for it, availability, information, knowledge about it, and social, cultural and ecological resources[34,35].

Consumers expect enriched foods to be priced similarly to conventional foods[36]. On the other hand, people with low income have limited selection and must rely on low-cost foods, mostly cereals, to meet their nutritional needs[37]. A study in South Africa considered consumer acceptance of yellow, pro-vitamin A-biofortified maize and observed that consumers would purchase yellow maize only if it were cheaper than the white majority maize[38]. The study also revealed that the urban respondents were more conscious of nutritional information, showing a trend comparable to that observed in a study conducted in Zambia, where the provision of nutritional information on orange maize translated into a higher acceptance of the orange variety and a lower acceptance of white maize[11]. More than half of the respondents agreed that the brand name of a product is very important to them when purchasing, which is consistent with earlier studies[39], which reported that packaging and labelling are the most important marketing attributes for the majority of consumers.

Consumers' WTP for biofortified mustard oil was found to be higher in both urban and rural areas than the current price of conventional mustard oil, which mirrored the findings of earlier studies that examined the market potential of foliate biofortified rice (FBR) in China and found that consumers were willing to pay 33.7% more than for regular rice[40] and that for bio-fortified cassava, Brazilian consumers were willing to pay a premium of 160% (ref. 41).

Regression analysis revealed that factors like age, gender, income, household size, food habits, awareness, education

and location influence WTP for biofortified products. Furthermore, previous studies have shown that age is negatively correlated with WTP for organic potatoes[42]. More educated consumers are willing to pay a premium for nutritionally improved products[20], food safety and nutrition[43,44]. The findings of the present study provide insights into stakeholder knowledge and awareness of biofortification, which has the potential to impact policy formulations and guide strategies for promoting micronutrient-rich products. To better understand the link between consumer awareness and perception of biofortified foods, further research is needed. This would allow for the development of consumer-based food products, potentially increasing consumer acceptance rate. The growing market for enriched foods, particularly biofortified foods, offers a potential opportunity to improve health while also allowing the development of new, micronutrient-rich food products.


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