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Consumer acceptance of an iron bean variety in Northwest Guatemala: The role of information and repeated messaging

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Abstract

We implement a field experiment in Guatemala to (i) evaluate consumer acceptance of organoleptic characteristics of an iron bean variety; (ii) measure consumer willingness to pay (WTP), for this iron bean variety;, (iii) investigate the role of nutrition information on consumer acceptance of the iron bean variety, and (iv) shed light on to the impact of repetition of information on consumer acceptance. We implement Home Use Testing and Becker – DeGroot-Marshak methods. Results indicate that consumers like both varieties equally, with a few differences in certain organoleptic characteristic. Although the WTP for the iron variety is higher, the difference is not statistically significant. Information plays a positive role in consumer acceptance of the iron variety but repetition of information does not have a significant impact on acceptance. These results are informative for the development and delivery of iron bean varieties for Guatemalan consumers.

Keywords: biofortification, iron bean, Becker-DeGroot-Marschak mechanism

JEL Codes: C35, C93, D12, D83, Q18

IAAE

1. Introduction

Micronutrient malnutrition, also known as hidden hunger, affects two billion people worldwide. One potential solution to its alleviation is biofortification—the process of breeding and delivering staple food crops with higher micronutrient content. Biofortification could prove to be a cost-effective and sustainable strategy, especially in rural areas of many developing countries where production and consumption of staple crops is high and high micronutrient deficiency rates are rampant (Meenakshi *et al*., 2010; Saltzman *et al.*, 2013). In recent years several varieties of beans, rice and maize with higher micronutrient levels were released in various countries in the Latin America and the Caribbean (LAC) region. Many more promising varieties with even higher levels of micronutrients are in the pipeline for release. Biofortification is increasingly gaining momentum in LAC, with some countries including it in their public regulations (e.g., Panama and Brazil) and many others considering it as an alternative intervention to strengthen their efforts to fight micronutrient malnutrition, especially in marginalized rural areas. Despite all these efforts and momentum, very little research has been done to evaluate consumer preferences for and acceptability of these biofortified varieties by target populations.

Guatemala is one of the LAC countries with the highest proportion of population living in rural areas. Mainly indigenous, rural Guatemalans have a deep-rooted tradition of bean consumption. An average Guatemalan consumes 34 grams of beans per day (ENCOVI, 2006). According to the National Survey of Micronutrients (2009 – 2010), iron deficiency is an important public health problem with 24% of children and 20% of women in rural areas not having sufficient iron in their diets. In general, iron deficiency in rural areas is slightly higher in indigenous communities than in non-indigenous ones (*mestizos*). Given the high bean consumption and high iron deficiency rates, especially in rural areas, biofortification of beans with iron could be a promising solution to reducing iron deficiency prevalence in Guatemala.

The success of biofortification depends on whether biofortified foods are accepted and consumed by target populations (Meenakshi *et al.,* 2010). This acceptance will depend on consumer preferences for various organoleptic characteristics (e.g., taste, color or texture), as well as their perception of relative prices for biofortified foods. This study contributes to the evaluation of consumer preferences for and acceptance of biofortified foods in the Latin-

American context. In this study we use similar methods to those used in Africa and Asia contexts (see e.g., Naico and Lusk, 2010; Chowdhury *et al.*, 2011; Meenakshi *et al.*, 2012, Banerji *et al.*, 2013; Oparinde *et al.*, 2014) thereby allowing for the comparison of acceptance of biofortified foods across regions.

Several studies have been conducted in developing countries to investigate consumer acceptance of biofortified foods and the role of information about nutritional benefits of such food in driving demand (see for example, Meenakshi *et al.*, 2012 and Banerji *et al.*, 2013 for vitamin A enriched maize in Zambia and Ghana, respectively; Lusk and Naico *et al.*, 2010 and Chowdhury *et al.*, 2011, for vitamin A enriched orange sweet potato in Mozambique and Uganda, respectively; Oparinde *et al.*, 2014 for vitamin A enriched cassava in Nigeria; Banerji et al., 2015 for high iron pearl millet in India and Oparinde et al., 2015, for high iron beans in Rwanda). The one time impact of information on acceptability that has been mostly studied in this emerging literature is complex to interpret since successful nutrition messaging often requires repetition (Meenakshi *et al.*, 2010).

The main goal is to shed light onto rural Guatemalan consumers' preferences toward and acceptance of an iron bean variety, namely *super chiva*, in comparison with the most popular traditional bean variety in the region, namely ICTA-Unapu. The aims of this study are (i) to understand consumer acceptance of the main organoleptic characteristics of the iron bean variety compared with the traditional one using sensory evaluation (hedonic scores), (ii) to measure consumer willingness to pay (WTP), i.e., the price premium/discount, for the iron bean variety compared with the traditional one, and the variation of this premium/discount with consumer specific socio-economic characteristics, (iii) to investigate whether nutrition information has an impact on driving demand for biofortified foods in the Guatemalan context, as it was shown to be in the African and Asian contexts, and iv) to understand the impact of the frequency with which information is given on consumer acceptance.

In what follows, section 2 presents the details of the selection criteria of the study site, sampling design, elicitation and data collection method, information and model used; section 3 describes and summarizes the main results and section 4 concludes the paper with policy recommendations.

2. Methodology

2.1 Study site

The data collection was conducted in August 2013 in the municipality of San Sebastian Huehuetenango, province of Huehuetenango, located in northwest Guatemala bordering Mexico. With a prevalence of 72.2%, this municipality ranks 27th in chronic malnutrition among all the municipalities in Guatemala (Gobierno de Guatemala, 2012). Huehuetenango was selected because of its high levels of bean consumption and production and high levels of iron deficiency, affecting over a third of children and pregnant women (MSPS, 2012), as well as the suitability of its agro-ecological conditions for production of the *super chiva* variety, as demonstrated by agronomical tests carried out by the Science and Agricultural Technology Institute of Guatemala (ICTA)[1].

2.2 Sampling Design

Power calculations were conducted to determine the optimal number of respondents to be surveyed. The price for beans in northwest Guatemala varies by color. Red and white varieties are the most expensive ones and they are usually consumed on special occasions, whereas black which are consumed daily are the cheapest. In July 2013 the average market price for these black bean varieties was 5 Quetzales[2]. Based on previous studies (Chowdury et al., 2011, Meenakshi et al., 2012 and Banerji et al, 2013) a 15% effect was anticipated corresponding to 0.5 Quetzales and a standard deviation of 2.5 Quetzales. Using a significance level of 5% and a power of 0.8, a sample size of 120 households per each one of the three treatments was estimated. In total, this yielded a minimum sample size of 360 respondents.

The objective of our sampling strategy was to draw a sample of 360 households from different communities of the San Sebastian Huehuetenango municipality. Unfortunately, there was no reliable secondary data from recent censuses to find out the total number of population or households in the municipality. Likewise, no official data existed that could reliably give an

[1] ICTA's bean breeder personal communication
[2] 7.67 Quetzales to 1 USD in July 2013 (http://www.oanda.com/currency/historical-rates/)

estimate of current population in each community. Therefore, local experts and community leaders in San Sebastian Huehuetenango were asked to estimate the current population in the municipality and in each of the communities. Data collection took place during the rainy season which makes transportation of the enumerators' teams to certain communities difficult, if not impossible. Moreover, the more remote a community is, the higher are the security risk and locals' reluctance to participate in any kind of study. As a result, a list of 20 accessible and less remote communities was drawn, from which 12 were randomly chosen. Because of the lack of household lists in these communities, household lists were drawn with the help of the community leaders. The number of participating households per community was determined based on the relative proportion of the population among the listed communities. Within these communities enumerators selected every 5^{th} or 7^{th} household on the list, proportionally to the size of the community. As a result, we obtained a self-weighing sample of households which is representative of the somewhat safer and less remote parts of the municipality of San Sebastian Huehuetenango. In order to prevent nutrition information contamination, the control (no information) group was done first (first week), the other two information treatments were done in the following two weeks. Although we tried to minimize the contamination of information, it is likely that there has been some across treatment arm contamination about the BDM and request of payment for the bean varieties evaluated (Oparinde et al., 2015).

2.3 The elicitation and data collection method

In this study we used the Home Use Testing (HUT) method, in which selected household received 1 pound of grain of both bean varieties (one variety each day, in a random order) to cook and eat at home. Based on average household size and demographics and information on quantity of bean consumed per person in the region, 1 pound was calculated to be sufficient for an average household's breakfast and lunch consumption. Each consumer had a chance to experience and to evaluate the following sensory and cooking attributes: raw bean color, raw bean size, bean taste, time of cooking, cooked bean thickness, cooked bean toughness, and the overall evaluation. Each one of these attributes was evaluated on a 7 point Likert scale ranging from 1 (dislike very much) to 7 (like very much) (other levels being 2. Dislike, 3. Dislike a little, 4. Neither like nor dislike, 5. Like a little, 6. Like). To investigate the role of information about the nutritional value of the iron bean cultivar, the sample was divided into three treatments. In

the first treatment (control group), none of the respondents received any information about the nutritional benefits of the high-iron bean variety tested; in the second one, respondents received information; and, in the third group, they received the information three times. Participants at each location were randomly assigned to one of the three treatments.

The flow of data collection from each household was as follows:

Before describing the study and asking participants' consent to participate, subjects were asked about their knowledge regarding iron bean varieties. In order to not to bias the results, those who stated any kind of knowledge were not invited to partake in this study (and the next 5^{th} or 7^{th} household on the list was selected). The household member who is responsible for food purchasing and cooking at home was asked to participate in this study.

Day 1 (early afternoon): The household received 1 pound of one of the bean samples. The respondents were requested to cook the sample according to their usual cooking practices[3] and without mixing it with any other bean variety they may already have at home. Households were visited early in the afternoon, because they usually cook the beans in the evening to consume at breakfast and lunch the following day. Each household was given one day to cook and consume the variety. One day was thought to be a sufficient amount of time for the households to form an opinion about the variety, while reducing the risk of information contamination through social networks. Household were visited in the afternoon hours, and they were asked for a follow up appointment on the next day in the afternoon hours. The follow up appointment was set after lunch so as to minimize a recall bias with respect to the organoleptic characteristics of the bean varieties.

Day 2 (after lunch): On the next day the enumerator visited the same household to conduct the sensory evaluation of the variety delivered the day before and to give the sample of the other variety.

Day 3 (after lunch): The sensory evaluation for the second sample was carried out on the third day along with the Becker – DeGroot-Marschak (BDM) auction-like mechanism for the elicitation of respondent WTP for both types of beans evaluated.

[3] Most of the families boil the beans without any other ingredient. When available, some herbs are used.

The incentive-compatible BDM mechanism was chosen due its suitability in rural settings (Banerji *et al.,* 2013) and its applicability in an individual basis, as it doesn't require a group of subjects (Lusk and Shogren, 2007). According to De Groote (2011), BDM mechanism is a much faster and efficient method than other experimental auctions, especially in rural context. In preference elicitation studies a participation fee is commonly given to the participants at the beginning of the experiment to avoid participants from being out of pocket in making purchases. However, standard economic theory suggests that initial endowments can distort optimal bidding behavior (Corrigan and Rousu, 2006) and empirical evidence shows mixed results (Loureiro *et al.,* 2003; Morawetz *et al.,* 2011; Banerji *et al.,* 2013). In this study we didn't include participation fees to avoid such biases and to make the experiment as real life like as possible, and told participants that they would be paying out their pockets if they "win" either one of the bean varieties in the auction-like mechanism.

Enumerators explained to the participants how the BDM mechanism worked. In particular they explained that bidding a higher price than their real WTP could result in them paying a higher price than the one they were originally willing to pay; whereas biding a lower price than their real WTP could result in them losing out on a profitable opportunity to purchase a desired product. Following this explanation, and after ensuring that the respondents understood the workings of the BDM mechanism, the respondent was asked to state a bid for each variety and these bids were written down by the enumerators. After the bidding one of the two varieties was randomly selected by the respondent, by picking a slip of paper from a bag containing two slips: each labelled with a different geometric figure, a triangle representing the iron bean variety and a square representing the local one. This pick determined the variety the respondent might end up purchasing. After picking the variety, the respondent picked another slip of paper from a second bag which had 16 slips with prices, ranging from 3.25 Quetzales (Q.3.25) to 7 Quetzales (Q.7), with 0.25 Quetzales (Q. 0.25) intervals. This was the uniform distribution of potential market sale prices that the subject was competing against. Respondents were previously explained that if the price picked from this random draw was lower than their initial bid for the bean variety also randomly picked from the first bag, the respondent had a chance to purchase one pound of that variety, making an out-of-pocket payment for a price equal to the competing bid. Otherwise, the respondent couldn't make a purchase.

2.4 Survey tools

A survey tool was designed in collaboration with local experts and was pretested prior to data collection. Because of its length, the survey was divided into three parts and each part was administrated during one of the three visits. In treatment arms, the information about nutrition and other characteristics of the iron bean variety were given through a recorded (simulated) radio message which the respondents listened to on individual MP3 devices (see Appendix 1 for the content of this message). Qualitative background studies and review of the literature revealed simulated radio messaging to be the most effective means for transmitting information in the context of rural Guatemala in which illiteracy rate is traditionally high, especially in indigenous communities, and radio ownership and usage is high, close to 90% (Avila, 2010). This nutrition message was recorded in Spanish, using local vocabulary and phrases and the content of the message was developed and validated by nutritionists as well as by local leaders. This message includes topics related to the agronomic and nutritional characteristics of the HIB variety and its potential benefits on children's and women's health.

As explained above, two bean varieties were used for the study. They are both black varieties, one being the iron bean variety (*super chiva*) with 75 ppm of iron, and the other being the local variety (*unapu*) with 50 ppm of iron. The HIB variety used in this study was procured from ICTA, which had grown it in 2013 *primera* season, whereas the traditional variety was procured from a local farmer, who had produced this variety in the same season.

2.5 Determinants of Willingness to Pay

Figure 1 presents the frequency distribution of the WTP for the traditional variety and the iron variety. For both varieties almost half (43.5%) of the bids are censored at market price (5Q/pound). According to this distribution:

1. Bids below 5Q are not censored. Non-censored bids comprise 43.2% and 31.2% of the bids for the traditional and the iron varieties, respectively.
2. Bids equal to 5Q, that is 43.5% of the bids for both varieties, are censored.
3. Bids greater than 5Q are not censored. These non-censored bids comprise 13.4% and 25.4% of the bids for the traditional and the iron varieties, respectively.

As most of the respondents (80%) are either bean sellers or purchasers in the local market, they have information about the market price of beans and therefore they stated the price at

which they could buy or sell in the market. Those bidding a higher price might have considered the transaction costs of getting the same local bean in the market meanwhile those biding a lower price might have done so because of cheaper alternatives available (own beans, other varieties).

[Insert Figure 1 here]

The high probability of a Q. 5 bid on either or both of the varieties, implies that premiums were potentially upper and lower censored (Long, 1997).

In this model there is a latent variable $prem_{I,bt}$* representing repondent i's premium/discount for variety b (iron variety) over the variety t (traditional) that is related to the observed differences between the bids (WTP_{ij}) for both varieties as follows (Bernard and Gifford, 2006):

$PREM_{i,bt}$ = 0 if $WTP_{i,b} = WTP_{i,t} >= 0$

$PREM_{i,bt}$ = 1 if $WTP_{i,b} > 5$ and $WTP_{i,t} \leq 5$

$PREM_{i,bt}$ = - 1 if $WTP_{i,b} < 5$ and ≥ 5

$PREM_{i,bt}$ = $PREM_{i,bt} = x\beta+\varepsilon_i$ if $WTP_{i,b} > 5$ and $WTP_{i,t} > 5$

Where: $WTP_{i,b}$ and $WTP_{i,t}$ are respondent i's WTP for iron and traditional varieties, respectively

X = The vector of independent variables, and

ε_i = normally distributed error with mean 0 and standard deviation σ

The interval data model states that the probability that the true WTP PREMIUM of a respondent, with characteristics Y, lies in the interval [$PREM_L$, $PREM_U$] is given by $\phi(PREM_U|Y)$ - ϕ $\phi(PREM_L|Y)$, where PREM is assumed to follow a distribution with a standard normal cumulative distribution function (ϕ). In order to check the robustness of the interval censored model we also estimate an Ordinary Least Square (OLS) model.

2.6 Independent Variables

The independent variables included in the models are shown in Table 1.

[Insert Table 1 here]

2.6.1 The Progress out of Poverty Index (PPI)

The PPI is a poverty measurement tool developed by Grameen Foundation. It is computed by using the answer to 10 questions about household characteristics and asset ownership, to determine the likelihood that the household is living below the poverty line (US$ 1.25 / day 2005 PPP). The PPI is country specific (Grameen Foundation, 2015). There are a set of 10 specific questions for 45 countries. In this study country specific questions for Guatemala were asked. The higher the PPI, the lower the likelihood of a household being below the poverty line.

2.6.2 Food Frequency Index (FFI)

A Food Frequency Index was constructed following Arimond and Ruel (2002). Data collected on 15 food groups for a seven- day recall period. Respondents were first asked if they consumed the food group in the last 7 days, and if yes, how many days in the last 7 days they consumed the food. For each food group, a household or individual receives a score of 0 for frequencies fewer than four days per week, a score of unity for frequencies from four to six (inclusive) days per week, and a score of 2 for frequencies of seven or more. The diversity count is then summed across food groups (Smale, et al. 2013).With 15 groups, the range of this indicator is considerably greater (1 to 30); whereas the maximum FFI in the data is 19.

2.6.3 Interaction Variables

Interactions between the treatment variables and gender and education were also included. Interaction with gender (genderxtreat2 and genderxtreat3) investigates the relationship between the respondent's gender and the presence of information or the repetition of information on respondent's acceptance of the iron bean variety. It is hypothesized that women respondents are better able to understand and internalize nutritional information compared to male respondents, since women are often responsible for their household's food consumption and nutrition outcomes. Similarly, the interactions between the treatment variables and education level of the respondent were included (edutreat2 and edutreat3). It is hypothesized that respondents with higher levels of education would be more likely to understand and process the information, resulting in a higher information effect. And interactions between the treatment variables and the

order in which the varieties was tested by the household (varorder variable) were also included. It is hypothesized that respondents who received the information and the iron variable on the second day could be willing to pay a higher price for the iron variety, since the information and the evaluation of the iron variety are still fresh in their minds (i.e., smaller recall bias).

3. Results

3.1 Descriptive statistics

Table 2 presents the key socioeconomic characteristics of the respondents and their households, by treatment arm, and reports the results of the ANOVA analysis for median homogeneity across the three groups. The key-socioeconomic characteristics listed are those hypothesized to affect respondent WTP.

[Insert table 2]

Most of the key participant and household level social and economic characteristics are similar across treatments, revealing that randomization into treatment arms worked well. Statistical differences are observed for gender between treatment 3 and other groups; the number of members per household between treatments 2 and 3, in the percentage of households with children between 1 to 5 years between treatments 3 and treatments 1 and 2.

Variables such as initial knowledge about iron deficiency and anemia and the quantity of bean they had at home were not significantly different across treatments, showing similar iron deficiency and anemia awareness endowment and levels of product ownership among groups. Information from NARS variable is similar across treatments as well. Similarly, there are no differences in the results of the BDM mechanism across treatments. 45% of the respondents "won" in the BDM experiment. Among "winners", 7.7% didn't want to pay and 10.2% were unable to pay. On average 15.2% of those who won and didn't pay stated lack of money as the main reason for not payment, this proportion was statistically similar across treatments as well.

3.2 Sensory evaluation

Table 3 shows the mean hedonic ratings of the sensory attributes of the two bean varieties. According to the results of the sensory evaluation, participants scored both varieties above 6 (80% or more). These results are similar for both varieties in all the three treatments, being marginally higher for the iron variety for all the characteristics evaluated except for cooked bean toughness in treatments 2 and 3. For treatment 1 mean scores are statistically different for time of cooking, cooked bean thickness and the overall evaluation, with HIB variety scoring statistically significantly higher than the traditional one. For treatments 2 and 3 HIB is rated statistically significantly higher than the traditional one for raw bean color, raw bean size, bean taste and time of cooking. In the overall evaluation the iron bean variety was scored higher, but this difference is statistically different only for treatment 1

[Insert Table 3 here]

Table 4 presents comparisons of hedonic ratings across treatments. Comparison of consumer evaluation of HIB in the absence (treatment 1), and presence (treatments 2 and 3) of information reveal significant differences for raw bean size and cooked bean toughness revealing that consumers rated these attributes higher for the HIB variety in the presence of information. When evaluating the impact of the frequency of the information on consumer sensory evaluation (treatment 2 vs 3), no significant differences were found.

[Insert Table 4 here]

3.3 Economic valuation

Table 5 reports the mean WTP results for the two bean types. According to these results average WTP for the HIB variety is marginally higher in all three treatments, though these differences between the WTP for HIB variety vs traditional variety are not statistically significant difference either across or within the three treatments. Therefore consumers value both varieties equally and the presence of information and the frequency in which this information was received didn't have any impact on consumers' WTP (Table 5).

3.4 Econometric analysis

Five models were estimated using the interval censored regression approach. The basic model controls for treatments (information) only; the second controls for treatments and the order in which the two varieties were given to the respondents to try; the third controls for treatment and socioeconomic characteristics, and the fourth model controls for all variables, including the interactions. In order to check for the explanatory powers of these models and to check the robustness of the results, across models, the R-squares within and overall are shown along with Rho which is the proportion of variation due to individual specific term.

Table 6 a presents the results of aforementioned regression models. In order to compare among the different models log-likelihood ratio and Akaike information criterion (AIC) are shown. Those models with smaller AIC fit the data better than those with larger AIC (Burnham and Anderson, 2002). Each one of these models were also estimated with an OLS model to check for the robustness of the results, and the results of the OLS models are available from authors upon request.

[Insert Table 6 here]

Between the treatments variables, only Treatment2 is significant in models (2) and (3), revealing that information matters on consumer acceptance but repetition does not. The order in which the bean varieties were sampled (varorder) is significantly and negatively related to the respondent WTP for the iron bean variety in models (3) and (4). If respondents received the iron bean variety on the first day, they are less likely to state a higher WTP for this variety. This is likely because the BDM mechanism was conducted at the end of the third day and because of potential recall effect (with a downward bias), respondents stated a lower WTP for that variety

Among the socioeconomic variables, age and product endowment (Qgrain) exhibit a negative and significant relationship with WTP in models (3) and (4).The older the respondent is, the lower they are WTP for the iron bean variety. This result reinforces the hypothesis of strong traditional values, and hence strong preferences for traditional varieties in these communities, especially among the older generations. Meanwhile the higher the initial endowment of bean

grain is, the higher is the WTP for the iron bean variety, although its impact is very small. Food Frequency Index (FFI) is positive and significantly related with WTP in model (4).

Nutrition information (treatment 2) plays a positive role in the magnitude of respondent's WTP, but when it is repeated (treatment 3) it doesn't have any effect on the WTP. Both treatments are significant and positive when interacted with education, indicating that the higher the education level of the potential consumers, the higher the effect of information and its repetition on their WTP.

4. Conclusions

The aim of this study was to investigate the consumer acceptance of a iron bean variety (*super-chiva*) vis-a-vis the most traditional bean variety in the study location of Northwest Guatemala. We tested the impact of nutrition information about the iron bean variety and the frequency with which such information is provided on consumer acceptance. We collected both sensory evaluation data using hedonic rating methods, and economic valuation data using the Becker – DeGroot-Marshak (BDM) mechanism. Both types of data were collected by using home use testing (HUT) approach.

A total of 360 households partook in this study. In each household the main respondent was the main decision maker on bean consumption and purchase decisions. One third of these households were asked to evaluate the two bean varieties without receiving any information on the nutritional benefits of the iron bean variety (control group – treatment 1), one third received information through simulated radio messaging (treatment 2) and the final third received the information three times – once every day during the duration of the experiment (treatment 3).

Sensory evaluation data revealed significant differences for only some of the bean attributes investigated. Among those that did not receive information (Treatment 1 - control group) significant differences were found between two varieties' time of cooking and cooked bean thickness. In the information treatments (2 and 3) significant differences were found for raw bean color, raw bean size, bean taste and time of cooking. In all cases the iron bean variety was rated higher than its traditional counterpart. The WTP values stemming from the BDM

mechanism were however not statistically significantly different for the two bean types either across or within treatments, although average WTP values for iron bean variety was higher in each treatment.

Based on these results, it is expected that consumers would like the iron bean variety as much as, if not more than the traditional one. Although respondents rated the iron bean variety higher in general sensory evaluation and revealed a marginal (though not statistically significant) premium, we cannot conclude that the iron bean variety is preferred to the traditional one in this context. Notwithstanding the insignificant differences, the possible respondent and household level variables that may affect the magnitude of the WTP were investigated by using Interval Censored and an Ordinal Least Squares estimation methods.

The results from the regression analyses suggest that presence of information had a significant and positive effect on WTP, meanwhile repetition doesn't. Based on that result we can argue that in this context having received the information has a bigger effect than repetitive information. This finding should have implications for social-marketing and awareness campaigns in these areas.

Once both treatment effects and socioeconomic variables are controlled for we find that respondents who come from households with better diet quality (high FFI) and high initial endowment of grain, exhibit higher WTP for the iron bean variety. Older and hence more traditional respondents, on the other hand, exhibit lower WTP for this new variety, which could be because of their attachment to the traditional varieties or because of their previous unsatisfactory experiences with products or people coming from outside their communities

The order in which the households received the samples of the two varieties tested was random. Inclusion of an order effect in the regression analysis revealed that respondents who received the iron variety on the first day were WTP less for that variety, revealing a downward recall bias for this variety.

The interaction variables of education with treatments 2 and 3 were positive and statistically significant, revealing that the higher the consumers' level of education, the higher the impact of information and repetition on their acceptance of the iron variety. Based on this finding, information and repetition should be used as instruments to increase biofortified

varieties in communities with a higher levels of welfare (e.g. higher education and better diet quality).

Similarly to Meenakshi *et al.* (2012) and Oparinde *et al.*(2014) we investigated the role of product endowment on consumer WTP. Unlike the other two studies, however, we found that the amount of grain at home had a positive and significant effect on WTP for the iron bean variety.

Tables and Figures

Figure 1. Frequency WTP for traditional and iron variety (Q./pound)

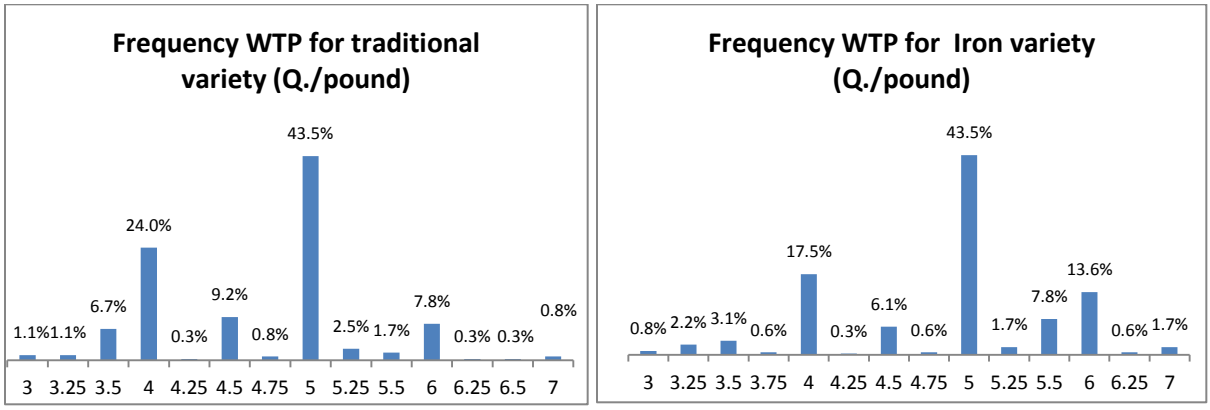

Table 1. Explanatory variables included in the models

Variables	Description
Treatment 2	= 1 respondent was in Treatment 2; 0 otherwise
Treatment 3	= 1 respondent was in Treatment 3; 0 otherwise
Varorder	= 1 if iron variety was received first; 0 otherwise
Gender	= 1; respondent is male; 0 otherwise
Age	Continuous variable indicating the age of the respondent
Education	Continuous variable indicating the years of education of the respondent

HHmembers	Continuous variable indicating the number of persons living in the respondent's household
The Progress out of Poverty index (PPI)	Grameen Foundation's Progress out of Poverty index (PPI) accounts for household's head education, household assets and income (Calculated by the authors from survey data, explained below).
Qgrain	Continuous variable indicating the quantity of bean grain at home at the time of the visit
Nopurchase	= if in the household doesn't purchase beans; 0 otherwise
Beancons	Continuous variable indicating the amount of beans consumed weekly by the household
Talk4	= 1 if the respondent talked with somebody else about this study in the last 4 days; 0 otherwise
Beanpurchase	Continuous variable indicating how long ago was the last time that in the household beans were purchased
FFI	Food Frequency Index, explained below

Table 2. Social and economic characteristics by treatment group

Variable	Definition	Mean (S.D)			
		Treatment 1 (no information) N=120	**Treatment 2 (information once) N=120**	**Treatment 3 (information three times) N=119**	**Prob > F**
Age	Respondent's age in years	36.24 (11.40)	35.82 (11.41)	34.96 (34.96)	0.73
Gender*	Respondent's gender (1 if male)	45.46%	23.01%	37.23%	0.00
Literacy	1 if respondent knows how to read and write	78.03%	76.25%	73.00%	0.77
HH size**	Number of members in the HH	6.32 (2.53)	6.06 (2.67)	5.46 (2.10)	0.02
Income	Total expenditures in the last 30 day in Quetzales	2,447 (1,217)	2,629 (2,179)	2,265 (1,071)	0.20
The Progress out of Poverty index (PPI)	HH Poverty level according to Grameen Foundation Index	60.93%	66.47%	65.45%	0.31
Food Frequency Index (FFI)	Count of 15 food groups consumed in the last 7 days (less than 4=0, 4-6=1,7+=2)	6.34 (3.19)	5.90 (2.44)	5.93 (2.57)	0.39
No. of infants	% HH with infants less than 12 months	22.51%	25.01%	20.34%	0.40
Children (1-5 years)***	% HH with children between 1-5 years	53.32%	40.03%	45.20%	0.06
Pregnancy	HH with pregnant women	3.33%	6.67%	5.04%	0.39
Quantity	Quantity of beans at home when the first sample was delivered (pounds)	405.95 (486.34)	326.54 (460.39)	343.85 (468.32)	0.39
Anemia knowledge	Index describing anemia knowledge (min= 0, max=12)	3.48 (3.06)	3.56 (3.54)	3.76 (3.69)	0.81
IRI***	Information Retention Index (min=0, max=4)	0 (0)	0.991 (0.78)	1.252 (1.03)	0.00

Information from NARS	National agricultural research system (NARS) is the main and most trustful source of information related to beans (min=0, max=1)	0.26	0.35	0.28	0.26
		39.10%	49.12%	47.02%	0.26
Winner	1 if participant won				
Won and paid	1 if participant won and paid	25.00%	25.83%	30.25%	0.62
Won and didn't pay	1 if participant won and didn't pay	6.67%	11.67%	5.04%	0.13
Won and couldn't pay	1 if participant won and couldn't pay	7.50%	11.67%	11.76%	0.45
No money	1 if lack of money was the main reason for no payment	9.40%	10.92%	10.92%	0.14

***= statistically different at 1% significance level; **= statistically different at 5% significance level; *= statistically different at 10% significance level

Table 3. Mean hedonic rating of bean varieties (home testing, northwest Guatemala)

	Bean variety	Raw bean color	Raw bean size	Bean taste	Time of cooking	Cooked bean thickness	Cooked bean toughness	Overall
Control (T1): No Information	Local	6.55±0.59	6.57±0.72	6.59±0.75	6.10±1.35	6.17±1.29	1.85±2.95	6.47±1.00
	HIB	6.63±0.72	6.61±0.67	6.75±0.74	6.58±0.74	6.66±0.66	1.95±3.07	6.66±0.66
	Difference in means							
	HIB vs. Local	0.75	0.042	0.16	0.47***	0.49***	0.11	0.19*
T2: Information present once	Local	6.53±0.46	6.5 ±0.56	6.63±0.52	6.37±1.09	6.40±0.93	1.42±2.73	6.59±0.63
	HIB	6.77±0.65	6.74±0.46	6.85±0.42	6.64±0.76	6.6 ±0.91	1.21±2.63	6.6±0.91
	Difference in means							
	HIB vs. Local	0.24***	0.24***	0.21***	0.26**	0.19	-0.21	0.01
T3: Information present	Local	6.55±0.57	6.54±0.55	6.63±0.53	6.39±0.67	6.53±0.54	1.34±2.63	6.59±0.59
	HIB	6.76±0.51	6.77±0.51	6.84±0.46	6.57±0.77	6.64±0.96	1.15±2.51	6.64±0.96
	Difference in means							
	HIB vs. Local	0.21***	0.23***	0.20***	0.17*	0.11	-0.19	0.06

***= statistically different at 1% significance level; **= statistically different at 5% significance level; *= statistically different at 10% significance level

Table 4: Differences in hedonic ratings of bean varieties across treatments

	Raw bean color	Raw bean size	Bean taste	Time of cooking	Cooked bean thickness	Cooked bean toughness	Overall
Local: T1 vs T2	0.02	0.07	-0.04	-0.26*	-0.23	0.42	-0.11
Local: T1 vs T3	0.00	0.03	-0.04	-0.28**	-0.36***	0.50	-0.11
Local: T2 vs T3	-0.02	-0.03	-0.00	-0.01	-0.12	0.08	0.00
HIB: T1 vs T2	-0.14*	-0.12*	-0.09	-0.05	0.06	0.75**	0.06
HIB: T1 vs T3	-0.13	-0.15**	-0.08	0.01	0.01	0.80**	0.01
HIB: T2 vs T3	0.01	-0.03	0.00	0.07	-0.04	0.05	-0.04

***= statistically different at 1% significance level; **= statistically different at 5% significance level; *= statistically different at 10% significance level

Table 5: Mean economic rating of bean varieties (northwest Guatemala)

Variety	**Average WTP± S.D.(Quetzals/pound)**
Super Chiva	
HIB (T1)	4.83±0.71
HIB (T2)	4.96±0.83
HIB (T3)	4.89±0.76
Traditional Variety	
Traditional (T1)	4.70±0.72
Traditional (T2)	4.67±0.74
Traditional (T3)	4.67±0.71
Within Treatment Comparison	**Premium/Discount**
T1 (HIB vs. Traditional)	0.13±0.90
T2 (HIB vs. Traditional)	0.28±0.94
T3 (HIB vs. Traditional)	0.22±0.81
Across Treatment Comparison	
T1 vs. T2	-0.12
T1 vs. T3	-0.05
T2 vs. T3	0.06

Note: Average market price: Quetzals 5/pound

Table 6. WTP for iron bean variety in Guatemala - Interval Censored model

Dependent Variable: PREMIUM	Treatment effect (1)	Sample order effect (2)	Treatment, sample order and Socioeconomic) (3)	All variables, interactions included (4)
Treatment2	0.22	0.25*	0.26*	0.31
	(0.14)	(0.14)	(0.15)	(0.30)
Treatment3	0.12	0.11	0.10	0.25
	(0.14)	(0.14)	(0.15)	(0.28)
Varorder		-0.13	-0.20*	-0.34*
		(0.12)	(0.12)	(0.19)
Gender (male=1)			-0.00	-0.19
			(0.13)	(0.21)
Age			-0.01**	-0.01**
			(0.00)	(0.00)
Education			-0.00	0.04
			(0.02)	(0.03)
HHmembers			-0.00	0.00
			(0.02)	(0.02)
Poverty Index			0.28	0.27
			(0.21)	(0.21)
Qgrain			0.00*	0.00*
			(0.00)	(0.00)
Nopurchase			-0.06	-0.11
			(0.37)	(0.37)
Beancons			-0.01	0.00
			(0.03)	(0.03)
Talk4			-0.16	-0.16
			(0.12)	(0.12)
Beanpurchase			0.02	0.02
			(0.03)	(0.03)
FFI			0.03	0.03*
			(0.02)	(0.02)
Genderxtreat2				0.31
				(0.32)
Genderxtreat3				0.09
				(0.29)
Edutreat2				0.09**
				(0.04)
Edutreat3				0.08*
				(0.04)
Varordertreat2				0.36
				(0.29)
Varordertreat3				0.09
				(0.29)
Number of obs.	359	359	359	359
Log-likelihood	-388.90	-390.04	-381.35	-377.11
AIC	2.18	2.19	2.14	2.22

***1% significance level; **5% significance level; * 10% significance level

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Appendix I. Radio message

M = Doña Rosa; H = Chepe

H: Good morning Mrs Rosa, are you coming from the market where you did your shopping?

M: Hi, yes, I bought the beans among other things for today's lunch

H: alright Mrs Rosa, then you have everything ready to cook some awesome, refried beans just like you know how to make them

M: yes indeed, Chepe, and these are going to be even better

H: and why is that Mrs Rosa?

M: well, because these beans are different

H: What do you mean different, if I see correctly they are the same as the ones we have always harvested or got at the market

M: well yes Chepe, on the outside they look alike but the difference is inside: they have more nutritional value

H: how is that Mrs Rosa?

M: A group of experts put together the best characteristics of different bean types of to develop this iron bean. It is similar to the one we have always eaten but with more iron.

H: and that more iron thing what is it useful for Mrs Rosa?

M: what do you mean that what is it useful for Chepe? you work so much from Sunday to Sunday, have a small son that barely crawls and another one in the way with your wife pregnant, and you don't know what is iron and what does it work for? Well, you are certainly careless!

H: Well, no Mrs Rosa, you know that for that kind of things I'm not very knowledgeable

M: Alright, you see Chepe that iron is like a vitamin that works to prevent anemia, let's say it's going to help you feel stronger, because it gives strength to your blood. It also helps small children develop healthy and to concentrate and learn more at school. This means that iron bean helps nourish the brain when it's growing. The soup helps but is not as potent as the bean.

H: oh I get it Mrs Rosa, then it works like the so called iron sulfate, that is given to the small children and the pregnant women at the health center and the clinics at the town?

M: yes Chepe, those products also have iron, but the flavor they sometimes have don't allow us to drink it and besides, they don't have the same amount of iron that the bean I'm talking about has.

H: Well, that sounds very good Mrs Rosa. Listen Mrs Rosa and those beans because of the iron won't taste different or will be harder?

M: you see Chepe, I bought these beans from Mr Juanito, from the corner store. He planted them in his plot and told me that there is no difference from the beans we eat here daily. Moreover, his wife has prepared some and says there is no difference. He also says that he plants and cultivates them like the others, they don´t need more fertilizer nor special care, and give equal pay or more than the other beans.

H: I believe that is nonsense Mrs Rosa

M: Chepito, if you want come along by my house for lunch and you try them, then you will know by yourself.....even more, bring along your boy and your wife, they will benefit the most. Don´t you see that iron also helps pregnant women to be stronger and have healthier pregnancies, helping at the same time the good development of the baby.

H: listen Mrs Rosa, with pleasure I accept your invitation, besides you cook very well, those beans with more iron content sounds good.

M: There you go Chepe, I will wait for you and your family later.

H: well Mrs Rosa, I will see you later. Thank you very much.

M: you are welcome Chepe, have a good day

H: Have a good day Mrs Rosa.