Eurasian Journal of Agricultural Economics

Factors Affecting The Most Preferred Local Tomato Variety "Akikon" Purchasing Prices in Benin

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ARTICLE INFO

Article History:
Received 25 July 2020
Accepted *1 March 2021*
Available online 8 April 2021

Keywords :
Benin
Tomato
Willingness to pay
Hedonic pricing

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ABSTRACT

Tomato is the most consumed vegetable in Africa. It is consumed by millions of people across the continent's diverse religious, ethnic and social groups. Even though it is not produced everywhere among the continent, there are some countries having endowments and producing local varieties. As an instance, there are many local varieties grown in the Benin Republic. However, within many local varieties of tomato grown in Benin, the mostly preferred variety and consumers' willingness to pay for this variety and its characteristics haven't been searched yet. This paper aimed to evaluate factors influencing consumers' willingness to pay for their most preferred local tomato variety. Through a formal structured questionnaire prepared based on the Hedonic-pricing model, data were collected from 223 consumers in Cotonou district of Benin Republic to identify the key factors that are most likely to affect consumers' accepted premium price for the most preferred tomato variety. 51% of consumers preferred mostly "Akikon" (*L.esculentum var. Pyriforme)* variety. The average accepted premium was 0.28 USD and the price rises to 0.64 USD with addition of 200 FCFA (0.36 USD), the standard market price of 400 grams of tomato. The reasoning behind the excepted premium was analysed and shape, colour, freshness, size, variety preference and income had appeared as the factors that mostly affect Akikon preference.

1. Introduction

Vegetables are important components of the daily diets of African residents and important sources of income, especially in urban and peri-urban areas. They have significant roles in reduction of rural poverty, increasing rural employment and economic development in Benin. For example, 15 % of agricultural GDP in Benin was constituted of only four types of vegetables, namely tomato, pepper, onion and okra with 80 million USD in 2007 due to the data retrieved from the National Institute of Statistics and Economic Analysis of Benin Republic (Anonymous, 2007).

As many as twenty different types of indigenous and exotic vegetables are grown at major vegetable production sites around West Africa. Tomato is one of the most popular and widely grown fruit in sub-Saharan Africa. Tomato ranks first among vegetable crops produced in Benin Republic (Colin & Heyd.1991). According to FAO statistics, 335,412 tonnes of tomato were produced Benin on 40,177 hectares in 2016, in the research year. Yet, the recent data of 2019 signs a declination 274,700 tonnes of production in 37,648 hectares. However, reasoning of this declination should be considered in the scope of another research (Anonymous, 2021). Tomato increases the benefit of gardeners and producers, offers employment to thousands of people without jobs and contributes significantly to poverty reduction in Benin (Ezin et al 2012). Therefore; tomato plays a vital role in social, economic and also nutritional scheme in Benin.

Fresh and processed tomato consumption has much more increased in the world. Tomatoes are Africa's most consumed fruit (or vegetable); eaten by millions of people across the continent's diverse religious, ethnic and social groups (Iwuoha, 2016). Tomato is central to most African diets and remains a regular ingredient in many soups, stews, sauces and dishes across the continent. The average growth rate of Benin's vegetable consumption in 1991-2007 was 22.94 %.

More than 20,000 varieties of tomato are produced in the world and more than fifteen indigenous tomato varieties are produced locally in Benin. Every variety has its own demand various desired characteristics which can be derived from consumer willingness to pay for it. Many research has been made on consumer's willingness to pay (Xu et al., 2015; Grebitus et al., 2013; Anonymous, 2011; Carpio & Isengildina-Massa, 2009; Darby et al., 2016; Giraud et al., 2005; Brown, 2003). However, little is known about the local variety of tomato that Benin consumers preferred most mostly, the premium price level that consumers are willing to pay for these variety characteristics and factors that affect consumer's premium prices in Benin. The main objective of this study is to analyse factors affecting market price including the accepted premium price of Akikon (L.esculentum var. Pyriforme) variety grown in Benin.

2. Material and Methods

2.1. Materials

Primary data was collected from Cotonou province of Littoral region in 2017 through a field survey for a Master thesis. Cotonou was selected as it is the economic and commercial capital of Benin Republic. Also, being a cosmopolitan city, Cotonou hosts various consumption attitudes. Heckman's random sample selection criteria were applied (Heckman, 1979) with reference to 95 % confidence interval (Collins, 1986) in determining the overall sample. Data set in this study is sourced from 223 consumers in 13 districts of Cotonou via simple random sampling with 95 % confidence interval (equation 1). The sample was distributed to the districts of Cotonou on a ratio basis respecting their population.

$$\boldsymbol{n = \frac{t^2}{E^2}\, P * Q} \qquad \textbf{(1)}$$

There are more than fifteen (15) different tomato varieties produced in Benin. Yet, six (6) local varieties as Tounvi (*L.esculentum var. cerasiforme*), Akikon (*L.esculentum var. pyriforme*), Sonafel, Ouaga (*L.esculentum var. grandifolium*) Mongal and Petromèche were selected for this research. So

consumers were asked to determine which one of these varieties is their first choice and also the reasons of their preference. A standard market price of 200 FCFA (0.36 USD) [1] for 400 grams of any other varieties that the consumer does not prefer was chosen as the reference price. Then, consumers were asked how much they were willing to pay more than this standard price in order to consume regularly their most preferred local tomato variety. Accordingly, Akikon (*L.esculentum var. pyriforme*) was the most selected variety of consumers due to its important various characteristics. The household purchase premium prices for Akikon (*L.esculentum var. pyriforme*) of consumers were collected.

In order to evaluate the impact of consumer's prices on Akikon (*L.esculentum var. pyriforme*) tomato various characteristics, a hedonic price model is next applied to determine the key factors mostly affect consumers' acceptance premiums prices for Akikon (*L.esculentum var. pyriforme*) tomato characteristics attributes.

2.2. Methods

Hedonic pricing was first implemented in agriculture by Waugh (Xu et al,, 2015) who analysed the effects of product characteristics (colour, size, variety) on vegetables and he found that the accepted price changes due to quality features of vegetables. Different applications of hedonic pricing can be noted as the price analysis of wheat (Espinosa & Goodwin,1991), apple (Tronstad et al., 1992), cottonseed (Misra & Bondurant, 2000) and tomato (Carpio & Isengildina-Massa, 2009; Xu et al., 2015).

Although product characteristics are neither produced nor consumed in isolation, hedonic price models assume that the price of a product reflects embodied characteristics valued by some implicit or shadow prices. Under the hedonic hypothesis, individual products themselves do not provide a consumer utility but instead are seen as bundles of individually valued attributes, and the value of a product is based on the utility delivered by these attributes. The hedonic price analysis offers a method to estimate the impact of individual attributes on retail prices. Early adopters such as Becker, Lancaster and Muth (Becker, 1965; Muth, 1966), they attribute these values strictly as consumers' value of these attributes.

Rosen extends this into the more widely accepted view where he demonstrated that the hedonic price functional form is a reduced form equation that reflects mechanisms of both supply and demand (Rosen, 1974). A further important task researchers facing is how to function the relationships of the dependent variable and the explanatory variables naturally, which imposes an incorrect functional form on the regression equation, and that will lead to misspecification bias.

The analytical framework of this article is based on Rosen's hedonic price theory. Products in the market are described by *n* objectively measured characteristics and, therefore, can be fully represented by the vector $z = (z_1. . z_n)$, where z_j describes the j^{th} attribute of the product. It is assumed that there exists a sufficiently large variety, but not necessarily every combination, of potential packages of attributes in the marketplace. Prices for products are then interpreted as functions of the bundled characteristics; in particular, the price p_i of product i is $p_i (z_1. . . z_n)$. Perfect competition is assumed where producers and consumers are price takers with perfect market information. Therefore, prices are revealed in the market through the usual mechanisms of individual consumer utility maximization, producer profit maximization, and market clearing conditions. In this framework, estimated hedonic price effects are not interpreted as identifying the structure of consumer preferences or producer technologies but instead are generated through a joint-envelope function of supply and demand.

[1] 24.11.2017: 1 USD = 554,31 FCFA XOF

The recent hedonic pricing methodology incorporates linear and log-linear models that enable valid interpretation of parameter estimates. Accordingly, double log-linear estimation was used in this study to estimate Akikon (*L.esculentum var. pyriforme*) tomato price for Benin following Diewert (Diewert, 2003).

$$\ln(PA_i) = a + b \times Akikon\ var._{\cdot i} + \sum_k \beta_k \times MF_{ki} + \sum_n \gamma_n \times QF_{ni} + \sum_r \theta_r \times S_{ri} + \sum_s \delta_s \times SD_{si} + e_i \quad (2)$$

In the equation 2 above, the dependent variable is a varying willingness to pay for the Akikon (*L.esculentum var. pyriforme*) tomato variety. Yet, the price was calculated with addition of a premium to the standard market price of 0.36 USD (200 FCFA) of 400 grams packaged of any other tomato variety except the Akikon variety. Therefore, the price referred to the consumer's accepted price for Akikon tomato in exchange to any other tomato variety. The explanatory variables are categorised due to average responses retrieved from survey participants. Table 1 presents the variables.

Table1: Name and description of variables

Variables	**Description**	
Dependent: PA_i	Accepted market price for **Akikon tomato** by ith consumer, with addition of price premium to standard price of any others variety except Akikon – (400 grams) (USD)	
Independents	**Modality**	
Akikon Preference $(PA)_i$	Akikon tomato variety choice of ith consumer (1-Akikon, 0- another variety)	
MF_{ki}	**Market related factors that incorporate four sub-factors.**	
a. Purchasing Places	1: Bazaar & district bazaar	0: Supermarket & peddler
b. Preferred package	1: Basket	0: Plastic bag & cardboard
c. Preferred size	1: Medium	0: Small & big
d. Purchasing frequency	1: More than once per week	0: Once or less than once per week
QF_{ni}	**Product quality related factors that incorporate four sub-factors**	
a. Hardness	1: Most preferred quality feature is hardness	0: not
b. Shape	1: Most preferred quality feature is shape	0: not
c. Colour	1: Most preferred quality feature is colour	0: not
d. freshness	1: Most preferred quality feature is freshness	0: not
S_{ri}	Dummy variable indicating seasonal fluctuations (1 - more consumption in local supply season, 0 -more consumption in other seasons)	
SD_{si}	**Socio-demographic features of the household giving the purchasing decision incorporates five sub-factors**	
a. Employment status	1: Employed	0: Unemployed
b. Age	1: If between 18 and 45	0: other
c. Gender	1: Female	0: Male
d. Education	1: If between 18 and 45	0: Other
e. Income	Household income in USD)	

3. Findings and Results

3.1. Socio-Demographic Outlay and Consumption Preferences

Considering surveyed 223 attendants, major socio demographic findings need to be interpreted. Most of the households surveyed were female with 81 %. The mean age of the sample was 44, while 60 % ranged between 25 and 45. While 17 % of the participants were unemployed, income generating activity of 37 % was small-scale sales businesses as street vending. 25 % of participants were working with payroll in public or private sectors. 51 %

of the respondents had secondary or above degree, with 17 % (37 participants) holding university degrees.

When the income distribution is considered, 210 participants indicated that they have personal income with an average of 152.39 2 USD (84,471.43 FCFA XOF) per month. The average household income was 275.55 USD (152,741.94 FCFA XOF) and 46 % of consumers declared that they have monthly family income below 180.4 USD (100,000 FCFA XOF).

The results show that 72 % of the interviewed consumers care about tomato variety while purchasing. Figure 1 below gives information on consumer's most preferred local tomato varieties .

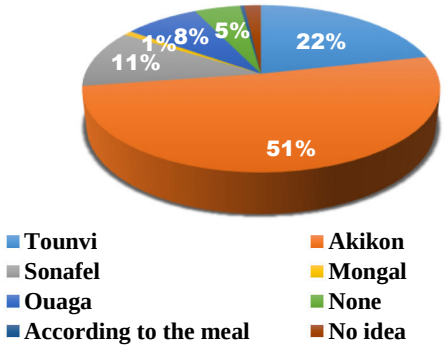

Figure 1: The distribution of the most preferred local tomato varieties

51 % of consumers choose Akikon (*L.esculentum var. pyriforme*) as the most preferred local variety within the pre-selected varieties above. 64 % of consumers explained that the Akikon variety was more expensive than other varieties. Tounvi (*L.esculentum var. cerasiforme*) and Sonafel (*L.esculentum var. grandifolium*) are respectively the second and the third most preferred variety chosen by participants. Consumers mentioned that Akikon (*L.esculentum var. pyriforme*) is the most preferred according to its attributes. Firstly this variety has a good taste (31 %), and possesses important nutritional values (30 %). Other reasons for this preference are the shelf life of Akikon tomato fruit (17 %), its freshness (10 %), its availability (8 %) and its price (4 %). Due to these various attributes of Akikon (*L.esculentum var. pyriforme*) tomato variety, consumers were asked if they were willing to pay for this variety in order to consume it regularly. 60 % of consumers had willingness to pay for Akikon (*L.esculentum var. pyriforme*) tomato attributes. The average gross premium price was 0.28 USD (153,85 FCFA XOF). Figure 2 shows consumers' willingness to pay a premium for Akikon (*L.esculentum var. pyriforme*) tomato variety.

Consumers were asked the potential premium that they were able to afford on a standard price of 400 grams of any other local tomato variety fixed at 200 FCFA (0.36 USD). Adding the gross average premium price (0.28 USD) to the fixed standard market price (0.36 USD), the final average accepted premium price was 0.64 USD (354.76 FCFA).

[2] 24.11.2017: 1 USD = 554,31 FCFA XOF

Figure 2: Distribution of consumers' willingness to pay a premium for Akikon tomato variety.

3.2. Hedonic Price Analysis

Since the dependent variable Akikon Price **"PA"** log-linear model estimation is performed, the normality test was first of all performed to check whether the data set of the dependent variable was appropriated for normal distribution. Normally test results for Akikon (*L.esculentum var. pyriforme*) tomato variety price are presented in the below Table 2 under the assumption of normal distribution.

Table 2: Normality Test for Local Variety "Akikon" Price

Kolmogorov-Smirnov		**Shapiro-Wilk**	
Statistics	**p-value**	**Statistics**	**p-value**
0.23	0.00*	0.751	0.00*

According to the p-values found above (both for Kolmogorov-Smirnov and Shapiro-Wilk), local tomato variety Akikon price doesn't have a normal dıstribution at 5% statistic level. Accordingly it is necessary to continue the analysis with the logarithmic transformation of continuous variables. In this study natural logarithm was applied. Therefore, local tomato variety "Akikon" price including the accepted premium price on the standard market price for 400 grams of any other variety sold in the market was estimated under the explanatory variables. The results of the estimated dependent variable with its explanatory variables are presented in above table 3.

Table 3: Estimation Output for Local Tomato Variety "Akikon" Price

Dependent Variables	**β**	**t**	**p-value**
Constant	2,966	9.776	0.00***
ln Income	0.081	2.722	0.007*
Akikon Preference	0.195	4.448	0.00***
Purchasing Place	0.043	0.546	0.586
Packaging	-0.02	-0.485	0.629
Size	-0.096	-2.002	0.047**
Frequency	-0.004	-0.082	0.935
Seasonal effect	0.05	0.936	0.350
Quality _ hardness	-0.091	-1.647	0.101
Quality _ shape	0.071	0.955	0.341
Quality _ colour	-0.195	-2.117	0.035**
Quality _ freshness	0.137	1.952	0.052*
Age	-0.066	-1.337	0.183
Employment Status	0.082	1.431	0.154
Gender	-0.012	-0.167	0.867
Education	0.016	0.336	0.737

*;**;*** refers to statistical significance of the estimate at 90 %, 95 % and 99 % confidence interval consecutively.

Firstly the variation explained by the dependent variables was found out as 24%. Yet, single significance and inference quality of the parameters need to be emphasized as well. Income, Akikon preference, size,

colour and freshness characteristics referring to quality of the product quality_ colour and quality _ freshness were found as statistically significant factors with 95 %. Even if the joint significance was high due to F-test with 4.395 (p<0.01*), there are non-interpretable factor estimates and a possible problem of overestimation. Accordingly, it was considered essential to check the linear relationship between Akikon price and independent variables. As most of the variables are dummy variables representing categories attached, it is essential to check the correlation between variables to infer on the linear relationship (Gujarati, 2003). Estimates of income, Akikon preference, purchasing place, freshness of the product as a quality characteristic and employment status were found to be positively correlated with "Akikon Price". However, the relationship was negative for colour quality and respondents' ages. These correlations are statistically significant at 95 % confidence interval. Therefore, in order to interpret the parameter estimates efficiently, the possible overestimation problem was overcome with reduction of the inefficient parameters and "Akikon" price was re-estimated with correlated and economically interpretable variables (Gujaratı. 2003). The findings were demonstrated in the Table 4.

Table 4: Estimation Output for Akikon Tomato Variety Price with Selected Variables

Dependent Variables	β	t	p-value
Constant	2.972	10.415	0.00*
ln Income	0.083	3.013	0.003*
Employment Status (ES)	0.086	1.592	0.113
Akikon Preference (AP)	0.192	4.531	0.00***
Seasonal Effect (SE)	0.046	0.881	0.379
Quality _freshness (QF)	0.125	1.846	0.066*
Size	-0.091	-2.085	0.038**
Quality _ hardness (QH)	-0.108	-2.039	0.043**
Quality_ colour (QC)	-0.215	-2.444	0.015**
Age	-0.068	-1.469	0.143

*;**;*** refers to statistical significance of the estimate at 90 %, 95 % and 99 % confidence interval consecutively.

The findings indicated that 24 % variation in "Akikon tomato price" was explained by the selected indicators. Yet, the correlated variables seemed to have statistical significance by 99 %, leaving *freshness quality* aside with a significance of 90 %. However, the high joint significance with F-statistics of 7.334 (0.00*) enabled us to interpret the insignificant *seasonal effect*, *age* and *employment* variables.

Therefore, the final estimation of "Akikon tomato price" equation can be summarized as follows:

$$\boldsymbol{ln(\widehat{PA}_i) = 2.972 + 0.192 * AP_i - 0.091 * Size + 0.046 * SE - 0.108 * QH - 0.215 * QC + 0.125 * QF + 0.083 * ln(Income) - 0.068 * age + 0.086 * ES} \quad \textbf{(3)}$$

It's important to emphasize some important details in parameters estimation stage. In order to reach sound interpretations, the dependent and explanatory variables especially the continuous variables were multiplied by 100 before inserting them into the analysis due to their considerably initial low values. The continuous variables such as "Akikon Price" variable and the explanatory variable "income" were used in Dollars after their transformation into natural logarithmic. Accordingly, the proportional change obtained by the logarithmic transformation in the explanatory variables is considered to estimate numerically the dependent variable "Akikon Price" rate (Gujarati, 2003). While the Ordinary Least Squares regression original variable (Y or lnPA in this present case) is used to estimate the expected arithmetic mean, the Ordinary Least Squares regression of the log transformed outcome variable is to estimate the expected geometric mean of the original variable.

Therefore, the value of estimated constant of 2.972 (Table 4) represents the unconditional expected mean. So the geometric mean is the exponentiated value (anti-

logarithm) of the constant that gives exp[3] (2.972) = 15.530. As the level variables were multiplied by 100, the average mean value for "Akikon Price" is 0.15 USD when all the variables were kept constants. In Benin local currency, consumers accepted to pay 83 FCFA XOF for Akikon tomato variety holding other variables constants.

When it comes to categorical variables estimated parameters interpretation, as their haven't been transformed such "Akikon preference (PA)", its exponentiated coefficient is the ratio of the geometric mean for Akikon variety choice to the geometric mean for any other variety choice[4]. Accordingly, we expected that consumers are willing to pay more 21% for Akikon preference than any other local tomato variety as exp(0.192)=1.211. This meant that consumers accepted to pay 0.03 USD or 17 FCFA more than the average price for 400 grams of Akikon tomato variety.

Size, age and tomato quality characteristics such as hardness and colour affect Akikon Price inversely. If the consumer's mostly valued quality preference was hardness, he /she declared that she/he accepted to pay 9 % less than average price (exp(-0.091): 0.91). It means that while consumers purchasing Akikon tomato variety, if their most preferred size is medium size, they would like to pay 9% less than the average price. The consumers who perceived hardness (QH) and colour (QC) as the most important quality characteristic for Akikon tomato variety were willing to pay respectively 10% (0.01USD or 8 FCFA) and 19% (0.03 USD or 16 FCFA) less than average mean since for QH exp(-0.108): 0.90 and QC exp(-0.215): 0.81.

For Akikon tomato variety, consumers who perceived freshness characteristic as the most important were willing to pay 13% (0,02 USD or 11 FCFA).

The most significant interpretation occurs with the parameter of logged income (ln(Income)). Without any requirement of anti-log transformation, a 100 % rise in consumer's average family income leads to 8 % more payment willingness for Akikon tomato variety. Accordingly, when consumer's family income rise by 100 %, they were willing to pay more than 0.16 USD (76 FCFA) on average price.

Although in this analysis age, employment status and seasonal effect were not statistically significant at the end of results it's necessary to evaluate their effects on Akikon price too. Hence, the consumers whose age range between 18 to 45 years were willing to pay 7% or 0.01 USD (6 FCFA) less than the average price as exp(-0.068)= 0.93; when it comes to interpret employment status and seasonal effect parameters, according to the values getting respectively from the geometrical mean as exp(0.086)= 1.09 and exp(0.046) = 1.047. This mean that the employed consumers (one who work) and those who prefer buying Akikon tomato variety mostly in tomato intense supply period were willing respectively to pay more 9 % (0.01 USD or 4 FCFA) and 5% (0.008 USD or 4 FCFA) on average price.

4. Discussion and Conclusion

In Benin, more than 15 local and improved tomato varieties are produced. But within these varieties locally grown which one is the consumer's favourite? This study informed about the most preferred locally grown tomato variety and examined the factors that likely affect this variety price (market price adding to the accepted premium price) for 400 grams of tomato by using hedonic pricing analysis. So it was checked if consumers had any mostly locally grown tomato variety, secondly if they had a willingness to pay for this variety and finally how much were they willing to pay more than 200 FCFA (0.36 USD), a standard market price fixed for 400 grams tomato weighted just in order to consume "Akikon" variety over the others locally grown tomato varieties.

[3] e=2,718

[4] Akikon preference is a categorical variable that is dichotomous (it has two categories such as "0-Akikon choice; 1- another variety) (Table 1)

It was found that 72 % of surveyed consumers cared about tomato variety while purchasing. Daily market and neighbourhood bazaar were the major sources of tomato supply. In this study within six (6) varieties that were chosen, 51 % of consumers had chosen “pears tomato” (*L.esculentum var. pyriforme*) locally called in Benin “Akikon” variety. They specified that despite its high price, due to “Akikon” characteristics attributes such as good taste its nutritional values, long shell life freshness, availability and price, they mostly preferred Akikon over the other varieties. Accordingly, 60 % of surveyed consumers had a willingness to pay for Akikon variety.

When all of the variables were neglected, consumers accepted to pay 0.15 USD for Akikon tomato variety. Those who had a huge preference for Akikon were willing to pay 21% as a premium price regard to the average price. Akikon preference, purchased size, market factors, household income and Akikon tomato fruit quality preferences such as hardness, colour and freshness affected mostly Akikon price. Moreover, there were also the inverse relationship between Akikon price and consumers who perceived tomato fruit’s hardness (QH) and colour (QC) as the most important quality characteristics for Akikon tomato and also for age and size. Those consumers were willing to pay less than the average price.

In conclusion, there was a significant positive relationship between local tomato preference and Akikon variety preference as well as local tomato price premium and the Akikon price premium. These results showed that there was an important potential demand for the Akikon tomato variety in Benin Republic. This study has provided some information regarding the development and application of marketing policies for tomato producers in Benin considering Akikon, a local tomato variety, consumers expected quality attributes for this variety, the most preferred package and size preference regard to seasonal preference and tomato consumption frequency. So, it is necessary to encourage production and marketing policies in Benin towards consumer’s most preferred tomato varieties.

Acknowledgement

Data used is retrieved from MSc thesis of Mouinatou Alidou entitled ‘Analysis of Factors Affecting Tomato Purchasing Price in Benin’ prepared in Graduate School of Natural and Applied Sciences in Akdeniz University, Turkey (2016-2017).

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