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Willingness To Pay for improved Gambarilifin, a by-product of maize in the South of Benin Republic

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Gambarilifin is a flour derived from dehulled and degermed maize, produced in a traditional way in Benin Republic. Production and packaging technology has recently been improved by research. This study assessed consumers' willingness to pay for improved Gambarilifin in southern Benin, as well as the determinants, by the contingent analysis approach and the weighted least squares (WLS) model. Data was collected from 97 consumers, identified in major markets and shops. The results showed that the average Willingness To Pay was estimated at about 70 FCFA/kg (0.11 euros/kg), which means a price of 170 FCFA for the improved Gambarilifin if the average price of traditional Gambarilifin costed 100 FCFA/kg (0.15 euros/kg). The major determinant associated with the respondent for this price was the source of income, indicating that people with a stable income source were more inclined to pay the improved product at 170 FCFA. Other factors were related to product quality, such as the availability of improved product in the markets, the absence of insects and pebbles, and the purchase price, also accounted for this price increase. These results revealed that the Beninese consumer is demanding processed agri-food products meeting certain quality requirements.

Keywords: *Zea mays*, contingent analysis approach, Weighed Least Squares, Benin Republic.

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INTRODUCTION

Maize is one of the most widely grown and consumed cereals in the world even than rice or sorghum (Soulé et al., 2008; FAO, 2011; Adégbola et al., 2013; Salami et al., 2015). Its average yearly per capita consumption varies from 69 to 103 kg in Benin (Adégbola et al., 2013). Over the last few decades, it has seen a great diversification in the use of its various components (Kagne et al., 2003). Maize can be consumed under a number of forms namely grilled, boiled, cornmeal, cakes, cookies, beverages, etc. (Adjadi et al., 2015). Most of these products are highly perishable and have low competitiveness because they stem from inefficient and non-standardized processing techniques. This is the case of maize derived flour commonly known as Gambarilifin, which is widely consumed in southeastern Benin Republic, Nigeria, Niger, Mali and Burkina Faso (Nago

and Hounhouigan, 1989). Gambarilifin is a flour derived from dehulled and degermed maize through a traditional method. This prestigious flour often used during special events (wedding ceremonies, funerals, baptisms and other special holidays) to prepare cornmeal which is a side dish for various sauces in these countries. When mixed with wheat flour, it can also be used, for pastry and bakery. Few studies have been done on Gambarilifin. Adjilé et al. (2014) tested the effect of this maize variety on the physicochemical and rheological quality of Gambarilifin. Houssou et al. (2016) carried out the characterization of the flour and demonstrated that dehulling, soaking and drying are the critical points of the technology that could affect the quality of Gambarilifin.

To overcome these constraints, the production technology has been improved through research, to produce a well-dried Gambarilifin of great hygienic quality (clean, with no foreign particles or unpleasant odors). These improvements to the traditional techniques of Gambarilifin have reduced the soaking time from 24 or 36 hours for traditional technologies to 16 hours (Houssou et al., 2016). Additionally, the use of hybrid dryers using both sun and gas make it possible to quickly dry the flour with a time saving of at least 1 to 2 days compared to 3 to 4 days for the traditional method and protects the flour against environmental contaminations. Yousfi (2002) has shown that improved and healthier methods of production positively influence the quality of flours and couscous; thereby attracting more consumers. Finally, the packaging has been improved, giving it the attractive visual appearance of a product ready to be sold in a fancy supermarket (Houssou et al., 2015). The tasting tests and the profitability analysis of the improved Gambarilifin were carried out by Adegbola et al., 2015. They proved on one hand, that the average yield of Gambarilifin is 61% for the traditional technology compared to 72% for the improved technology with a time saving of 42 hours 58 minutes. On the other hand, they found that the ratio NOI/TC (net operating income/total consumption) is 1.13 for anyone who invests in the production of Gambarilifin.

However, tasting and profitability tests cannot suffice to predict the consumer or market's acceptance of a product. Consumers' willingness to pay for products and setting prices according to consumers' minimum purchasing power are essential data in the field of marketing (Le Gall-Ely, 2009). Thus, the present study will assess of willingness to pay for improved Gambarilifin in southern Benin Republic.

METHODOLOGY

Study zone

The study was conducted in Benin Republic, a West African country with a population of approximately 10.32 million (World Bank, 2010). Precisely, it was in urban areas and peri-urban areas of southeastern Benin which are areas of high production and great consumption of Gambarilifin.

Sampling

The minimum sample size to be surveyed for this study was determined using Dagnelie's formula (1998) with a 95% confidence level and a 10% margin of error:

$$n_1 = \frac{U^2_{1-\frac{\alpha}{2}} P(1-P)}{d^2}$$

Where:

n_1 is the required sample size, expressed in number of consumers

$U^2_{1-\frac{\alpha}{2}}$ is the factor to attain a 90% confidence interval $U_{1-\frac{\alpha}{2}} = 1{,}96$

P is the expected or anticipated prevalence for the key indicator to estimate. When P is unknown, we use P=0.5; and
d^2 is the desired margin of error. In this case, d=10%

$$n_1 = \frac{1{,}96^2 * 0{,}5 * 0{,}5}{0{,}10^2} = 96{,}04$$

Given that this more of a quantitative survey within a finite parent-population then n_1 is corrected by the following formula:

$$n_2 = \frac{n_1 * \mathrm{N}}{n_1 + \mathrm{N}}$$

With N= Total population size of the area of study (N=1178268)
Thus $n_2 = 97$

A total of 97 consumers were surveyed for this present work.

Theoretical frame

Lancaster's theory (1966) allows a better understanding of the behavior, demands or the preferences of an economic agent in the face of a given good. This theory

posits the hypothesis of a choice that maximizes utility for consumer under budgetary constraints. However, the utility U is a function of the intrinsic specifications (x) of the good or the attributes and individual characteristics (z) of the agent. The linear expression becomes:

$$U = f(x, z)$$

where *x* represents the specifications of the product and *z* the characteristics relating to the economic agent.

Theoretically, two approaches exist to economically evaluate the increase in the well-being of an individual brought about by the introduction of a given product. These are the stated preference methods where individuals declare their preferences for goods that do not yet exist, thus in a context of experimental choice (hypothetical situation); and the revealed preference methods that make it possible to confront individuals to a real situation and observe their behaviors.

In the present study, the declared preference methods was used because improved Gambarilifin is not yet known to consumers in the study area (Donfouet, 2013). To operationalize this approach, the most commonly used collection methods are joint analysis, contingent valuation etc. The contingent valuation method, which relies on the direct questioning of contingent willingness to pay upon presentation of a fictitious scenario of provision of a good (Mitchell and Carson, 1989), is particularly well suited for ex-ante evaluation of the economic value of new goods that have not yet found commercial opportunities (Bradford *et al*., 2004). Contrary to the joint analysis method, it limits the evaluation difficulties related to the improved goods, which present intangible and really new attributes by giving priority for the evaluation, to a general approach of the offer and its potential benefits (Le Gall-Ely, 2003; Bradford *et al*., 2004). Contingent valuation was used by Durand (2009) in the ex-ante evaluation of the RFId service provided to the library. It was also used by Kertous (2012) in the study of the willingness to pay of Algerian subscribers to improve the quality of drinking water service.

Various econometric models can be used to identify the determinants of WTP. The most commonly used models for WTP studies are Tobit, Logit, Probit, Ordinary Least Squares (OLS) regression and Heckman's selection model (Kertous, 2012; Donfouet, 2013; Gbinlo, 2014). The application of the Probit and Logit models takes into account the dichotomous nature of the explained variable. Kah (2003) asserts that Logit models were initially introduced as an approximation of Probit models for simpler calculations. The Tobit model is a statistical model used to describe a relationship between a censored dependent variable and one or more independent variables (Yovo, 2010). Ami and Desaigues (2016) argue that the application of censored variable models to data from a contingent valuation survey does not yield satisfactory results. The main reason is that the null values recorded are not censored values but correspond to values having an economic meaning, that of an absence of variation of the function of well-being or a zero marginal willingness to pay. Therefore, it is appropriate to use the Tobit model because null values cannot be treated in the same manner as censored values.

The Heckman model is used in the contingent valuation method when there are protest responses (Gbinlo, 2014; Ami and Desaigues, 2016). Thus, the values of willingness to pay for these observations appear as missing data. This is the case of this study. A common practice in contingent valuation studies is to delete protest responses in the sample. However, this can skew the results. The selection model developed by Heckman (1979) makes it possible to test if there is a selection bias and to correct it.

Implementation of the contingent approach

Willingness to pay (WTP) can be measured using several methods: open-ended questions, closed-ended questions, or an auction system (Terra, 2005). The choice of either of these procedures affects the data processing. Open questions coupled with the auction system provide the most accurate estimate of the value given to the product (Terra, 2005; Kertous, 2012). However, with the closed questions, some respondents tend to accept the product regardless of the amount they are offered. This problem, termed "yea-saying", gives rise to a biased estimate of willingness to pay. Therefore, the open-question approach coupled with the auction system, inspired by the one suggested by Terra (2005), was used in this study. The products were presented to respondents and they were asked first if they were ready to use it, and then the premium they were willing to pay for improved Gambarilifin compared to its traditional counterpart of whose average price is fixed at 100FCFA/kg. It should be noted that several pre-tests were conducted to refine the individual questionnaire drawn up on the basis of information from the literature and informal interviews with certain experts in the field, for the collection of quantitative data in 2015.

Application of the analysis model

Heckman's model uses two equations: one participation equation and a second equation for the amount consumers are willing to pay if the product is accepted. Based on the studies of Donfouet (2013) and Gbinlo (2014), the model can be formalized as follows for each respondent *i*.

- Selection equation: willingness to pay for improved Gambarilifin

The selection equation is estimated by a Probit model. For the selection equation, the respondent *i* answer yes if the utility U_i that he associates with the improved Gambarilifin exceeds his current utility. The variable to be explained in this case is called discrete with two modalities. Let $Y_i = 1$ if the individual has a willingness to pay for the improved Gambarilifin and $Y_i = 0$ if otherwise. Indeed, U_{i1} corresponds to the value of the utility derived from the choice of the improved product and U_{i0} that derived from the alternative choice. For a rational individual, the decision to choose is made as follows:

$$Yi = \begin{cases} 1 \text{ si } U_{i1} \geq 0 \\ 0 \text{ si } U_{i1} \leq U_{i0} \end{cases} \quad (1)$$

U_{ik} is not observable. It is noted by the subscript *Id* (utility or profit).

$$Id = \sum \beta_i X_{ik} \quad (2)$$

X_{ik} is the value of the variable k determining the choice made by *i*. Therefore,

$$P_i = \mathrm{F}\left(X_i' \beta_i\right) \quad (3)$$

With F the symbol of an appropriate probability function; P_i the probability that the respondent *i* chooses alternative 1, in our case improved Gambarilifin; $0 \leq P_i \leq 1$

Mathematically, the Probit model is represented by the following theoretical model:

$$\Phi(\beta X_i) = \int_{-\infty}^{\beta X_i} \frac{t}{\sqrt{2\Pi}} \exp\left(-\frac{t^2}{2}\right) \quad (4)$$

(βX_i) follow the normal distribution law, the probability that a respondent *i* pays for improved Gambarilifin. β is a vector of coefficients to be determined. X_i is a vector of the individual characteristics of *i*. t is a random variable following the normal distribution law and *exp* is an exponential function.

The second equation is a linear regression model.

- Substantial equation: estimation of the forecasted WTP (observable only if U_i=1)

$$Y_i = \beta X_i + \sigma \lambda_i + v_i \quad (5)$$

Y_i is the WTP of the consumer *i*. β and σ are parameters of the model to estimate ; X_i is the same as in equation (2); v_i is the error term; λ_i is the inverse Mills' ratio.

If λ_i is not significant, one can conclude that there is no selection bias. The inexistence of a selection bias has been corrected then by an application of the general linear regression model of ordinary least squares (OLS) (Ami et Desaigues, 2016; Heckman, 1979). However, the results of the Breusch-Pagan test (Novales, 1993) indicate the rejection of the null hypothesis arguing that the error terms were homoscedastic (93.71 while the critical value for a 1% materiality level is 6.63). Consequently, the weighted least squares (WLS) model was used to analyze the factors determining the amount of the WTP. The general form (Willet and Singer, 1998) of the linear regression model WLS can the written in this matrix form:

$$WTP = \alpha + \beta_i X_i + \varepsilon_i \quad (6)$$

WTP translates the value of the willingness to pay which is the variable to explain; α is a constant; β_i the estimated coefficients of the explicative variables ; X_i a set of explicative variables and ε_i the error term.

The empirical model

The respondents were asked to declare their willingness to consume and pay a premium price for the improved Gambarilifin versus its traditional counterpart which costs 100 FCFA/kg. According to studies conducted by researchers such as Coulibaly *et al*. (2006), Angulo and Gil (2007), Kertous (2012), Durand (2009), the potential explanatory variables of WTP are related to the socio-economic characteristics of the consumer and his perception of some attributes of the product. These variables are among others:

- Gender : The gender of the consumer which is a binary variable which takes the value 1 when the respondent is a man and 0 for a woman. Women are the main actors in consumption-related activities in households. Therefore, as Gambarilifin is a product essentially derived from processing, women will tend to pay more because it would be easier for them to recognize the value added to the improved product. As a result, the expected sign of the coefficient of the variable is the negative sign.
- Age: Young people are attracted to new products and need more growth foods than older people (Valli and Traill, 2004). They will tend to value this product compared to older people. As a result, the expected sign of the coefficient of the variable is the

positive sign.

- The main source of income is also a binary variable which takes the value 1 when the respondent is a civil servant employed or by a company, and 0 if not. The correlation matrix showed that the income variable, at the education level, was correlated with the variable characterizing working as a civil servant/employee for income. These variables were not included in the model. It is generally accepted that people with a high level of willingness to pay are those with a high level of income and/or a stable source of income and a high level of education (Kostakis and Sardianou, 2011, Wu et al., 2012). Being a company employee or a civil servant comes with a stable source of income and/or is evidence of a high degree of education. This variable is therefore expected to positively affect the WTP in this study.
- Zone is a binary variable that expresses consumer's place of residence. It takes the value 1 if it is in an urban area and 0 if not. This variable is supposed to positively affect the WTP, as consumers in urban areas are more likely to buy and consume new products (Gil and Sanchez, 1997).
- Price: those who value prices will tend to want to pay less (Kertous, 2012). This variable would have a negative influence on the reported amount. Polyzou (2011) shows that price is an indicator of quality. It could therefore be inferred that they will be ready to buy the expensive product provided that it has several other characteristics more important than the price.

Consumer perception is also critical in willingness to pay. It is captured by the binary variables related to the importance of Gambarilifin in the household diet, the importance of the price, the look/packaging of the product, the cooking time and the cleanliness (absence of pebbles and insects) at purchase.

- The perception of the importance of Gambarilifin in the diet of the consumer would influence his willingness to pay, because the more he likes to eat Gambarilifin, the more he would be willing to pay if quality is improved. This variable is therefore expected to positively affect the WTP in this study.
- The cleanliness (absence of pebbles or insects at the time of purchase) would be a source of intrinsic motivation, bringing the consumer to be interested in the quality of this new product put on the market. It would be positively associated with the WTP proposed by consumers.
- The look or packaging would be a motivating factor for the purchase of the product (Limayem and Rowe, 2006), so it would be positively associated with the WTP proposed by consumers.
- The relatively short cooking time of improved Gambarilifin compared to that of the traditional product would contribute to its acceptability and to a high WTP, because a long cooking time generates a high energy consumption and is expensive for households (Harmim et al., 2008).

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The empirical model is written as follows:

$$WTP_i = \alpha + \beta_{1i}\text{Gender} + \beta_{2i}\text{Age} + \beta_{3i}\text{Civil servant/office employee} + \beta_{4i}\text{Importance of Gambarilifin in the household diet} + \beta_{5i}\text{Price} + \beta_{6i}\text{Availability of Gambarilifin} + \beta_{7i}\text{Cooking time} + \beta_{8i}\text{Absence of pebbles and insects} + \beta_{9i}\text{Zone} + \beta_{10i}\text{Product look / Packaging} + \beta_{11i}\text{Interaction Age* Product look / Packaging} + \varepsilon_i \quad (7)$$

with WTP, the value of the willingness to purchase being the variable to be explained. α a constant ; β_i the estimated coefficients of the explanatory variable; X_i a set of explanatory variables and ε_i the error term.

The variables included in the empirical model are summarized in Table 1.

Once the parameters β, λ of the model are estimated, a WTP indicator can be determined (Jeanty, 2007; Durand, 2009) using the following formula:

$$\textit{Average WTP} = \frac{\hat{\alpha} + \bar{X}\hat{\Upsilon}}{\beta} \quad (8)$$

where $\bar{X}$ is the vector of the average of the characteristics, behaviors and significant preferences. X_i, et ($\hat{\alpha}, \beta, \hat{\Upsilon}$) are the estimated parameters of the model ; α being a constant of the latter.

RESULTS

Socio-demographic characteristics of the respondents

The socio-demographic characteristics of the respondents are presented in Table 2. The table 2 shows that the number of respondents in urban areas (72.16%) was significantly higher than those in peri-urban areas (27.84%). The proportion of men surveyed (13.40%) is significantly lower than that of women (86.60%) regardless of the area. This is explained by the fact that women are the main actors in food-related activities in Beninese households. The average age (44 years) of all respondents highlights the relative experience in purchasing food for their households. With regards to profession, it appeared that there was a significant

Table 1: Description of the variables of the model

Variable	Form	Expected sign
WTP	Numerical variable	
Gender	1 = Male et 0 = Female	-
Age	Numerical variable	-
Civil servant / Office employee	1= Yes et 0= Otherwise	+
Importance of Gambarilifin in household diet	1= Yes et 0 = Otherwise	+
Price	1= Yes et 0 = Otherwise	-/+
Product look/packaging	1= Yes et 0 = Otherwise	+
Cooking time	1= Yes et 0 = Otherwise	+
Cleanliness (Absence of pebbles and insects)	1= Yes et 0 = Otherwise	+
Zone	1= Urban area et 0= Otherwise	+
Interaction Age* Product look / Packaging	1= Yes et 0 = Otherwise	-

Table 2: Socio-demographic characteristics of the respondents

Characteristics	Urban Area	Peri-urban Area	Sets	Test
Relative frequency (%)	72.16	27.84	100	-
Gender				
Male (%)	15.71	7.41	13.40	χ^2=1.15
Female (%)	84.29	92.59	86.60	
Age (years)	45.02 (11.64)	40 (10.32)	43.63 (11.46)	t=-1.96**
Profession				
Civil servant/office employee (%)	11.11	10	10.31	F=0.23*
Merchant/Trader (%)	65.75	40.74	58.76	
Craftsperson (%)	1.43	3.70	2.06	
Farmer (%)	0	0	0	
Food processor (%)	10	14.81	11.34	
Housewife (%)	7.14	22.22	11.34	
Others (retirees, students, pupils, etc.) (%)	5.71	7.41	6.19	
Importance of Gambarilifin in household diet (%)	72.86	29.63	60.82	χ^2=15.27***

(..) : Standard deviation; F: Fisher's Test (Anova)

difference according to the area ($p<0.10$). In fact, the proportion of civil servants (11.11%) and traders (64.75%) in urban areas was higher than for respondents in peri-urban areas (10% of civil servants and 40.74% of traders). Food processors were more concentrated in peri-urban areas by 14.81%. Results also showed that Gambarilifin was wore important in urban household eating habits than in peri-urban areas.

Relative importance of the attributes of choice for Gambarilifin

Table 3 presents the results of the Principal Components Analysis of the characteristics used by consumers to make their choice according to the degree of importance. It shows that the Kaiser-Meyer-Olkin index (KMO) is 0.76 and that the Bartlett sphericity test is significant ($p <0.01$),

Table 3. Principal Components Analysis of Gambarilifin characteristics for the choice by consumers

Characteristics	**1**	**2**	**3**	**4**
Very fine particle size	**0.818**	0.124	-0.182	-0.147
Whiteness of color	**0.801**	0.026	0.251	0.016
Absence of insects and pebbles	**0.719**	-0.210	-0.153	0.407
Ease of cooking	-0.018	**0.727**	0.281	-0.159
Cooking time	-0.116	**0.614**	-0.101	0.512
Taste	0.019	**0.613**	0.256	0.076
Ability to produce a consistent corn meal	0.449	**0.561**	0.014	-0.290
Availability	0.006	0.194	**0.826**	-0.071
Product look/Packaging	0.112	0.024	-0.094	**0.631**
Price	-0.200	-0.165	0.427	**0.596**
% of the total variance	21.03	19.42	12.25	9.73
Bartlett Chi2 Test (55)	209.58 ***			
KMO Index	0.76			

Note: *** Significant at 1%, ** Significant at 5%, * Significant at 10%;

Table 4. Principal Components Analysis of the Choice Attributes of Gambarilifin

	1	**2**	**3**	**4**
Granulometry Finesse	**0.818**	0.124	-0.182	-0.147
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% of the total variance	21.03	19.42	12.25	9.73
Bartlett Chi2 Test (55)	209.58 ***			
KMO Index	0.76			

Note: *** Significant at 1%, ** Significant at 5%, * Significant at 10%;

determining the validity of the component factor analysis conducted (Benzecri, 2012). The matrix of the components after rotation made it possible to identify the main characteristics related to the choices of Gambarilifin namely: the physical properties perceptible at the time of the purchase, the organoleptic and culinary properties, the presentation of the product and finally the price.

The first component, mainly relating to physical properties, accounted for 21.03% of the total variance. The weights of the factors at the component level show that the very fine particle size, the white color, the absence of insects and pebbles represented, in this order of priority, the decisive physical properties in the choice of Gambarilifin.

The second component mainly relating to organoleptic and culinary properties accounted for about 19.42% of the total variance. The weights of the factors at the component level show that ease of conservation, cooking time, taste and ability to produce a consistent cornmeal represented, in this order of priority, the organoleptic and culinary properties that were decisive to the choice of Gambarilifin.

The third component, relating exclusively to the availability of the product, accounted for 12.25% of the total variance.

Finally, the fourth component, packaging and price, accounted for 9.73% of the total variance. Therefore, the availability and the look of the product were more decisive than the price. (Table 4)

Econometric results

The results of the estimation of the Heckman selection model, using the Stata software, are summarized in Table 5. The probability associated with the coefficient of the lambda and Rho estimator is 0.90 (Table 5). This value being much greater than the theoretical value ($p<0.05$), it appears that the two equations are independent. Therefore, there is no selection bias. The selection equation is of no importance. An estimate with the OLS regression model was therefore appropriate (Ami and Desaigues, 2016; Heckman, 1979). However, the results of the Breusch-Pagan test (Novales, 1993) indicated the rejection of the null hypothesis positing that the error terms were homoscedastic (93.71 while the critical value at the 1% level of significance is 6.63).Therefore, the weighted least squares model was used to analyze the factors determining the amount of WTP.

The results from the weighted least squares model estimate are shown in Table 5. The model is globally significant ($p <0.01$), indicating that the explanatory variables introduced into the model are not simultaneously equal to zero. The pseudo R^2 is relatively high at 63%, which shows that approximately 63% of the variations in the WTP of the respondents are explained by the explanatory variables included in the model. This shows a good fit between the estimated model and the data, therefore enhancing the explicative powers of the estimation.

The majority of respondents (93.81%) were ready to eat the improved Gambarilifin. A minority (6.18%) did not want to eat it because they were not used to it. Alternatively, they preferred a traditional product that they can produce themselves rather than an improved product.

The coefficient associated with the gender variable was not significant. Therefore, gender does not determine the willingness to pay for the improved Gambarilifin. Nevertheless, the positive sign of this variable indicated that the male target group showed a tendency to pay more for improved Gambarilifin than the female counterpart. The premium price was estimated at 25 FCFA/kg (0.03 euros at a fixed exchange rate of 1 euro = 655 FCFA) or a 25% surplus on the price of traditional Gambarilifin which costs 100 FCFA/kg (0.15 euros per kg).

The age of the consumers had no impact on the WTP. Nevertheless, the negative sign of the coefficient of the age-related variable showed that the youngest consumers were more likely to give a higher premium estimated at 10 FCFA (or 0.06 euros). This seemed normal for young people who were more attracted to improved products than older people. The negative coefficient for the interaction term between age and presentation / packaging expressed an increased likelihood of consumers paying for improved Gambarilifin with good packaging ($p <0.05$). Branger *et al*. (2007) came to the same conclusion that young people placed more emphasis on new products.

The positive sign of the civil servant/office employee variable expressed the willingness of civil servants to pay a high WTP, which was estimated at 70 FCFA/kg (0.10 euros per kilogram), a surplus of 70% on the price of traditional Gambarilifin.

The positive sign of the area variable determined the predisposition of urban consumers to pay a surplus of 15 FCFA/kg (0.02 euro per kilogram) over the average price of traditional Gambarilifin.

The WTP expressed by respondents was also positively influenced by the importance of the product in their diet, as well as the availability of the product ($p <0.05$). The positive and significant influence of Gambarilifin's place as a food stated that, when it is more important in the diet, the consumer is willing to pay a 25% increase from price of traditional Gambarilifin.

The WTP to benefit from the availability of the improved product was more than half the average price of the traditional product (about 55 FCFA, or 0.08 euros per kilogram).

The positive and significant sign of the variable "price importance" showed that consumers who gave importance to price were willing to pay an estimated surplus of 70 FCFA (or 0.11 euros).

The positive and significant influence of the consumers' perception meant that the better packaged the product was, the higher consumers were willing to pay for it. This was in line with our prediction ($p <0.05$). The negative coefficient for the interaction between age and product look / packaging expressed an increased likelihood of younger consumers paying for improved Gambarilifin with good packaging ($p <0.05$).

Respondents who appreciated the cleanliness, a product without pebbles or insects, were ready to pay a high positive WTP estimated at 65 FCFA/kg (or 0.09 euros per kilogram). The influence was also positive and significant.

Finally, the duration of the cooking proved to be decisive. The negative and significant influence of the variable related to cooking duration and the price of the product is contrary to our prediction and stipulates that consumers, caring less about the cooking time and the price of Gambarilifin, were willing to pay a positive WTP of 5 FCFA/kg(0.008 euros per kilogram) for the improved Gambarilifin ($p <0.05$).

Using the estimated factors of the WLS model, average willingness to pay was predicted and the results presented in Table 6. This premium was the best estimate of the maximum amount that a consumer respondent was willing to pay for the improved Gambarilifin. The premium price was set at 70 FCFA/kg (or 0.11 euros per kilogram) or a surplus of 70% of the

Table 5: Estimation using two-stage models with Heckman and WLS

Variable	Heckman Model	WLS Model	
Value of the willingness to pay (Substantial equation)			**Marginal effect**
Gender	12.46 (51.30)	23.21 (45.62)	23.21 (45.62)
Age	-29.07 (48.38	-6.43 (48.91)	-6.43 (48.91)
Status of Civil servant / Office employee	78.16 (55.30) **	70.87 (50.54) *	70.87 (50.54) *
Importance of Gambarilifin in household diet	12.21 (29.11) **	23.78 (28.04)	23.78 (28.04)
Price	-75.50 (28.24) ***	-66.78 (27.28) **	-66.78 (27.28) ***
Product availability	45.19 (28.85)	53.27 (28.04) **	53.27 (28.04) **
Cooking time	-22.12 (43.55)	-7.57 (43.41)	-7.57 (43.41)
Cleanliness (absence of insects and pebbles)	39.87 (47.33) *	62.52 (35.92) **	62.52 (35.92) **
Zone	16.62 (31.56)	11.57 (30.42)	11.57 (30.42)
Product look/Packaging	4,50 (30,94)	3,84 (30,37) **	3,84 (30,37) **
Interaction Age*Product look/Packaging		-1.16 (0.64) **	-1.16 (0.64) **
Constant	149.66 (185.68)	38.51 (184.14) ***	38.51 (184.14) ***
Willingness to eat (Selection Equation)			
Gender	-2.16 (18.22)		
Age	-11.11 (13.81)		
Civil servant/office employee	13.47 (10.65)		
Importance of Gambarilifin in household diet	0.97 (4.45)		
Price	3.84 (10.71)		
Product availability	10.46 (16.70)		
Cooking time	-6.79 (5.82)		
Cleanliness (absence of insects and pebbles)	15.54 (10.45)		
Zone	8.97 (6.67)		
Constant	35.14 (46.69)		
Mills			
Lambda	-6.01 (413.24) 0.05<p<0.90		
Rho	-0.05		
Sigma	112.98		
Number of observations	97	97	
Number of censored observations	6		
Number of uncensored observations	91		
Chi-square (15)	21.56 ***		
F-Statistics		2.26 ***	
Adjusted R^2		0.63	

Note: () = Standard deviation; *** Significant at 1%, ** Significant at 5%, * Significant at 10%

Tableau 6: WTP calculated using the WLS model

	Observation	Average	Confidence Interval	
			Minimum	Maximum
WTP (FCFA)	97	67,77 (59,16)	57,18	272,42

average price of traditional Gambarilifin which costs 100 FCFA kg (0.15 euros per kg).

DISCUSSION

Using the results obtained from the questions on the WTP to consume the one kilogram of improved versus traditional Gambarilifin, the latter costing 100 FCFA/kg, we obtain additional information on consumer behavior. Consumers' WTP has been affected by two categories of factors, namely the socio-economic characteristics of the consumer and his perception of certain attributes of the product.

Men proposed a higher WTP than women. This result is contrary to expectations and doesn't agree with those of Laroche et al. (2001) showing that women, being more concerned about the quality of food, are likely to pay more than men. We explained the present result by the fact that women are the ones who traditionally process maize to Gambarilifin. However, buying an improved product requires an important source of income. Having generally less money than men, women don't want to buy something they can make themselves.

Younger consumers gave higher premiums compared to older people. This seemed normal in view of the fact that young people are more attracted to improved products compared to older people. Branger *et al*. (2007) reached the same conclusion that young people place more emphasis on new food products.

Public servants, who are better educated and have a stable source of income and/or a high income level, had a greater WTP than the lesser educated respondents. It is generally accepted that employees of a company or civil servant are educated (Kostakis and Sardianou, 2011; Wu et al., 2012), which justifies their willingness to pay a high WTP. In the same vein, Yousfi (2002) argues that educated people are attracted to new products given their awareness of increase in quality resulting from improved methods and techniques of product processing.

Consumers living in urban areas are more able to buy and consume new products compared to those in peri-urban areas, especially when these products are sold on supermarket shelves. Lagerkvist et al. (2013) as well as Rungsaran et al. (2016) found that the presence of traditional products in supermarkets alongside with products usually sold in boxes such as couscous or pasta, has a positive influence on consumer purchasing behavior. Thus, the presence of the improved packaged Gambarilifin in supermarkets would reassure consumers regarding the product's quality. Given that supermarkets are more prevalent in large cities, the lack of access to the new improved product could prevent its acceptability and large-scale consumption in the study area. In addition, the WTP was also influenced by product packaging or presentation, specifically at the younger consumers' levels. These results are consistent with those of Green Facts (2012) which showed that some consumer products on the European market attract more young people when they are well packaged.

Consumers who had a high frequency of traditional Gambarilifin in their household are willing to pay more to benefit from the improvement in quality. In the same vein, those who value high quality Gambarilifin as a clean product, free of pebbles or insects, were willing to pay a high positive WTP. These results confirmed those of Couvreur and Lehuédé (2002), and of Beneke et al. (2013). Consumers who valued the price were similarly willing to pay a surplus. This result matched that of Polyzou (2011) which showed that the high price of a product is a performance and quality indicator.

Consumers were not ready to pay a premium for a food that would be time consuming to cook. This result was similar to the results of Coulibaly et al. (2006) and those of Homburg et al. (2005) proving that the product efficiency positively influenced consumers' WTP.

The premium price predicted from the least squares weighted model is higher than the usual average price of the traditional product. It is justified by the advantage that consumers give to improved Gambarilifin, which distinguishes itself by several qualities that make it unique in the eyes of the consumer. The explanatory factors of this WTP are mainly related to the consumer's Civil servant/office employee and stability of sources of income. The absence of insects and pebbles plus the look/packaging of the improved Gambarilifin are the attributes of the product that have been decisive.

In view of these results, consumers are ready to buy improved Gambarilifin at a price higher than the traditional product. These results confirm those of Angulo and Gil (2007) who presented the case for labeled beef for which consumers had a higher willingness to pay than that of traditional meat.

CONCLUSION

This study focused on assessing the willingness to pay for improved Gambarilifin. Using the contingent approach, the results overwhelmingly showed a willingness to pay for the improved Gambarilifin. The only decisive socioeconomic characteristic of the consumer is the status of Civil servant/office employee. Next, the characteristics of the improved product such as hygienic quality and look positively impact the price consumers of Gambarilifin are willing to pay.

Food manufacturers and policymakers will use these results in their ongoing efforts to improve the quality and sale of maize byproducts in the West region of Africa at an affordable price. Moreover, it will be possible for local products to be available to the diaspora.

In perspective, the characteristics of the product

determining the WTP must be standardized. Other characteristics that might strengthen the WTP should be explored.

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