No. 13

HarvestPlus Working Paper | June 2014

Information and Consumer Willingness to Pay for Biofortified Yellow Cassava: Evidence from Experimental Auctions in Nigeria

Adewale Oparinde
Abhijit Banerji
Ekin Birol
Paul Ilona

HarvestPlus
Better Crops • Better Nutrition

Information and Consumer Willingness to Pay for Biofortified Yellow Cassava: Evidence from Experimental Auctions in Nigeria

Adewale Oparinde[1], Abhijit Banerji[2], Ekin Birol[1], and Paul Ilona[3]

ABSTRACT

In this paper we use the Becker-deGroot-Marschak auction mechanism to estimate consumer demand for biofortified yellow cassava varieties in two states of Nigeria: Imo in the southeast and Oyo in the southwest. These two states exhibit distinct habitual product color preferences for staple food made with cassava. We estimate the effect of nutrition information campaigns and nature of planting material delivery institutions on consumer demand. Willingness to pay estimation accounted for the effect of product endowment censoring in bids and payment. Without a nutrition information campaign, biofortified varieties are unlikely to be accepted in the southeast as they are associated with substantial discounts. In the southwest, consumers are willing to pay a premium for light yellow biofortified cassava varieties even in the absence of nutrition information. The paper finds that nutrition information results in a large and significant price premium for biofortified yellow cassava in both states, but the nature of delivery institution has a small effect in the southwest only.

1 HarvestPlus, International Food Policy Research Institute (IFPRI), Washington, DC, USA
2 Delhi School of Economics, University of Delhi, Delhi, India
3 HarvestPlus, International Institute for Tropical Agriculture (IITA), Ibadan, Nigeria

CONTENTS

I. INTRODUCTION

Biofortification is the process of breeding and delivering staple food crops with higher micronutrient content (Saltzman et al., 2013). It is a cost-effective strategy for reducing micronutrient deficiencies among the rural poor, whose diets consist of staple crops (Meenakshi et al., 2010). Vitamin A deficiency (VAD) is a major public health problem in Nigeria, where about 30 percent of children under five are vitamin A deficient (Maziya-Dixon et al., 2006). In southern Nigeria, cassava is an important staple food. Cassava varieties biofortified with vitamin A are, therefore, a potential solution for reducing VAD in the major cassava-consuming regions of the country. Owing to their higher beta-carotene content, vitamin A-enriched cassava varieties are yellow in color. Since the pulp of commonly consumed conventional cassava varieties is white, successful introduction of vitamin A biofortified yellow cassava (henceforth yellow cassava [YC]) depends on its acceptability and consumption by target populations.

In Nigeria cassava is mainly consumed as *gari*, a grated and roasted form of cassava flour. Preferences for *gari* differ cross ethnocentric regions of the country. In the Igbo-dominated southeast, cassava flour is mixed with palm oil resulting in yellow *gari*, whereas the majority of the *gari* consumed in the Yoruba-dominated southwest is white. In both regions, however, it is possible to find *gari* in different shades of yellow in the local markets.

This paper has three objectives. First, using an incentive-compatible auction mechanism, we elicit consumer willingness to pay (WTP) for YC varieties and estimate the magnitude of premium or discount relative to white varieties. Although in theory experimental auctions are incentive compatible and, hence, expected to reveal true valuation, the presence of outside substitutes raises questions about the validity of bids as true revelations of consumer WTP for novel products (Harrison et al., 2004). Availability of substitutes either through the market or home inventory can undermine revelation of true WTP. In view of this, the paper investigates the effects of price-censoring thresholds and the color and quantity of products consumers have at home on their WTP.

Second, we investigate the impact of nutrition information on consumer acceptance of YC varieties. This is important because understanding such impact and its magnitude can assist in the design of appropriate information campaigns to drive maximum adoption and consumption of YC varieties. There is a growing body of literature looking at the impact of information and awareness campaigns on acceptance and diffusion of new technologies, products and practices in developing countries (see e.g., Naico and Lusk, 2010; Chowdhury et al., 2011; Meenakshi et al., 2012; Luo et al., 2012; McKenzie et al., 2012).

In launching a new product, such as planting materials, perceptions of the delivery medium can influence how consumers construct their attitudes (Huffman et al., 2004). In Nigeria there is no formal seed system for cassava and planting materials are usually introduced through public institutions. Therefore, the third objective of this paper is to investigate whether the nature of the public delivery authority- i.e. national (Federal) versus international- impacts consumer acceptance of YC varieties.

In order to meet these objectives, we designed a consumer acceptance and WTP experiment using the Becker-deGroot-Marschak (BDM) mechanism adapted from experimental economics literature, and hedonic tests adapted from food science literature (List, 2003; Tomlins et al., 2007; Corrigan et al., 2009). The BDM mechanism was chosen among various auction techniques because it is easier to implement on an individual basis in rural settings (Banerji et al., 2013). Unlike several other experimental auction studies, this study eliminated participation fees and participants paid out of pocket for the *gari*. Standard theory suggests that initial endowments can distort optimal bidding behavior (Corrigan and Rousu, 2006), though the empirical evidence in this regard has been mixed (Loureiro et al., 2003; Morawetz et al., 2011; Banerji et al., 2013). Thus, a fourth objective of this paper is to compare the bids of participants who paid out of pocket against those who were unable to pay due to liquidity constraints.

This experiment was implemented in 18 central locations in rural areas of Oyo State in the southwest and Imo State in the southeast of the country. Six hundred and seventy-one rural cassava consumers participated in it. They undertook a sensory evaluation of *gari* made from three cassava varieties (one local and two YC) after which they had an opportunity to purchase *gari* in a BDM setting. The local varieties used in the experiment were purchased from the community markets in each study location. The local *gari* in Oyo was white, whereas in Imo it was deep yellow mixed with palm oil. Of the two YC varieties evaluated in the study, one was light yellow (YC1), and the other (YC2) was very deep yellow.

Participants at each location were randomly assigned to one of three treatment arms. In the control group (T1), no information was given regarding the nutritional benefits of YC varieties, whereas in the first (T2) and second (T3) treatment groups nutrition information was provided through simulated radio messages. The key difference between T2 and T3 was the delivery authority. In T2, the message conveyed that the Federal Government was responsible for delivering planting materials for YC

varieties, while in T3 the delivery authority was generically referred to as 'international authority'. Through these two treatment and control groups, the study could (1) compare consumer evaluation (hedonic tests) and valuation (WTP) of local *gari* versus YC1 and YC2 *gari*, and (2) estimate the impact of nutrition information and delivery authority on consumer valuation of YC varieties relative to local ones.

The next section explains the methodology. The empirical model is presented in section three, while section four presents and discusses the results. Section five concludes the paper with implications for delivery, adoption and consumption of YC in southern Nigeria.

2. METHODOLOGY

2.1 BDM Mechanism

BDM is a widely applied auction-like mechanism in consumer acceptance analyses in rural Africa (e.g. Hoffmann et al., 2009; Kiria et al., 2010; De Groote et al., 2011; Morawetz et al., 2011; Banerji et al., 2013). In a BDM mechanism, the individual places a bid, b, for the product on sale. The decision rule for winning the product is based on the comparison of y to a random price (p) drawn from a distribution (K) already established ex ante: the individual wins the object if $b > p$, and pays price p. If $b < p$, the bidder loses (does not get the object or pay a price). This paper defines the individual's WTP for a unit of the product as the price that induces indifference between winning and not winning it. That is, $u(1,w - WTP) = u(0,w)$, where w is the individual's wealth at the beginning of the experiment. Rational behavior under this mechanism is to place a bid equal to WTP (Lusk and Shogren, 2007).

$$max \int_0^b u(1,w - p)dK(p) + u(0,w)\left(1 - K(b)\right) \qquad (1)$$

A first order condition of this expression (1) shows that the optimal bid solves $(u(1,w - b^*) = u(0,w)$, and it is, therefore, equal to the WTP.

2.2 Study Area and Sampling Design

The study was conducted in Ibarapa East local government area (LGA) in Oyo State and Ohaji/Egbema LGA in Imo State, both of which produce and consume large volumes of cassava and are targeted for YC variety delivery by HarvestPlus and partners. Within these LGAs, the sampling of Enumeration Areas (EA) and of households within EAs were based on the National Bureau of Statistic (NBS) master sampling frame developed for the 2011 World Bank Living Standards Measurement Survey – Integrated Survey on Agriculture (LSMS-ISA, 2011). The NBS created the master sampling frame by systematically selecting 30 EAs to be representative of each LGA. The YC consumer acceptance study involved all 30 EAs in Ohaji/Egbema LGA, clustering them into 10 central locations (CLs) based on proximity, with one CL comprising two or more EAs. In Ibarapa East LGA, only 21 of the 30 EAs were included in the sample as the others had already been informed about the YC varieties by a non-governmental organization (NGO) and might bias information treatments. The selected EAs were clustered into eight CLs, also based on proximity.

The total sample size for this experiment was estimated by considering the average treatment effect expected. In Oyo State consumers commonly purchase *gari* in *Kongos*, while in Imo State consumers usually purchase *gari* in *Nescafé* cups. In Imo, the price of *gari* varied by color, with deep yellow most expensive, followed by light yellow and then white. The prevailing market prices for half a *Kongo* (500g), or 3 Nescafé cups (300g), of *gari* in Oyo and Imo states, respectively, varied between ₦20 to ₦50 (US$1≈ ₦150 when the study was implemented). Based on recent studies on vitamin A biofortified orange sweet potato in Uganda (Chowdhury et al., 2011) and orange maize in Zambia (Meenakshi et al., 2012) and Ghana (Banerji et al., 2013), we anticipated effects of 15 percent or 20 percent, corresponding to ₦5 or ₦7 as well as a standard deviation of ₦30- ₦35. The power calculation result indicated that for the pooled data over the two states and for the one-tailed test, 450 (150*3) participants were required for the three treatments, that is 225 participants per state.

Consequently, in each EA cluster, NBS household lists were used to randomly select 30-40 households for the study. The households were visited a day prior to the study and were invited to participate the next day. They were introduced to the study and informed of the option to purchase one of the *gari* types they were going to evaluate, hence the need for them to bring along cash. In each household, female and male members over the age of 18 years were invited alternately. Participants at each CL were randomly assigned to one of three treatments, each of which comprised one-third of the sample size. To control for information contamination, the treatment with no information provided (T1) was conducted first. Data were collected in November-December 2011 in the local languages.

2.3. BDM Elicitation Procedure

Preparation and presentation of cassava food products

The YC1 and YC2 *gari* presented to the participants were made from YC varieties obtained from the International Institute for Tropical Agriculture (IITA) cassava fields. *Gari* quality is usually a function of the cassava variety as well as the various harvesting, storage and processing methods. Yellow cassava roots from YC1 and YC2 were harvested at the same time and stored and transported in

the same manner. In view of the associated complexities and correlations in factors that determine *gari* quality, the study employed women groups from one of the non-sampled EAs in each study LGA to process the *gari* from the two YC varieties. Other consumers in the communities were invited to witness the *gari* processing and were asked to continuously check the *gari* during processing so as to ensure that it met local consumers' definition of best quality. The same group of women assisted in sourcing best quality local *gari* from the local markets. White *gari* was purchased in Oyo, while yellow *gari* mixed with palm oil was purchased in Imo. Finally, in each of the study EAs, the same study team member cooked all three *gari* types into *eba* (dough from *gari*) on the day of the experiment. The order of presentation of *gari* and *eba* types was randomized across participants.

Hedonic tests and WTP elicitation

After describing the study and asking for participants' consent to participate, we asked a series of questions on participants' household demographics, cassava production and consumption characteristics, knowledge of vitamin A and sources of agricultural and health information. Following these, participants in T2 and T3 were asked to listen to a five-minute simulated radio message on MP3 players. This message provided the participants with information on the nutritional benefits of YC and the importance of having sufficient vitamin A in households' diets.

Subsequently, participants were asked to taste the three types of *gari* and *eba*, one by one. A 5-point hedonic scale (1=dislike very much to 5=like very much) was utilized to evaluate the sensory attributes of these *gari* types (Tomlins et al., 2007). In both states, participants evaluated the color, feel and taste of *gari*, with drinking quality additionally evaluated in Oyo State. Participants in both states also evaluated the color and feel of *eba* but not taste, as *eba* is usually eaten with soup which, if included in the study, might have interfered with taste.

Following the hedonic tests, participants were instructed in detail on how to participate in the auction. Enumerators explained to the participants that it was optimal to state a bid equal to their true WTP. In particular, participants were told that stating a bid higher than their true WTP could result in them having to buy at a higher price than they were originally willing to pay, whereas stating a bid lower than their true WTP could result in losing out on a profitable opportunity to purchase. An example of this bidding process was demonstrated before the auction began.

Participants were asked to submit separate WTP bids for a specified quantity of each of the YC1, YC2 and local *gari* they evaluated. The quantity bid per *gari* type was 3 Nescafé cups (300g) in Imo State and half a *Kongo* (500g) in Oyo State. Following this, each participant selected the "binding" *gari* type by randomly picking a labeled chip from an opaque bag that contained three chips corresponding to each of the three *gari* types. For this binding variety, the participant was asked to draw a 'competing bid' by randomly selecting a price strip from another opaque bag containing 10 price strips (₦15 to ₦60) with a uniform distribution around the average market price. Participants were informed of this price distribution before randomly picking the binding price. If the participant's WTP for the binding *gari* type exceeded the competing bid, the participant would "win" and purchase the *gari* type, making an out-of-pocket payment for a price equal to the competing bid. Otherwise, the participant did not "win" the *gari* and hence couldn't make a purchase.

3. DATA AND EMPIRICAL STRATEGY

3.1 Participant and Household Characteristics

Participants' social and economic characteristics by treatment group, state and payment status are presented in Table 1. In both states a majority of key participant characteristics are similar across treatments, revealing that the randomization worked well and the results across treatment groups are comparable. There are, however, some significant differences across treatments in Imo State: participants in T1 are significantly older (p-value <0.05) and have lower years of education compared to participants in T3 (p-value <0.10). A majority of the participants in both states had *gari* at home at the time of the survey, but the quantity of that *gari* was not significantly different across treatment groups in each state. This suggests different levels of ex ante product endowments among participants.

The color of *gari* that participants had at home varied across states, reflecting the range of *gari* colors in markets. The *gari* across local markets in the study area can be graded by color from white (1), cream (2), light yellow (3), yellow (4), slightly deep yellow (5), deep yellow (6) to very deep yellow (7). The color of the *gari* that participants had at home at the time of the experiment was not significantly different across treatment groups. In Imo, about 52 percent and 43 percent of participants had yellow and white *gari*, respectively, at home. Thirty-one percent of the participants stated that they habitually ate very deep yellow *gari*, against 15 percent who ate deep yellow *gari* and 41 percent who ate white *gari*. In Oyo, about 94 percent of the participants habitually ate white *gari*. Thus, from the consumers' perspective, deep yellow *gari* is habitually preferred in Imo,

Table 1: Social and economic characteristics by treatment group and state

Variable	Definition (Key participant and household characteristics)	T1 - No Information	T2 - Information & delivery by Federal authorities (Info_Fed)	T3 - Information & delivery by International authorities (Info_Intl)	T1 - No information	T2 - Information & delivery by Federal authorities (Info_Fed)	T3 - Information & delivery by international authorities (Info_Intl)
			Imo State			Oyo State	
		N = 116	N = 108	N = 104	N = 114	N = 114	N = 115
Socio-economic							
Peri-urban	1 if participant is in peri-urban area	0 %	0 %	0 %	41 %	40 %	49 %
Male	1 if participant's gender is male	63 %	69 %	60 %	68 %	61 %	66 %
Aware of vitamin A	1 if participant is aware of vitamin A	79 %	82 %	77 %	56 %	46 %	50 %
Produce cassava	1 if participant's household is producing cassava	99 %	100%	99 %	84 %	90 %	92 %
Cassava area (ha)	Area of land in hectares cultivated with cassava in the last 12 months by the participant's household	0.94 (1.02)	1.09 (1.50)	1.43 (2.58)	1.23 (1.40)	0.95 (0.73)	1.26 (1.30)
Age*	Participant's age in years	51.96 (14.82)	47.40 (14.48)	47.59 (17.45)	49.39 (16.14)	47.50 (14.97)	48.08 (17.73)
Education*	Participant's education in years	6.31 (4.89)	7.74 (5.09)	7.49 (5.16)	6.67 (5.97)	6.57 (5.77)	6.10 (5.67)
HH Size	Household size	8.97 (4.27)	8.86 (4.34)	9.65 (4.65)	8.15 (4.90)	8.54 (5.67)	8.50 (6.26)
Under 5	Number of children under 5	1.40 (1.53)	1.16 (1.34)	1.38 (1.41)	0.93 (1.09)	1.11 (1.25)	1.15 (1.38)
Gari status at home							
Don't buy *gari*	1 if participant's household doesn't buy *gari*	22 %	19 %	23 %	33 %	34 %	37 %
Gari at home	1 if participant;s household had *gari* at home at time of survey	80 %	91 %	86 %	63 %	68 %	64 %
UH color same	1 if participant's color of habitually consumed *gari* is the same as the color of *gari* at home	57 %	70 %	66 %	56 %	63 %	63 %
Diff_colorLocal	Difference between color of *gari* participant had at home and color of local *gari* at CLT (white = 1 to very deep yellow = 7)	2.78 (1.88)	2.49 (2.01)	2.84 (1.96)	0.24 (0.96)	0.15 (0.65)	0.10 (0.54)
Diff_colorYC1	Difference between color of *gari* participant had at home and color of YC1 *gari* at CLT (white = 1 to very deep yellow = 7)	2.22 (1.16)	2.66 (1.11)	2.28 (1.09)	-1.80 (0.74)	-1.85 (0.53)	- 1.86 (0.43)
Diff_colorYC2	Difference between color of *gari* participant had at home and color of YC2 *gari* at CLT (white = 1 to very deep yellow = 7)	3.33 (2.41)	2.82 (2.63)	3.41 (2.46)	-5.80 (0.74)	-5.85 (0.53)	-5.88 (0.43)
Qty home *gari*	Quantity of *gari* at home (kg)	11.86 (20.45)	14.79 (30.22)	13.49 (22.71)	3.53 (9.53)	7.05 (20.63)	4.21 (12.11)
Payment Status							
Won *gari*	1 if participant won *gari*	51 %	60 %	50 %	60 %	53 %	65 %
Won and paid	1 if participant won *gari* and paid	40 %	46 %	39 %	52 %	48 %	60 %
Won and couldn't pay	1 if participant won *gari* and couldn't pay	9 %	10 %	8 %	5 %	5 %	4 %
Won and didn't pay	1 if participant won *gari* and didn't want to pay	2 %	4 %	3 %	3 %	0 %	1 %
Trust in Institutions							
Trust in state/Federal	Trust in state/Federal government agencies (1 - distrust very much to 5 - trust very much	4.14 (0.71)	4.13 (0.75)	4.18 (0.86)	3.36 (0.94)	3.53 (1.01)	3.48 (0.94)
Trust in international	Trust in international health and agricultural agencies/NGOs (1 - distrust very much to 5 - trust very much)	4.34 (0.84)	4.47 (0.55)	4.47 (0.70)	3.96 (0.80)	3.84 (0.72)	4.04 (0.71)
Trust in local	Trust in local administration/village leadership (1 - distrust very much to 5 - trust very much)	4.20 (1.07)	4.43 (0.75)	4.26 (1.07)	4.00 (1.03)	3.70 (1.14)	3.92 (1.07)

*One-sided t-tests reveal statistically significant differences in participant/household characteristics across treatment arms; (): standard deviation

while white *gari* is habitually preferred in Oyo. As a result, WTP could be conditional on the color difference between the participant's habitually preferred *gari* and that of the auctioned *gari*(s) such that, rationally, participants should be willing to pay more when the color of auctioned *gari* is closer to that of their habitual preference.

Meanwhile, for some households (36 percent in Imo and 39 percent in Oyo) the color of habitually consumed *gari* was different from the color of *gari* at home. It is likely that these participants were sellers. Therefore, the difference between the colors of habitually consumed *gari* and *gari* at home was computed for only participants for whom the two matched.

Although participants were asked to bring cash to the CLs, some were unable to pay or did not want to pay for *gari* after 'winning' (see Table 1). Of interest is whether or not these participants were systematically different from those who won and paid. In both states, the study found no statistical difference in terms of many of the socio-economic characteristics, including wealth status, of the two categories of participants.

3.2 Hedonic Tests and WTP Data

The mean hedonic scores are shown in Table 2. Although most participants scored local products above three (i.e., "like" or "like very much"), in each state the mean scores are statistically significantly different across product types for all sensory attributes evaluated. Participants in Oyo did not rate color and taste of YC2 *gari* differently from those of local *gari*. In Imo, local products have the highest scores, followed by the very deep yellow YC2 and light yellow YC1. In Oyo, light yellow YC1 products rated highest, while YC2 eba color and feel were perceived better than those of local eba. Drink quality was not evaluated in Imo because consumers in this state do not typically drink *gari*.

An agglomerative hierarchical (AH) cluster analysis was conducted on hedonic data using *gari* and eba attributes (color, feel and taste) as the clustering variables. The algorithm displays three distinct clusters for each state's data. The composition of consumers in each cluster is only slightly different across states (see Figures 1 and 2). About 75 percent of participants in each state liked the sensory attributes of both biofortified *gari* types as much as those of local *gari* (cluster 1). As a result, cluster 1 participants are defined as "All likers". Interestingly, while 14 percent of

Table 2: Mean hedonic rating of cassava products (all treatments)

Product Variety	Gari				Eba	
	Color	Feel	Taste	Drink quality	Color	Feel
Imo State						
Mean score						
Local	4.66 ± 0.80	4.77 ± 0.68	4.61 ± 0.84	-	4.68 ± 0.82	4.63 ± 0.81
YC1	3.45 ± 1.61	3.57 ± 1.54	3.57 ± 1.57	-	3.60 ± 1.51	4.15 ± 1.36
YC2	4.21 ± 1.24	4.29 ± 1.45	4.20 ± 1.25	-	4.31 ± 1.14	4.41 ± 1.14
T-statistic difference in means						
Local vs. YC1	-12.25***	-12.88***	-10.57***	-	-11.36***	-5.50***
Local vs. YC2	-5.55***	-6.50***	-4.88***	-	-4.82***	-2.85***
YC2 vs. YC1	6.80***	6.76***	5.69***	-	6.74***	2.64***
Oyo State						
Mean score						
Local	3.99 ± 1.21	3.94 ± 1.25	4.25 ± 1.05	4.10 ± 1.16	3.52 ± 1.38	3.70 ± 1.32
YC1	4.60 ± 0.78	4.68 ± 0.64	4.66 ± 0.73	4.61 ± 0.81	4.63 ± 0.72	4.69 ± 0.61
YC2	4.00 ± 1.22	4.22 ± 1.03	4.29 ± 1.07	4.21 ± 1.17	4.13 ± 1.17	4.20 ± 1.11
T-statistic difference in means						
Local vs. YC1	7.85***	9.69***	5.89***	6.70***	13.10***	12.58***
Local vs. YC2	0.16	3.17***	0.43	1.25***	6.19***	5.42***
YC2 vs. YC1	-7.65***	-7.00***	-5.32***	-5.20***	-6.67***	-7.07***

***1% significance level, **5% significance level, *10% significance level (One-sided tests)

Figure 1: Sensory evaluation of gari by cluster (Imo State)

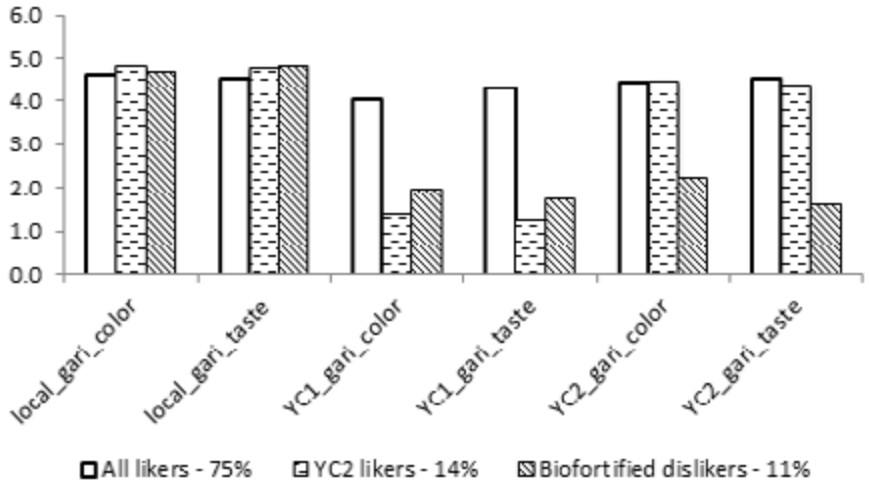
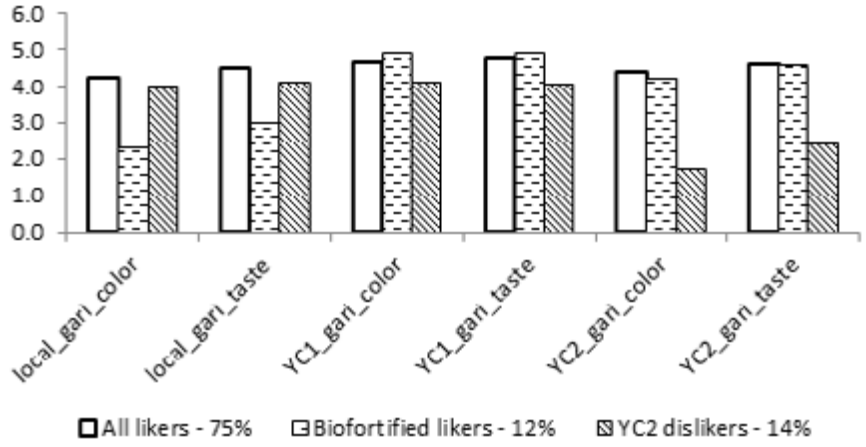


Figure 2: Sensory evaluation of gari by cluster (Oyo State)



participants in Imo (cluster 2) liked the sensory attributes of YC2, the same percentage disliked this variety in Oyo (cluster 3). Therefore, cluster 2 in Imo is defined as "YC2 likers" while cluster 3 in Oyo is defined as "YC2 dislikers". About 11 percent of participants in Imo (cluster 3) disliked the taste and color of both YC varieties; in contrast, about 12 percent in Oyo (cluster 2) liked the taste and color of both YC varieties. Thus, the study also defines cluster 3 consumers in Imo as "YC dislikers" and cluster 2 consumers in Oyo as "YC likers". These data reflect the regional variations inherent in consumer preference for color of typically consumed *gari* in each state. Although participants in T2 and T3 received nutritional information before tasting the product, a multinomial logit model of cluster membership was estimated to investigate if this had some effect on hedonic scores used to construct the cluster membership. In both states, the main effect of information is not significant (see Appendix).

The frequency distributions of WTP data show that some participants' bids were above the market price range (₦20 – ₦50) at the time of the survey, and this is particularly striking for local *gari* (see Appendix). However, the distribution of WTP data for the pool does not clearly suggest right or left censoring in bids, but worth noting is that the majority of the bids are at currency rounds.

As shown in Figures 3 and 4, the quantile-quantile (Q-Q) plots comparing ordered values of WTP with quantiles of the normal distribution represented by the fitted line confirm the existence of outliers. The first issue considered in this case is whether or not these values are true outliers as they could have resulted from the hypothetical nature of bids submitted by those participants who won *gari* in the BDM game but made no payment. Their average WTP is

Figure 3: Quantile-Quantile (Q-Q) plots for WTP Data (Imo)

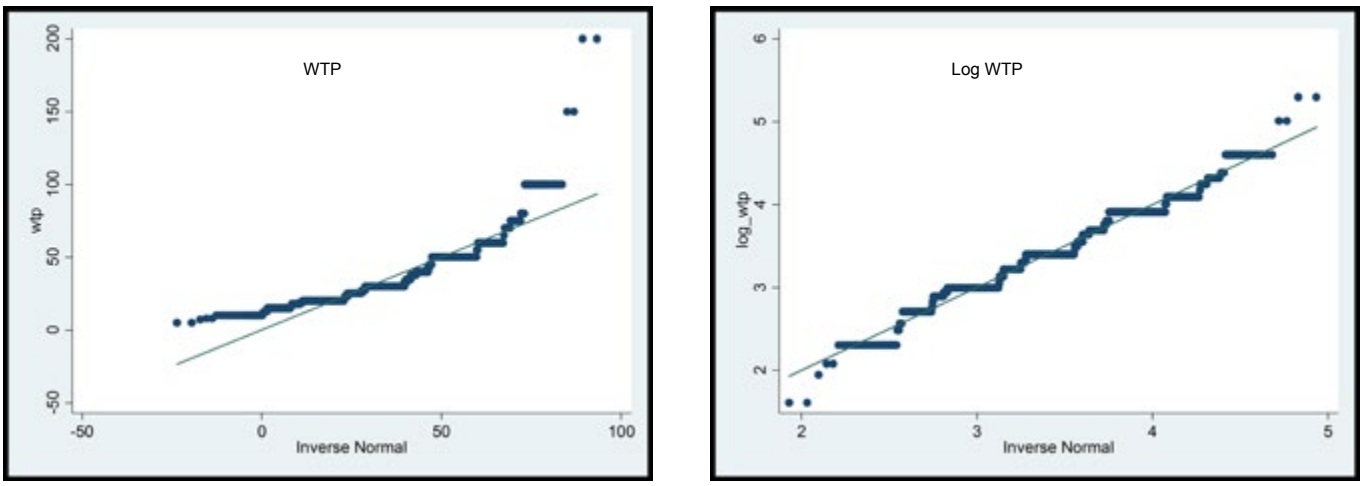
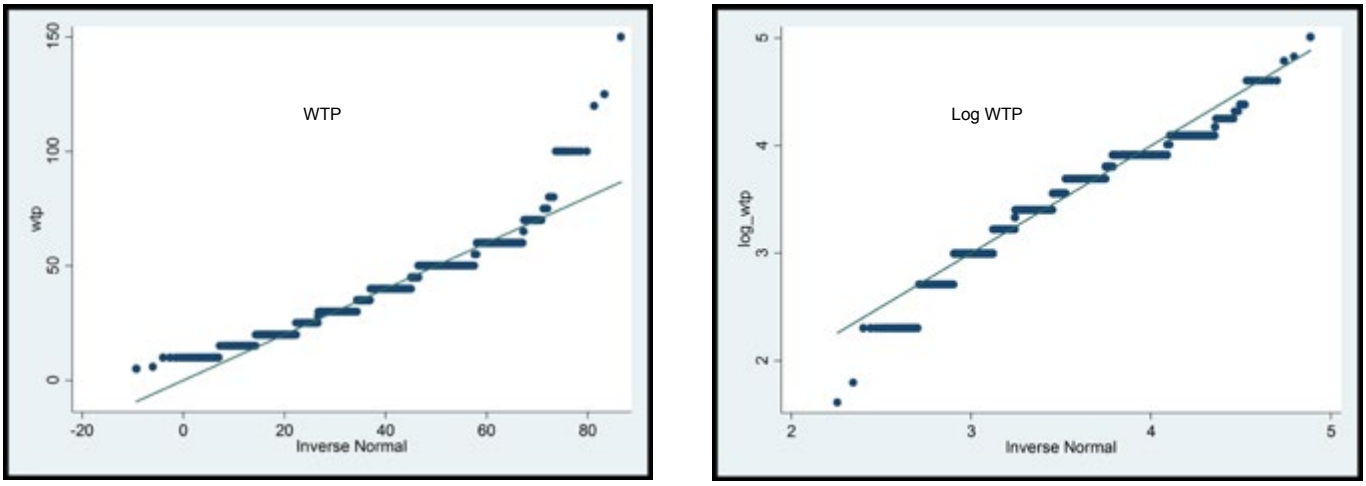


Figure 4: Quantile-Quantile (Q-Q) plot for WTP Data (Oyo)



significantly higher than that of participants who won and paid (Table 3). Rather than drop these observations, a log transformation of WTP was taken.

3.3 Econometric Strategy

The study aimed to estimate how consumer WTP is affected by product characteristics, information and a set of controls. Considering the panel nature of the data, we start by estimating a basic panel-generalized least square model of WTP. Consumer *i*'s WTP for *gari* type *j* of quantity *q* is assumed to be determined by product characteristics *x*. Since consumers bid against the same distribution of market price in the BDM experiment, their WTP is correlated, such that the bids can be explained under a random-effect framework where the individual-specific effect can be assumed to be randomly distributed. A standard Hausman test rejects a fixed effect estimator for both states. The random effect model can thus be specified as:

$$log(WTP_{ij}) = \alpha + \beta' x_j + \mu_i + e_{ij} \quad (2)$$

In this case, *x* represents color of the *gari*, μ_i accounts for the disturbance introduced into the model due to correlations across a consumer's WTP for the different products *j*, and e_{ij} represents the normally distributed error term for the consumer's WTP. The random effect model assumes that β' are unbiased parameter estimates where μ_i is uncorrelated with endogenous variables. Consumers' preference for *gari j* may not only be affected by its attributes. We also include a vector of participant

Further, considering the taste heterogeneity demonstrated by the sensory clusters discussed earlier, we include cluster membership as dummy variables in the estimation

characteristics, Z_i and a vector of experimental treatment variables, T_i, in order to identify the effect of information, such that:

$$log(WTP_{ij}) = \alpha+\beta' x_j +\theta' T_i+\gamma_1 Z_1+\gamma_2 Z_2+\ldots+\gamma_n Z_n+\mu_i+e_{ij} \quad (3)$$

where γ_1 to γ_n are the vector of parameters corresponding to participant characteristics and θ' are parameter estimates corresponding to the treatment variables. For the study's basic identification strategy to be valid, we include both the main and cross effects of both participant characteristics and treatment variables. Since there are two YC products of interest in the study, a model with cross effects for both products will suffer from a multicollinearity problem. We only include cross effects in cases where these variables are not highly correlated.

3.4 Robustness Analysis

Following the basic model estimation, we conduct several robustness analyses to check the validity of our identification strategy. First, in order to investigate whether or not their estimation is sensitive to the outliers, both models with and without bids submitted by participants who won and made no payment were estimated. About 12 percent and 6 percent made no out-of-pocket payment in Imo and Oyo, respectively. Second, similar to Corrigan and Rousu (2006), we estimate random effect Tobit models that take into account both the panel nature of our data and the possible influence of censoring in bids. In Imo State, about 4 percent stated bids less than or equal to ₦15 and 16 percent greater than or equal to ₦50, while in Oyo State 2 percent and 20 percent, respectively, stated the same.

Following Cherry et al. (2004) and Harrison et al. (2004), we make four censoring threshold assumptions. First, is the "left-censored" model (eq. 4) where bids are assumed to be censored from below at the lower limit of the gari market price range or at the lower limit of the price distribution used in the BDM game (i.e. ₦15) since participants were informed of this distribution before stating their bids. It is possible to assume that those participants who submitted bids equal to the minimum obtainable market price did so because of perceived cheaper alternatives outside the auction. This may be due to the perceived product endowment in terms of the quantity and characteristics of gari at home.

$$\text{Left censored model: } log(WTP_{ij}) = \begin{cases} \log(WTP^*_{ij}) & if \quad WTP^*_{ij} > 15 \\ \log(15) & if \quad WTP^*_{ij} \leq 15 \end{cases} \quad (4)$$

WTP_i is the observed bid for product j by participant i while WTP^*_i is the latent variable for bids. Main and cross effects for explanatory variables shown in equation (3) are included in equation (4) as well. Two right-censored models are also estimated. As a strategy to account for upper censoring, bids in the 'right-censored model I' are assumed to be censored from above at the upper limit of gari market price range (i.e. ₦50). In the 'right-censored model II', bids are assumed to be censored from above at the upper limit of the price distribution used in the BDM game (i.e. ₦60). Banerji et al. (2013) note that participants who state bids equal to the market price may have higher WTP due to perceived transaction costs of obtaining the same product outside the auction but bid the price at which they could buy a product in the market. Harrison et al. (2004) also found that there could be several alternative products outside the auction that may result in participants holding higher WTP than the obtainable market price. For instance, participants could obtain local gari similar to the one auctioned in an open market.

We also estimate an interval-censored regression model. Besides the possible effect of outside options, the data show that most of the observed WTP are in currency rounds. Therefore, participants' bids could bind between the currency intervals. In such a scenario, what is observed for each data point is not WTP_{ij}, but rather lower and upper bounds of WTP_{ij}, such that WTP_{ij} can be left- and/or right-censored. Denoting lower bound as WTP_{Aij} and upper bound as WTP_{Bij} and considering equation (2) as well as the distribution of the random effect μ_i, we use the joint unconditional density of the observed to compute the likelihood function (L):

$$log\, L = \Sigma_{i=1}^{n} log \int_{\infty}^{-\infty} \frac{e^{\frac{-\mu_i^2}{2\sigma_\mu^2}}}{\sqrt{2\pi\sigma_\mu}} \left[\pi_{j=1}^{ni}\ F(WTP_{Aij}, WTP_{Bij}, x_j\beta+\mu_i)\right] d\mu_i \quad (5)$$

where $F(WTP_{Aij}, WTP_{Bij}, \Delta_{ij})$ is conditioned on the censored data points ($\forall i = 1,\ldots,n$).

Table 3: Consumer willingness to pay (WTP) for cassava gari in Imo (₦/3 Nescafé cups (300g)) by treatment group and payment status

		Mean WTP (Std Dev)			Mean diff. in WTP (Std Dev): WTP for traits (₦/3 Nescafé cups)					
		(1) Local	(2) YC1	(3) YC2	(4) YC1 - Local	(5) %	(6) YC2 - Local	(7) %	(8) YC2 - YC1	(9) %
T1: No Information	Won and paid (N = 46)	42.76	34.84	38.22	-7.94***	-22.80	-4.54***	-11.88	3.39*	8.87
		(17.44)	(14.65)	(19.30)	(15.48)		(12.13)		(12.96)	
	Group sample (N = 116)	38.82	30.35	34.05	-8.47***	-27.91	-8.47***	-24.88	3.71***	10.90
		(16.23)	(13.13)	(17.50)	(13.82)		(13.82)		(11.74)	
T2: Information + Federal Delivery	Won and paid (N = 50)	36.22	36.64	41.6	0.42	1.15	5.38**	12.93	4.96**	11.92
		(14.10)	(16.93)	(18.06)	(16.35)		(17.42)		(15.22)	
	Group sample (N = 108)	35.98	34.23	40.82	-1.76	-5.14	4.84**	11.86	6.59***	16.14
		(19.48)	(19.58)	(31.00)	(15.95)		(25.17)		(21.83)	
T3: Information + Int'l Delivery	Won and paid (N = 41)	36.10	37.10	42.07	1.00	3.15	5.98**	14.21	4.98**	11.84
		(16.45)	(18.75)	(18.58)	(14.73)		(15.87)		(12.30)	
	Group sample (N = 108)	33.03	31.76	34.94	-1.27	-3.42	1.91	3.41	3.18***	9.10
		(14.32)	(15.77)	(16.17)	(13.79)		(13.20)		(9.36)	
Overall	Won and paid (N = 137)	38.37[a]	36.17	40.61[b]	-2.21	-6.11	2.23	5.49	4.44***	10.93
		(16.18)	(16.69)	(18.58)	(16.01)		(15.99)		(13.57)	
	Won but no payment (N = 39)	47.85	39.12	49.73	-8.73***	-22.32	1.89	3.80	10.62**	21.36
		(26.02)	(20.44)	(40.21)	(18.21)		(30.96)		(30.65)	
	Lost (N = 152)	30.92	26.57	29.54	-4.35***	-16.37	-1.38	-4.67	2.97***	10.05
		(12.17)	(12.79)	(16.88)	(12.51)		(15.25)		(9.65)	
	Full sample (N = 328)	36.05	32.07	36.56	-3.98***	-12.41	0.51	1.40	4.49***	12.28
		(16.94)	(16.34)	(22.66)	(14.88)		(18.11)		(15.31)	
	All likers (N = 243)	36.11	34.36	38.44	-1.75*	-5.09	2.33*	6.78	4.08***	10.61
		(17.72)	(17.11)	(24.12)	(15.27)		(19.17)		(16.21)	
	YC2 likers (N = 46)	33.72	23.28	33.70	-10.44***	-44.85	-0.02	-0.06	10.41***	30.92
		(15.70)	(10.67)	(19.26)	(11.93)		(13.02)		(14.31)	
	Biofortified dislikers (N = 35)	38.77	28.27	28.53	-10.55***	-37.14	-10.24***	-35.89	0.26	0.91
		(13.18)	(12.93)	(13.74)	(11.92)		(12.43)		(6.16)	
Across treatments		t-statistics difference in mean			Local - Local	%	YC1 - YC1	%	YC2 - YC2	%
Premium for info	T2 vs T1	1.19	1.75*	-2.02**	-2.84	-7.89	3.88*	11.34	6.77**	16.59
Premium for info	T3 vs T1	2.79***	-0.73	-0.39	-5.79***	-17.53	1.41	4.44	0.89	2.55
Premium for fed	T2 vs T3	1.25	1.01	1.72*	2.95	8.20	2.47	7.22	5.88*	14.41

[a]Mean (won but no payment) is significantly higher than the mean (won and paid) for local *gari* by 24.71% at 1% level (one-sided t-test)

[b]Mean (won but no payment) is significantly higher than the mean (won and paid) for YC2 *gari* by 22.46% at 5% level (one-sided t-test)

***1% significance level, **5% significance level, *10% significance level (one-sided t-test)

Table 4: Consumer willingness to pay (WTP) for cassava gari in Oyo (₦/1/2 *Kongo* Cups (500g)) by treatment group and payment status

		Mean WTP (Std Dev)			**Mean diff. in WTP** (Std Dev)**: WTP for traits (₦/1/2 *Kongo* Cups)**					
		(1) Local	(2) YC1	(3) YC2	(4) YC1 - Local	(5) %	(6) YC2 - Local	(7) %	(8) YC2 - YC1	(9) %
T1: No Information	Won and paid (N = 59)	41.78	46.02	40.51	4.23**	9.19	-1.27	-3.14	-5.51***	-13.60
		(16.10)	(21.45)	(15.53)	(14.70)		(13.22)		(14.29)	
	Group sample (N = 114)	38.90	41.18	35.75	2.28*	5.54	-3.16***	-8.84	-5.44***	-15.22
		(14.60)	(20.00)	(14.94)	(13.50)		(11.90)		(12.98)	
T2: Information + Federal Delivery	Won and paid (N = 55)	36.64	47.64	44.73	11.00***	23.09	8.09***	18.09	-2.91*	-6.51
		(10.10)	(16.55)	(16.57)	(14.16)		(13.73)		(12.27)	
	Group sample (N = 114)	32.37	41.01	40.04	8.64***	21.07	7.67***	19.16	-0.97	-2.42
		(11.90)	(16.61)	(16.68)	(12.29)		(12.67)		(10.83)	
T3: Information + Int'l Delivery	Won and paid (N = 69)	35.73	48.19	44.57	12.46***	25.86	8.84***	19.83	-3.62***	-8.12
		(12.04)	(14.22)	(14.24)	(15.35)		(13.09)		(10.81)	
	Group sample (N = 115)	33.96	43.44	40.91	9.48***	21.82	6.96***	17.01	-2.52**	-6.16
		(11.44)	(14.13)	(13.93)	(14.35)		(12.89)		(10.52)	
Overall	Won and paid (N = 183)	37.90[a]	47.32	43.31	9.37***	19.80	5.36***	12.38	-4.02**	-9.28
		(13.20)	(17.45)	(15.42)	(15.15)		(14.03)		(12.43)	
	Won but no payment (N = 21)	44.76	51.67	44.76	6.91**	13.37	0.00	0.00	-6.91*	-15.44
		(9.28)	(16.46)	(11.78)	(13.55)		(10.84)		(15.61)	
	Lost (N = 139)	29.82	33.24	32.22	3.42***	10.29	2.40**	7.45	-1.01	-3.14
		(11.07)	(12.32)	(13.19)	(10.92)		(12.71)		(9.33)	
	Full sample (N = 343)	35.07	41.88	38.90	6.81***	16.26	3.83***	9.85	-2.98***	-7.66
		(12.99)	(17.06)	(15.35)	(13.75)		(13.40)		(11.61)	
	All likers (N = 254)	35.59	41.79	40.29	6.20***	14.84	4.70***	11.67	-1.50**	-3.72
		(12.69)	(16.67)	(15.63)	(13.47)		(13.20)		(10.51)	
	Biofortified likers (N = 39)	29.62	43.72	40.13	14.10***	32.25	10.51***	26.19	-3.59*	-8.95
		(12.59)	(15.88)	(13.35)	(9.59)		(9.51)		(12.87)	
	YC2 dislikers (N = 46)	36.85	40.44	30.98	3.59	8.88	-5.87***	-18.95	-9.46***	-30.54
		(13.88)	(18.07)	(13.15)	(15.23)		(12.40)		(10.23)	
Across treatments		t-statistics difference in mean			Local - Local	%	YC1 - YC1	%	YC2 - YC2	%
Premium for info	T2 vs T1	-3.70***	-0.07	2.05**	-6.53***	-20.17	-0.17	-0.42	4.29**	10.71
Premium for info	T3 vs T1	-2.86**	0.98	2.71***	-4.94**	-14.55	2.26	5.20	5.16***	12.61
Premium for fed	T2 vs T3	1.03	1.19	0.43	-1.59	-4.91	-2.43	-5.93	-0.87	-2.17

[a]Mean (won but no payment) is significantly higher than the mean (won and paid) for local *gari* by 15.33% at 5% level (one-sided t-test)

***1% significance level, **5% significance level, *10% significance level (one-sided t-test)

models. One potential source of bias is that participants in the control group were interviewed in the morning, while those in the treatment groups were interviewed in the afternoon as a strategy to control for information contamination. Therefore, we computed the time distance to lunch hour in order to investigate any hunger effect on the observed WTP. Finally, there might have been some participants who lost in the BDM game who might not have paid out of pocket if they had won. This represents a possible source of bias in the study's estimation, which would have been eliminated if we had asked whether these participants would have paid if they had won. However, such data may have been unreliable.

4. RESULTS AND DISCUSSION

4.1 WTP for Biofortified Yellow Cassava *Gari*

Participants' mean WTP for each variety is reported in tables 3 and 4, by treatment group and payment status. These tables also report differences in mean WTP within and across treatment groups. The consumer WTP for different *gari* types was generally within the market price range observed (₦20 – ₦50 Naira, mean: ₦34). Averaging bids over the pool sample resulted in WTP of about ₦36.1/300g for the palm-oil-mixed deep yellow local *gari* in Imo State(see column 1, Table 3) and about ₦35.1/500g for the local white *gari* in Oyo State (see column 1, Table 4). In Imo, mean WTP for *gari* types shows that consumers in the control group (T1) were willing to pay the most for the local *gari* (₦42.8/300g). They have a discount of about 28 percent for the YC1 *gari*, and about 25 percent for YC2 *gari* compared to the local one. In Oyo T1 participants were willing to pay more for the light yellow YC1 *gari* compared to the white local *gari*. Compared to the local *gari*, they were willing to pay a premium of 6 percent for YC1 and a discount of 9 percent for YC2.

Across treatment groups, participants in Imo generally had a significantly higher WTP for YC2 compared to YC1, which is not surprising since YC2 *gari* is deeper yellow (column 9, Table 3). T2 participants who were informed that the delivery would be undertaken by the Federal Government were willing to pay more for YC2 (N40.8/300g) than T3 participants (N34.9/300g) who were informed that the delivery would be undertaken by an international authority. The reverse is true for Oyo where participants generally had a higher WTP for YC1 than YC2 (column 9, Table 4), and the mean WTP for YC1 is not significantly different when compared across T2 and T3.

The basic random-effects model (Eq. 2) was estimated for both states and is presented in tables 5 and 6 below. Product characteristics entered into each model are light yellow YC1 (1 = light yellow, 0 = not light yellow) and very deep yellow YC2 (1 = very deep yellow, 0 = not very deep yellow). Local *gari* is thus the base comparison product (column 1, tables 5 and 6). As revealed by the hedonic scores, participants in Imo generally liked the taste and color of local *gari* more than of either of the YC varieties. This is also evident from the negative sign on both YC varieties (column 1, Table 5). In Imo YC1 obtained a large and significant discount, while the discount for YC2 was insignificant. In contrast, YC1 had a large and significant premium in Oyo (column 1, Table 6). These results suggest that, in the absence of information, YC2 cannot compete with the palm-oil-mixed yellow local *gari* in Imo State, despite the former's very deep yellow color. In Oyo State, on the other hand, light yellow YC1 was assessed at a premium compared to the white *gari*.

The mean WTP of participants who won in the BDM game and made out-of-pocket payments was higher than the group average in most cases, which is consistent with the BDM game condition that a winner's bid is higher than the randomly drawn price. As expected, the mean bids submitted by participants who won but did not make out-of-pocket payment were significantly higher than the mean bids submitted by participants who won and paid. In Imo, participants who won but made no payment stated 25 percent and 23 percent higher bids, respectively, for local and YC2 *gari*, compared to the bids submitted by participants who won and paid. Similarly, participants in Oyo who won but made no payment submitted significantly higher bids for the local variety. As shown in Table 3, "YC dislikers" in Imo had high discounts for both YC varieties since they disliked their sensory attributes (37 percent discount for YC1 and 35 percent discount for YC2), compared to the local variety. Likewise, the "YC2 likers" in the same state who disliked the taste and color of YC1 *gari* also had the highest discount for the latter variety (45 percent). Moreover, "YC likers" in Oyo had the highest premium - about 26 percent - for YC2 compared to "YC2 dislikers" whose highest discount was about 19 percent for the same variety (Table 4).

4.2 Effect of Nutrition Information and Delivery Authority on WTP

The basic random-effects specification was expanded in a stepwise manner by first controlling for information (model 2). We then estimated equation (3), controlling for cross-effects between: the local product attribute and information (model 3); information-cum-delivery mechanism (model 4); color difference and very deep yellow YC2 variety (model 5); and, participant characteristics (models 6 - 7). Finally, models 8 – 11 are the random-effects Tobit models

Table 5: Parameter estimates from models estimating determinants of willingness to pay (WTP) for 3 Nescafé cups (300g) of *gari* in Imo

	RE			Tobit							Interval	
Dependent variable: log (WTP)	**(1)** Basic (F)	**(2)** Info (F)	**(3)** Info cross-effect (F)	**(4)** Delivery cross-effect (F)	**(5)** Color difference cross effect (F)	**(6)** Socio-economic (F)	**(7)** Socio-economic (P)	**(8)** Left (F)	**(9)** Left (P)	**(10)** Right I (F)	**(11)** Right II (F)	**(12)** Interval (F)	**(13)** Interval (P)
Light yellow YC1 (Yes = 1)	-0.14***	-0.14***	-	-0.26***	-0.26***	-0.26***	-0.25***	-0.25***	-0.25***	-0.31***	-0.27***	-0.28***	-0.27***
	(0.02)	(0.02)		(0.04)	(0.04)	(0.04)	(0.04)	(0.03)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
Very deep yellow YC2	-0.03	-0.03	0.11***	-0.16***	-0.14***	-0.15***	-0.16***	-0.15***	-0.16***	-0.21***	-0.17***	-0.15***	-0.16***
(Yes = 1)	(0.02)	(0.02)	(0.02)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.05)	(0.04)	(0.04)	(0.05)
Local (Yes = 1)		-	0.27***	-	-	-	-	-	-	-	-	-	-
			(0.03)										
Info		-0.01	0.06	-0.14**	-0.14**	-0.27**	-0.34***	-0.25**	-0.32***	-0.26**	-0.29***	-0.34***	-0.42***
		(0.05)	(0.05)	(0.06)	(0.06)	(0.11)	(0.12)	(0.10)	(0.11)	(0.13)	(0.11)	(0.12)	(0.13)
Info x Local			-0.20***	-	-	-	-	-	-	-	-	-	-
			(0.04)										
Info_Fed x YC1				0.19***	0.19***	0.19***	0.19***	0.19***	0.20***	0.20***	0.19***	0.22***	0.23***
				(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.06)	(0.05)	(0.06)	(0.06)
Info_Fed x YC2				0.23***	0.23***	0.22***	0.23***	0.23***	0.25***	0.22***	0.21***	0.25***	0.27***
				(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.06)	(0.05)	(0.06)	(0.06)
Info_Intl x YC1				0.19***	0.19***	0.20***	0.20***	0.19***	0.20***	0.23***	0.20***	0.25***	0.24***
				(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.06)	(0.05)	(0.06)	(0.06)
Info_Intl x YC2				0.20***	0.20***	0.22***	0.24***	0.23***	0.26***	0.26***	0.24***	0.26***	0.28***
				(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.06)	(0.05)	(0.06)	(0.06)
Diff_color YC2					0.02**	0.03**	0.02**	0.02**	0.02**	0.03**	0.02**	0.03**	0.03**
					(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
UH color same x					-0.01*	-0.01**	-0.02**	-0.02**	-0.02**	-0.01*	-0.01**	-0.02**	-0.02**
Diff_colorYC2 x YC2					(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
YC2 likers						-0.25***	-0.26***	-0.23***	-0.26***	-0.30***	-0.26***	-0.26***	-0.27***
						(0.07)	(0.08)	(0.07)	(0.08)	(0.08)	(0.07)	(0.08)	(0.09)
YC2 likers x YC2						0.15***	0.17***	0.12**	0.16***	0.15**	0.14**	0.15**	0.19***
						(0.05)	(0.06)	(0.05)	(0.06)	(0.06)	(0.05)	(0.06)	(0.07)
Age						-0.002	0.003**	-0.002	-0.003**	-0.002	-0.002	0.03	0.04
						(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.06)	(0.06)
Male						0.02	0.03	0.03	0.04	0.04	0.03	-0.002	-0.004**
						(0.05)	(0.05)	(0.05)	(0.05)	(0.06)	(0.05)	(0.002)	(0.002)
Education						0.0002	0.0007	-0.0001	0.0009	-0.0019	-0.0007	-0.0007	-0.0001
						(0.0058)	(0.0059)	(0.0054)	(0.0056)	(0.0066)	(0.0057)	(0.0062)	(0.0063)
Aware of Vitamin A						-0.16	-0.17*	-0.14	-0.16*	-0.14	-0.16*	-0.18*	-0.20*
						(0.10)	(0.10)	(0.09)	(0.10)	(0.11)	(0.10)	(0.11)	(0.11)
Aware of Vitamin A x info						0.19	0.25**	0.16	0.22*	0.16	0.20*	0.22*	0.29**
						(0.12)	(0.13)	(0.11)	(0.12)	(0.14)	(0.12)	(0.13)	(0.14)

Table 5: cont'd

	RE					Tobit						Interval	
	(1) Basic (F)	(2) Info (F)	(3) Info cross-effect (F)	(4) Delivery cross-effect (F)	(5) Color difference cross effect (F)	(6) Socio-economic (F)	(7) Socio-economic (P)	(8) Left (F)	(9) Left (P)	(10) Right I (F)	(11) Right II (F)	(12) Interval (F)	(13) Interval (P)
Cassava area (ha)						-0.02*	-0.2	-0.02*	-0.02	-0.03*	-0.02*	-0.03*	-0.02
						(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.01)	(0.01)	(0.01)
Qty home *gari* (kg per capita)						0.0002	0.0005	0.0001	0.0004	-0.0006	-0.0003	0.0005	0.0008
						(0.0028)	(0.0028)	(0.0026)	(0.0026)	(0.0032)	(0.0027)	(0.0030)	(0.0029)
Don't buy *gari*						-0.12**	-0.07	-0.12**	-0.09	-0.11	-0.11**	-0.14**	-0.10
						(0.06)	(0.06)	(0.06)	(0.06)	(0.07)	(0.06)	(0.06)	(0.06)
Gari is most frequently consumed cassava product in a year (Yes =1)						0.08	0.08	0.09*	0.08	0.10	0.08	0.09*	0.09
						(0.05)	(0.05)	(0.05)	(0.05)	(0.06)	(0.05)	(0.06)	(0.06)
Wealth index						0.06**	0.06*	0.06**	0.05*	0.07**	0.05*	0.06*	0.05
						(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
Afternoon (Yes = 1)						-0.06	-0.05	-0.06	-0.06	-0.08	-0.06	-0.06	-0.05
						(0.05)	(0.06)	(0.05)	(0.05)	(0.06)	(0.05)	(0.06)	(0.06)
Time interval between lunch time and time of interview (hours)						-0.01	-0.01	-0.01	-0.01	-0.02	-0.01	-0.02	-0.01
						(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Constant	3.49***	3.49***	3.31***	3.58***	3.50***	3.83***	3.87***	3.82***	3.86***	3.96***	3.86***	3.76***	3.81***
	(0.03)	(0.04)	(0.04)	(0.05)	(0.06)	(0.14)	(0.15)	(0.13)	(0.14)	(0.17)	(0.14)	(0.15)	(0.16)
Number of obs.	984	984	984	984	984	954	837	954	837	954	954	954	837
R^2 within	0.0000	0.0648	0.1072	0.1076	0.1113	0.1236	0.1236	-		-	-	-	-
R^2 overall	0.0153	0.0154	0.0240	0.0249	0.0384	0.1020	0.1039	0.1016	0.1033	0.0990	0.1009	0.1001	0.1019
Log-likelihood	-	-	-	-	-	-400.0304	-330.9948	-379.2364	-368.6558	-569.6056	-457.0315	-1495.8039	-1269.7203
AIC	-	-	-	-	-	852.0609	713.9896	810.4729	789.3117	1191.2110	966.0630	3043.6080	2591.4410
Sigma_u	0.3995	0.4002	0.4015	0.4012	0.3982	0.3896	0.3760	0.36	0.3549	0.4431	0.3773	0.4120	0.3958
Sigma_e	0.2724	0.2724	0.2669	0.2674	0.2670	0.2674	0.2632	0.25	0.2587	0.2878	0.2662	0.2820	0.2774
ρ (fraction of variance due to μ_i)	0.6827	0.6834	0.6936	0.6925	0.6898	0.6797	0.6712	0.67	0.6532	0.6532	0.6678	0.6809	0.6706

RE: Random effects, F: Full Sample, P: Part Sample (those who won and did not make a payment were removed), AIC: Akaike's information criterion

*** 1% significance level, ** 5% significance level, * 10% significance level

Table 6: Parameter estimates from models estimating determinants of willingness to pay (WTP) for 1/2 Kongo (500g) of *gari* in Oyo

	RE					Tobit					Interval	
Dependent variable: log (WTP)	**(1)** Basic (F)	**(2)** Info (F)	**(3)** Info cross effect (F)	**(4)** Delivery cross effect (F)	**(5)** Color difference cross effect (F)	**(6)** Socio-economic (F)	**(7)** Socio-economic (P)	**(8)** Left (F)	**(9)** Left (P)	**(10)** Right I (F)	**(11)** Right II (F)	**(12)** Interval (F)	**(13)** Interval (P)
Light yellow YC1 (Yes = 1)	0.17***	0.17***	-	0.02	0.01	0.02	0.01	0.02	0.01	0.01	0.02	0.04	0.03
	(0.02)	(0.02)		(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.04)	(0.03)	(0.03)	(0.04)
Very deep yellow YC2	0.09***	0.09***	-0.08***	-0.11***	-0.08**	-0.03	-0.02	-0.02	-0.02	-0.06	-0.03	-0.001	0.003
(Yes = 1)	(0.02)	(0.02)	(0.02)	(0.03)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.05)	(0.04)	(0.041)	(0.043)
Local (Yes = 1)	-	-	0.01	-	-	-	-	-	-	-	-	-	-
			(0.03)										
Info		0.01	0.10**	-0.16***	-0.15***	-0.18***	-0.18**	-0.18***	-0.19***	-0.22***	-0.19***	-0.18**	-0.20**
		(0.04)	(0.04)	(0.05)	(0.05)	(0.07)	(0.07)	(0.07)	(0.07)	(0.08)	(0.07)	(0.07)	(0.08)
Info x Local			-0.26***	-	-	-	-	-	-	-	-	-	-
			(0.03)										
Info_Fed x YC1				0.21***	0.21***	0.20***	0.21***	0.20***	0.21***	0.26***	0.21***	0.23***	0.24***
				(0.04)	(0.04)	(0.04)	(0.05)	(0.04)	(0.05)	(0.06)	(0.05)	(0.05)	(0.05)
Info_Fed x YC2				0.29***	0.29***	0.26***	0.27***	0.25***	0.27***	0.31***	0.29***	0.29***	0.30***
				(0.04)	(0.04)	(0.05)	(0.05)	(0.04)	(0.05)	(0.06)	(0.05)	(0.05)	(0.05)
Info_Intl x YC1				0.25***	0.25***	0.25***	0.27***	0.24***	0.27***	0.32***	0.27***	0.24***	0.27***
				(0.04)	(0.04)	(0.04)	(0.05)	(0.04)	(0.05)	(0.06)	(0.05)	(0.05)	(0.05)
Info_Intl x YC2				0.31***	0.30***	0.27***	0.29***	0.26***	0.29***	0.34***	0.29***	0.27***	0.29***
				(0.04)	(0.04)	(0.04)	(0.05)	(0.04)	(0.05)	(0.06)	(0.05)	(0.05)	(0.05)
Diff_color YC2					-0.003	0.001	0.01	0.002	0.01	-0.002	-0.003	-0.01	0.01
					(0.035)	(0.035)	(0.04)	(0.033)	(0.04)	(0.042)	(0.036)	(0.04)	(0.03)
UH color same x					-0.01	-0.01	-0.01*	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
Diff_colorYC2 x YC2					(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
YC2 likers						-0.04	-0.07	-0.03	-0.06	-0.01	-0.04	-0.03	-0.06
						(0.06)	(0.07)	(0.06)	(0.07)	(0.08)	(0.07)	(0.07)	(0.07)
YC2 likers x YC2						-0.21***	-0.20***	-0.21***	-0.21***	-0.29***	-0.21***	-0.26***	-0.25***
						(0.05)	(0.05)	(0.05)	(0.05)	(0.06)	(0.05)	(0.05)	(0.06)
Age						0.001	0.002	0.001	0.002	0.002	0.001	0.04	0.08*
						(0.001)	(0.002)	(0.001)	(0.002)	(0.002)	(0.001)	(0.05)	(0.05)
Male						0.04	0.06	0.03	0.06	0.05	0.04	0.001	0.002
						(0.04)	(0.05)	(0.04)	(0.05)	(0.05)	(0.05)	(0.001)	(0.002)
Education						0.003	0.004	0.002	0.004	0.003	0.003	0.003	0.005
						(0.004)	(0.005)	(0.004)	(0.004)	(0.005)	(0.004)	(0.005)	(0.005)
Aware of Vitamin A						-0.07	-0.08	-0.07	-0.09	-0.08	-0.08	-0.06	-0.06
						(0.07)	(0.08)	(0.07)	(0.08)	(0.09)	(0.08)	(0.08)	(0.08)
Aware of Vitamin A x info						0.12	0.11	0.13	0.12	0.15	0.13	0.11	0.08
						(0.09)	(0.09)	(0.08)	(0.09)	(0.10)	(0.09)	(0.09)	(0.10)

Table 6: cont'd

	RE					Tobit						Interval	
	(1) Basic (F)	(2) Info (F)	(3) Info cross-effect (F)	(4) Delivery cross-effect (F)	(5) Color difference cross effect (F)	(6) Socio-economic (F)	(7) Socio-economic (P)	(8) Left (F)	(9) Left (P)	(10) Right I (F)	(11) Right II (F)	(12) Interval (F)	(13) Interval (P)
Cassava area (ha)						-0.02*	-0.02	-0.02*	-0.02	-0.03*	-0.02*	-0.03*	-0.02
						(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.01)	(0.01)	(0.01)
Qty home *gari* (kg per capita)						0.0002	0.0005	0.0001	0.0004	-0.0006	-0.0003	0.0005	0.0008
						(0.0028)	(0.0028)	(0.0026)	(0.0026)	(0.0032)	(0.0027)	(0.0030)	(0.0029)
Don't buy *gari*						-0.12**	-0.07	-0.12**	-0.09	-0.11	-0.11**	-0.14**	-0.10
						(0.06)	(0.06)	(0.06)	(0.06)	(0.07)	(0.06)	(0.06)	(0.06)
Gari is most frequently consumed cassava product in a year (Yes =1)						0.08	0.08	0.09*	0.08	0.10	0.08	0.09*	0.09
						(0.05)	(0.05)	(0.05)	(0.05)	(0.06)	(0.05)	(0.06)	(0.06)
Wealth index						0.06**	0.06*	0.06**	0.05*	0.07**	0.05*	0.06*	0.05
						(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
Afternoon (Yes = 1)						-0.06	-0.05	-0.06	-0.06	-0.08	-0.06	-0.06	-0.05
						(0.05)	(0.06)	(0.05)	(0.05)	(0.06)	(0.05)	(0.06)	(0.06)
Time interval between lunch time and time of interview (hours)						-0.01	-0.01	-0.01	-0.01	-0.02	-0.01	-0.02	-0.01
						(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Constant	3.49***	3.49***	3.31***	3.58***	3.50***	3.83***	3.87***	3.82***	3.86***	3.96***	3.86***	3.76***	3.81***
	(0.03)	(0.04)	(0.04)	(0.05)	(0.06)	(0.14)	(0.15)	(0.13)	(0.14)	(0.17)	(0.14)	(0.15)	(0.16)
Number of obs.	984	984	984	984	984	954	837	954	837	954	954	954	837
R^2 within	0.0000	0.0684	0.1072	0.1076	0.1113	0.1236	0.1236	-		-	-	-	-
R^2 overall	0.0153	0.0154	0.0240	0.0249	0.0384	0.1020	0.1039	0.1016	0.1033	0.0990	0.1009	0.1001	0.1019
Log-likelihood	-	-	-	-	-	-400.0304	-330.9948	-379.2364	-368.6558	-569.6056	-457.0315	-1495.8039	-1269.7203
AIC	-	-	-	-	-	852.0609	713.9896	810.4729	789.3117	1191.2110	966.0630	3043.6080	2591.4410
Sigma_u	0.3995	0.4002	0.4015	0.4012	0.3982	0.3896	0.3760	0.36	0.3549	0.4431	0.3773	0.4120	0.3958
Sigma_e	0.2724	0.2724	0.2669	0.2674	0.2670	0.2674	0.2632	0.25	0.2587	0.2878	0.2662	0.2820	0.2774
ρ (fraction of variance due to μ_i)	0.6827	0.6834	0.6936	0.6925	0.6898	0.6797	0.6712	0.67	0.6532	0.7021	0.6678	0.6809	0.6706

RE: Random effects, F: Full Sample, P: Part Sample (those who won and did not make a payment were removed), AIC: Akaike's information criterion

*** 1% significance level, ** 5% significance level, * 10% significance level

with various threshold assumptions earlier discussed while models 12 and 13 are the interval censored models. Models 7, 9 and 13 are estimated using the partial sample that excludes participants who won and made no payment.

In order to select among the various estimated models, we present in tables 5 and 6 Akaike's information criterion (AIC), which is computed based on the log likelihood function and is appropriate for non-nested models (Burnham and Anderson, 2002). Models 8 – 13 are estimated via maximum likelihood. In order to allow for comparison across all models and to obtain AIC, we estimated models 6 and 7 via the maximum likelihood (mle) option in Stata. Parameter estimates obtained via the mle option are very similar to those from the random effects GLS route, thus we report the latter. In general, a model with smaller AIC fits the data better than one with larger AIC (Burnham and Anderson, 2002). We also computed R2 for models 8 – 13 by obtaining multiple squared correlation between predicted and observed values of WTP.

Comparing models 6 vs. 7, 8 vs. 9 and 12 vs. 13 can reveal whether or not making a payment had an effect on the WTP estimation. In the case of Imo State (Table 5), the partial sample left-censored model 9 has a smaller AIC value than the full sample left-censored model 8. Similarly, the partial sample interval-censored model 13 has a smaller AIC value than the full sample interval-censored model 12. Random effects GLS (RE) models 6 and 7 also have slightly different parameter estimates. These results indicate that in Imo, including bids submitted by participants who won and made no payment matters to the WTP estimation as it limits the model fit.

Among models controlling for bid censoring in both states (tables 5 and 6), it is apparent that Tobit models have significantly lower AIC values than interval-censored models. In Imo, the partial sample left-censored model 9 has the lowest AIC value and is, therefore, compared to the partial RE model 7. There is no marked difference between parameter estimates obtained from both models, i.e. factoring censoring thresholds into consumer bids does not matter.

The result is mixed in the case of Oyo when partial and full sample models are compared. Table 6 shows that the partial sample interval-censored model 13 has a smaller AIC value than the corresponding full sample model 12. In contrast, the partial sample left- censored model 9 has a larger AIC value than the corresponding full sample model 8. While left-censored Tobit models suggest that including bids of participants who won and made no payment does not reduce the model robustness, interval-censored models suggest otherwise. Meanwhile, among all models controlling for censoring in bids, the full sample left-censored model 8 has the smallest AIC value. Thus, we compare this model to the full sample RE model 6. Parameter estimates obtained from both models are similar, suggesting that censoring in bids did not matter in Oyo data. Therefore, we utilize the full sample RE model 6 in interpreting the econometric results for Oyo state and partial sample RE model 7 for Imo, while estimates from other models are also presented for comparison.

When local *gari* is the base comparison product, basic model 2 shows that the main effect of information is negative in Imo and positive in Oyo. With the introduction of interaction terms between product and information (model 4), the main effect of information becomes negative and significant in both states. In order to show the reason for this, we report model 3 where the base comparison product is YC1 *gari*. As expected, the result indicates that the nutrition information provided had a negative and significant effect on participant WTP for local *gari* (model 3), thus the main effect of information becomes positive in both states but significant in Oyo only.

In both states, the coefficient estimates obtained on information-cum-delivery and product interaction terms in model 4 remained the same with the inclusion of variables controlling for the color difference (model 5). These change only slightly when other covariates are controlled for in model 6. For Oyo, the negative coefficient obtained on YC2 *gari* in model 5 becomes insignificant in model 6 with the inclusion of variables controlling for socio-economic characteristics. Once participants in both T2 and T3 are informed about the nutritional benefits of YC, there is a significant increase in their WTP for these varieties. The discount (28 percent) on YC1 becomes a premium (19 - 20 percent) in Imo State in the presence of information. Likewise in Oyo State, the discount (9 percent) on YC2 becomes a premium (26 – 27 percent). While YC1 has a higher WTP relative to YC2 in Oyo in the absence of information, consumer premium for YC2 (26 – 27 percent) is higher than for YC1 (20 – 25 percent) when information is provided. This suggests that Oyo consumers could have implicitly attached color intensity to vitamin A level in cassava, even though they were not explicitly informed about the concentrations of beta-carotenoids in the two YC varieties.

It is reasonable to expect that these results could have been influenced by time-of-day effect. A dummy variable controlling for afternoon interviews (Yes=1, i.e. after 12:00 p.m.) is not significant across partial and full sample models in both states, which removes the possibility of hunger effect. However, the effect of a variable controlling for the difference between interview start time and lunch time is significant at 1 percent in Oyo. This reveals that the farther the interview start time was from lunch time the more consumers were willing to pay. One possible

explanation is that Oyo participants included those who lived in peri-urban areas and were more likely to purchase *gari* in the evening markets after returning from day jobs other than farming. These results are comparable to the findings of other studies in Africa (see e.g. Rutsaert et al. 2009; Morawetz et al. 2011).

Information regarding the authority delivering the planting material affects WTP for the two YC varieties differently. Although in Imo the difference in means is significant at 10 percent when WTP for YC2 is compared across T2 and T3 using full group samples (see last row, Table 4), the result differs when participants who did not pay are excluded from the sample (column 7, Table 5). In Imo, the parameter estimates indicate that participants were willing to pay the same premium for YC regardless of the delivery authority. However, the premium for YC2 is higher than the premium for YC1 by about 3 – 4 percent, independent of the delivery medium.

Similarly in Oyo, the parameter estimates indicate that participants were willing to pay a higher premium for YC2 compared to YC1, irrespective of the delivery medium (column 8, Table 6). Although the difference in means (T2 vs. T3) presented in Table 5 (last row) suggests that the delivery medium did not have a significant effect on Oyo participants' WTP for YC varieties, econometric results indicate otherwise when socio-economic variables are incorporated into the regression analysis. The premium for YC2 variety is the same for both delivery media. However, when the delivery involved the "international authority", Oyo participants were willing to pay 5 percent more for YC1 compared to delivery through "Federal authority". These results reveal that Oyo consumers would prefer that YC1 be delivered through the 'international authority' while consumers in Imo are indifferent to international and Federal authorities. This could be due to the fact that Oyo State is the hub of various international agricultural development organizations. To illustrate, while only 2 percent of participants in Imo was aware of IITA, about 16 percent of participants in Oyo knew of the organization.

4.3 Other Determinants of WTP

Contrary to expectations, the effect on WTP of per capita quantity of *gari* that participants had at home was insignificant. The main effect of the difference between the color of *gari* at home and color of auctioned YC2 *gari* is insignificant in both states. However, the cross-effect between this color difference and YC2 variety is small (2 percent) but negative and significant at 5 percent significance level in Imo State only. The result shows that in the absence of information, the more distinct the color of YC2 compared to the color of habitually consumed *gari* the less Imo consumers are willing to pay for YC2. This reflected participants' familiarity with the status quo product, suggesting that WTP depends on habitual choice strategy. Using an empirical model of habitual choice, Adamowicz and Swait (2012) also showed significant evidence of the effect of habitual decision strategy on WTP. Participants' familiarity with the deep yellow *gari* in Imo could have been responsible for the disutility of YC1 and YC2 in the absence of information. The results are similar to those from recent studies in Kenya and Zambia (De Groote et al., 2011; Meenakshi et al., 2012).

Furthermore and as expected, Imo participants in the "YC2 likers" sensory cluster had a large and significant premium for YC2. On the other hand, "YC2 dislikers" in Oyo assessed YC2 at a large discount of about 21 percent. Given that the product on auction is a major staple food for many, only a few socio-economic variables were found to significantly explain consumer WTP. The partial sample RE model (7) finds that participants in Imo who were aware of vitamin A beforehand submitted statistically significantly higher bids when they received the nutrition information. The same model also found that wealthier consumers in Imo were willing to pay more.

5. CONCLUSIONS

The primary aim of this study was to understand consumer acceptance of *gari* made with two vitamin A-enriched yellow cassava (YC) varieties – light yellow (YC1) and very deep yellow (YC2) – vis-à-vis local varieties. We investigated the impacts of nutrition information and nature of the delivery authority on consumer acceptance of YC varieties. The study was implemented in two different ethnic settings in Nigeria: Imo State in the southeast and Oyo State in the southwest. Hedonic rating and random-price BDM auction mechanism were used to investigate consumer acceptance.

Without an information campaign, YC varieties are unlikely to be accepted in the southeast. In the absence of information, YC1 can favorably compete with the habitually consumed local white *gari* in the southwest. Across both states, YC varieties capture large premiums when nutrition information exists. Consumers in the southeast are indifferent to the authority delivering the YC planting material, whereas consumers in the southwest prefer delivery through international authority.

Recent theoretical predictions show that outside market prices and the availability of outside options can distort consumer bidding behavior in experimental auctions. Therefore, to arrive at the conclusion that YC1 is likely to be accepted in Oyo State without information and

neither of the YC varieties is likely to be accepted in Imo State without information, the study accounted for the (1) potential censoring in bids, (2) home inventory of *gari*, (3) payment effect, and (4) time-of-day effect.

In contrast to Morawetz et al. (2011) who find that WTP estimates are biased upward at lunch time, this study found no such evidence. However, it found that WTP was biased upward by 4 percent toward the evening in the southwest. Incorporating censoring in the WTP estimation did not improve model robustness, likely due to the fact that there were several grades of *gari* color in the market at different prices. This raises a critical question of how to decide which market price information is to be factored into WTP estimations. There could be several market price thresholds across consumers which could make censoring insignificant in the study's analysis since it only incorporated price limits and currency rounds as thresholds. Therefore, researchers should attempt to obtain consumer-perceived market prices as an alternative approach to inform the specification of thresholds for investigating censoring in bids.

Similar to Meenakshi et al. (2012) who found that product endowments have a small effect on WTP for orange maize in Zambia, this study found that the effect of quantity of product at home was insignificant while the effect of color difference was small but negative for YC2 only.

Empirical evidence suggests that YC1 and YC2 could be much easier to introduce and perhaps most cost-effectively in the southwest and southeast, respectively. The study results also reveal that distortion in optimal bidding behavior due to cash-in-hand effect can be avoided altogether if an auction mechanism is implemented in an out-of-pocket context. Such a context could improve the robustness of experimental auctions, given the study's finding that the payment effect can skew the WTP upward by 24 percent. As for participatory fees, whether or not they can be eliminated in auction mechanisms will depend on the context.

APPENDIX

Table A: Multinomial logit modes of sensory cluster membership by state

	IMO		OYO	
	All likers	**YC2 likers**	**All likers**	**Biofortified likers**
	(1)	(2)	(3)	(4)
Variable	Coef. (Std Error)	Coef. (Std Error)	Coef. (Std Error)	Coef. (Std Error)
YC1 *gari* taste	1.42***	-0.98**	0.85***	1.81***
	(0.35)	(0.46)	(0.27)	(0.60)
YC2 *gari* taste	1.75***	1.84***	1.75***	1.59***
	(0.33)	(0.35)	(0.26)	(0.35)
Male	-0.84	-0.78	0.39	-0.08
	(0.89)	(0.96)	(0.60)	(0.68)
Age	-0.03	-0.02	-0.01	-0.03
	(0.03)	(0.04)	(0.02)	(0.02)
Info (participant received information = 1, otherwise = 0)	2.59	1.89	-0.12	-1.17
	(1.72)	(1.91)	(0.83)	(1.13)
Education	-0.02	0.17	0.03	0.04
	(0.14)	(0.18)	(0.06)	(0.07)
Education x Information	-0.04	-0.01	-0.07	-0.12
	(0.17)	(0.19)	(0.09)	(0.12)
HH Size	-0.07	0.12	0.00	-0.08
	(0.10)	(0.11)	(0.05)	(0.07)
Under 5	0.25	0.48	-0.28	0.16
	(0.34)	(0.34)	(0.24)	(0.28)
Gari at home	-2.26*	-2.21*	-0.25	-0.59
	(1.28)	(1.31)	(0.55)	(0.64)
Aware of vitamin A	3.28**	0.25	-0.42	-0.41
	(1.40)	(1.53)	(0.55)	(0.66)
Aware of vitamin A x information	-2.10	-0.53	0.85	2.52**
	(1.93)	(2.03)	(0.85)	(1.18)
Wealth Index	0.10	0.17	-0.29	-0.27
	(0.54)	(0.53)	(0.22)	(0.26)
Constant	-6.34**	-4.04	-8.05***	-12.54***
	(2.51)	(2.67)	(2.01)	(3.44)
N	*320*		*326*	
Pseudo R²	*0.73*		*0.33*	
Log likelihood	*-63.53*		*-158.32*	

*** 1% significance level, ** 5% significance level, * 10% significance level

Figure A: Distribution of WTP for *gari* types in ₦ (Imo state)

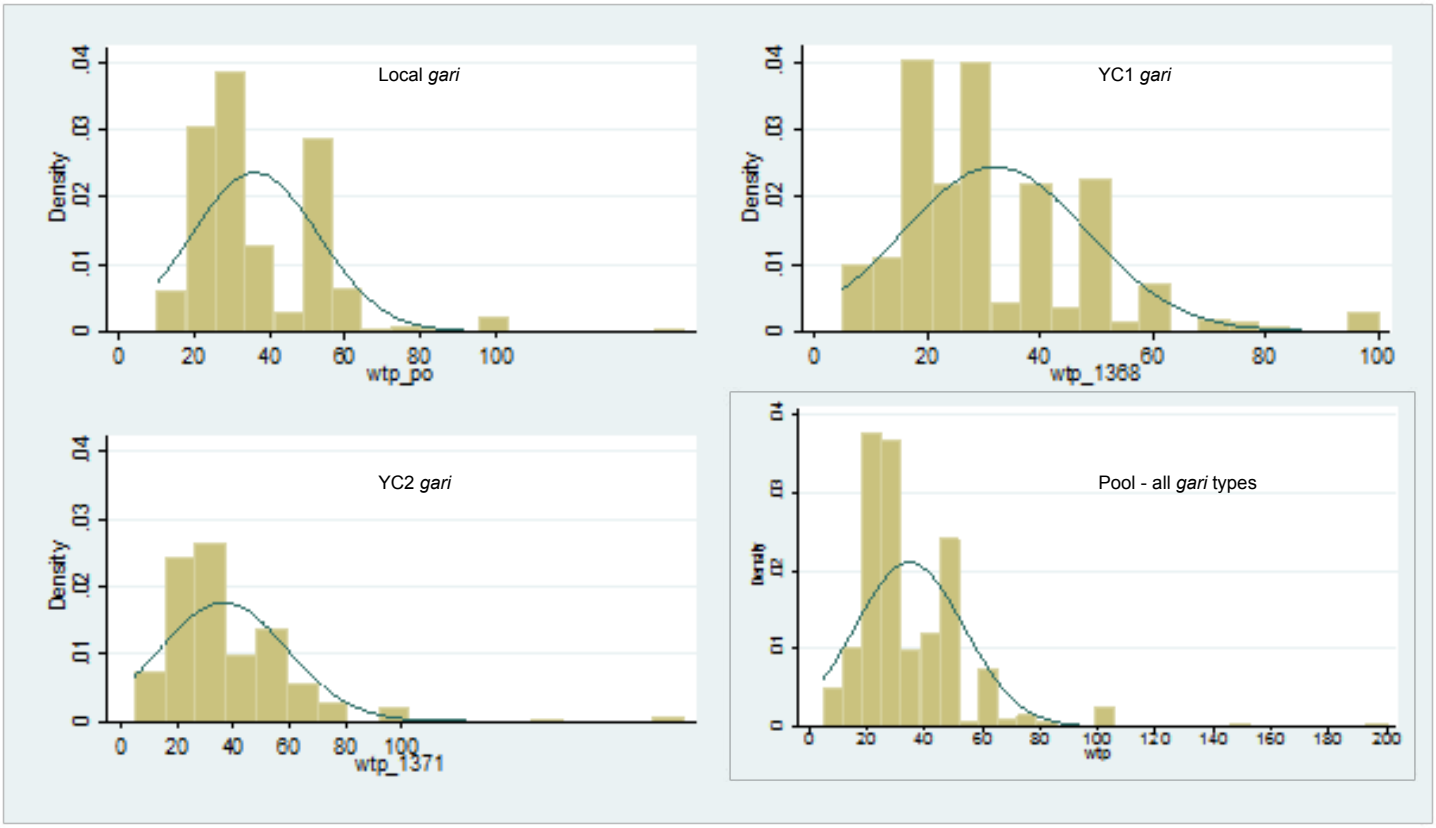
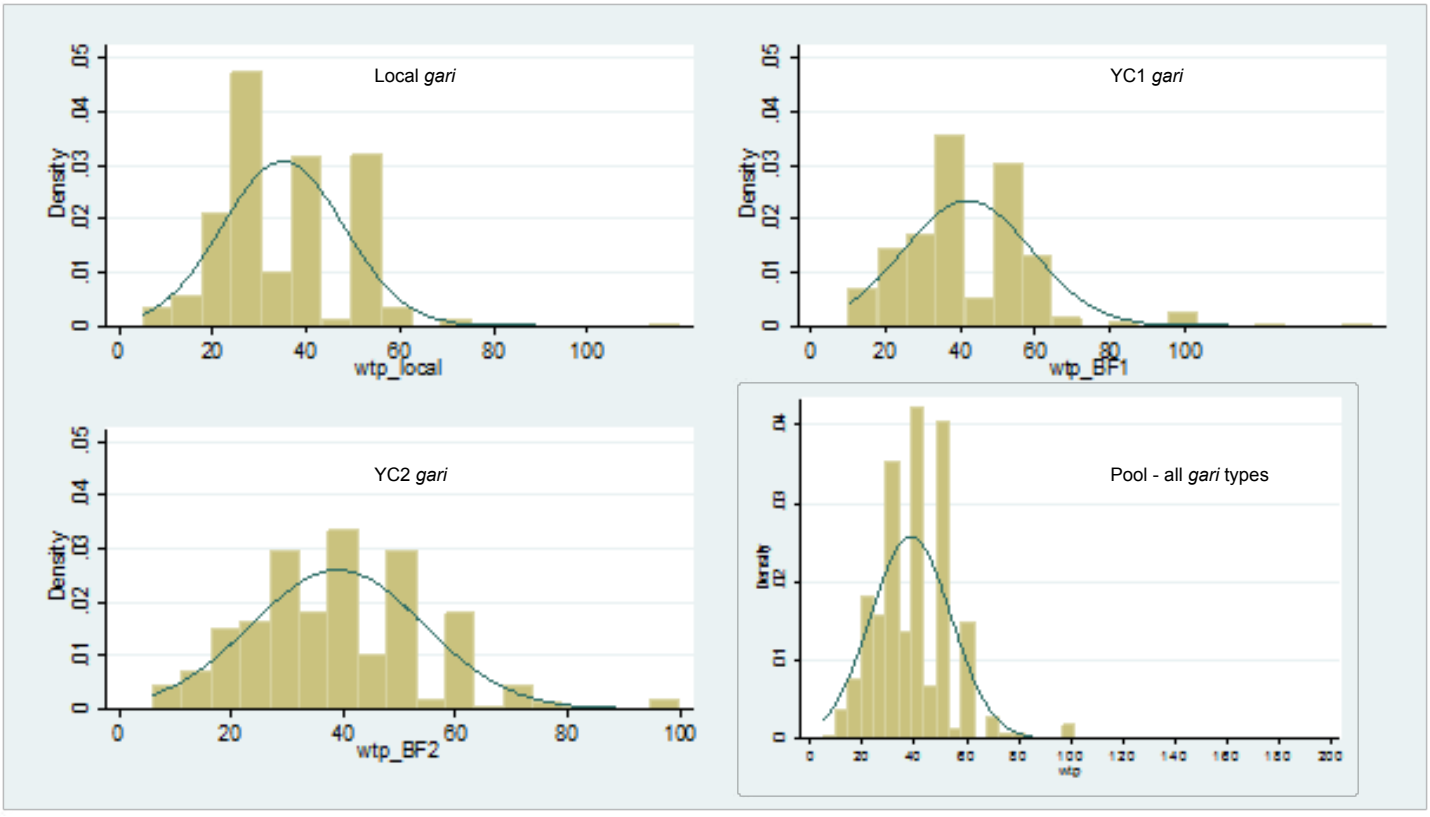


Figure A: Distribution of WTP for *gari* types in ₦ (Oyo state)



REFERENCES

Adamowicz, W. L. and J. D. Swait (2012), Are food choices really habitual? Integrating Habits, variety-seeking and compensatory choice in a utility-maximizing framework, Amer. J. Agr. Econ. 95(1): 17–41.

Banerji, A., S. Chowdhury, H. De Groote, J. V. Meenakshi, J. Haleegoah and M. Ewool (2013), Using Elicitation Mechanisms to Estimate the Demand for Nutritious Maize: Evidence from Experiments in Rural Ghana, HarvestPlus Working Paper, 10: 1-19.

Burnham, K. P., and Anderson, D. R. (2002), Model selection and inference: a practical information theoretic approach. 2nd Edition. Springer-Verlag, New York, NY.

Carson, R. T. and Y. Sun (2007), The Tobit Model with a Non-Zero Threshold, Econometrics Journal 10: 488 – 502.

Cherry, T., Kroll and J. Shogren (2005), The impact of endowment heterogeneity and origin on public good contributions: evidence from the lab, Journal of Economic Behaviorand Organization 57: 357-65.

Cherry, T. L., P. Frykblom, J. F. Shogren, J. A. List and M. B. Sullivan (2004), Laboratory Testbeds and Non-Market Valuation: The Case of Bidding Behavior in a Second-Price Auction with an Outside Option, Environmental and Resource Economics 29: 285 – 294.

Chowdhury, S., J. V. Meenakshi, K. Tomlins, and C. Owori (2011), Are consumers willing to pay more for biofortified foods? Evidence from a field experiment in Uganda, American Journal of Agricultural Economics, 93: 83-97.

Corrigan, J. R., D. T. Depositario, R. M. Nayga, X. Wu and T. P. Laude (2009), Comparing open-ended choice experiments and experimental auctions: an application to golden rice, American Journal of Agricultural Economics, 91(3): 837-853.

Corrigan, J.R. and M. Rousu, 2006, The Effect of Initial Endowments in Experimental Auctions, American Journal of Agricultural Economics, 88(2): 448-57.

De Groote, H., S. C. Kimenju, and U. B. Morawetz (2011), Estimating Consumer Willingness to Pay for Food Quality with Experimental Auctions: The Case of Yellow versus Fortified Maize Meal in Kenya, Agricultural Economics, 42: 1–16.

Harrison, G. W., R. M. Harstad, and E. E. Rustrom (2004). Experimental Methods and Elicitation of Values, Experimental Economics, 7: 123-140.

Hoffmann, V., C. B. Barrett and D. R. Just (2009), Do free goods stick to poor households? Experimental Evidence on Insecticide Treated Bednets, World Development, 37(3): 607 – 617.

Huffman, W., M. Rousu, J. F. Shogren and A. Tegene (2004), The effects of prior beliefs and learning on consumers' acceptance of genetically modified foods, Journal of economic behaviour & organization, 63: 193-206.

Kiria, C. G., H. Vermeulen, and H. De Groote. "Sensory Evaluation and Consumers' Willingness to Pay for Quality Protein Maize (QPM) using Experimental Auctions in Rural Tanzania." 3rd International Conference of the African Association of Agricultural Economists, Cape Town, South Africa. 19-23 September 2010.

Loureiro, M. L., W. J. Umberger and S. Hine (2003), Testing the Initial Endowment Effect in Experimental Auctions, Applied Economics Letters, 10: 271-275.

List, J. A. (2003), Does Market Experience Eliminate Market Anomalies? Quarterly Journal of Economics, 118: 41–71.

Lusk, J. L. and J. F. Shogren, (2007), Experimental Auctions: Methods and Applications in Economics and Marketing Research, Cambridge: Cambridge University Press.

Luo, R., Y. Shi, L. Zhang, H. Zhang, G. Miller, A. Medina, and S. Rozelle (2012), The Limits of Health and Nutrition Education: Evidence from Three Randomized Trials in Rural China, CESifo Economic Studies, 58(2): 385-404.

Manyong, V., A. Dixon, K. Makinde, M. Bokanga, and J. Whyte (2000). The contribution of IITA-improved cassava to food security in sub-Saharan Africa: an impact study, International Institute of Tropical Agriculture, Ibadan, Nigeria.

Maziya-Dixon, B. B., I. O Akinyele, R. A. Sanusi, T. E. Oguntona, S. K. Nokoe and E. W. Harris (2006), Vitamin A Deficiency Is Prevalent in Children Less Than 5 y of Age in Nigeria, Journal of Nutrition 136: 2255–2261.

McKenzie, D., S. de Mel, and C. Woodruff (2012), Business Training and Female Enterprise Start-up , Growth, and Dynamics: Experimental Evidence from Sri Lanka, World Bank Policy Research Working Paper, No. 6145, July 2012.

Meenakshi, J.V., A. Banerji, V. Manyong, K. Tomlins, N. Mittal, P. Hamukwala (2012), Using a discrete choice experiment to elicit the demand for a nutritious food: willingness to pay for orange maize in rural Zambia, Journal of Health Economics 31: 62-71.

Meenakshi, J. V., V. M. Manyong, H. De Groote, J. Javelosa, D. R. Yanggen, F. Nasher, C. Gonzalenz, J. Gracia and E. Meng (2010), How cost-effective is biofortification in combating micronutrient malnutrition? An ex ante assessment, World Development 38(1): 64–75.

Morawetz, U. B., H. De Groote and S. C. Kimenju, (2011), Improving the Use of Experimental Auctions in Africa: Theory and Evidence, Journal of Agricultural and Resource Economics, 36(2): 263-279.

Naico, A . T. and J. Lusk (2010). The Value of a Nutritionally Enhanced Staple Crop: Results from a Choice Experiment Conducted with Orange fleshed Sweet Potatoes in Mozambique, Journal of African Economies, 19(4): 536-558.

Saltzman, A., E. Birol, H. Bouis, E. Boy, F. De Moura, Y. Islam, and W. Pfeiffer (2013), Biofortification: Progress toward a more nourishing future, Global Food Security, 2(1): 9-17.

Tomlins, K. I., J. Manful, J. Gayin, B. Kudjawu, and I. Tamakloe (2007), Study of Sensory Evaluation, Consumer Acceptability, Affordability and Market Price of Rice. Journal of the Science of Food and Agriculture, 87: 1564 – 1575.