PRICING OF SPIDER PLANT (CLEOME GYNANDRA) QUALITY ATTRIBUTES IN KIAMBU COUNTY, KENYA

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(Received 05th January 2022; accepted 29th March 2022)

Abstract. Spider plant (*Cleome gynandra*) is a very important source of livelihoods and food for the majority of households in Kenya. Consumers show preference to spider plant compared to other African leafy vegetables due to its nutritional value and health benefits. This study sought to elicit implicit prices and preference levels for spider plant attributes. A cross-sectional survey research was used to obtain data from 100 consumers with the aid of semi-structured questionnaires. Hedonic pricing model in STATA 11.0 was fitted to estimate the influence of attributes on observed prices. Results indicated that leaf size and leaf colour significantly influenced the price paid by consumers to spider plants at $P<0.01$ and $P<0.05$ respectively. Consumers paid premium price for green colour leaves and discounted purple colour leaves. Based on the findings of this study, it is recommended that spider plant breeding activities should focus on broad leaves and green leaf colour as the main attributes positively influencing consumption utility and farmer income.
Keywords: *attributes, hedonic pricing, spider plant, observed prices*

Introduction

Agriculture is the mainstay of Kenya's economy providing the basis of development for other sectors of the economy. The Agricultural sector contributes about 30% of the gross domestic product and accounts for over 75% of the total labour force (HCDA, 2010). It is envisaged that the agricultural sector will continue to play a leading role in stimulating and supporting the country's economic growth mainly through the vibrant horticulture industry (Muendo and Tschirley, 2004). African Indigenous Vegetables (AIVs) represent a diverse and widespread set of vegetables that are consumed across Kenya. Leaves, fruits, and roots from over 1,000 species of AIVs form the backbone of traditional diets (Muhanji et al., 2011) but in many cases have been ignored at the expense of introduced vegetables like kale and cabbage (Adeka et al., 2009; Omiti et al., 2005; Okeno et al., 2003). These include both wild and domesticated leafy greens such as cowpea (*Vigna unguiculata*), nightshade (*Solanum spp.*), spider plant (*Cleome gynandra*), amaranth (*Amaranthus cruentus*), and jute mallow (*Corchorus olitorius*). Government policies take little account of the role AIVs play in the agricultural sector and have done little to promote research and investment (Figueroa et al., 2009). Often, AIVs are a more sustainable alternative to exotic crops such as kale or cabbage, as they can be pest-resistant, require fewer external inputs, and are well adapted to local agro ecological conditions (Ekesa et al., 2009).

African indigenous vegetables production value in Kenya exceeded 30 million USD in 2010 (HCDA, 2010). They are the cheapest source of macro and micronutrients in Kenya; in addition, they provide vitamins A, B, and C, as well as minerals like calcium, iron, and potassium (Uusiku et al., 2010). In Kenya, the daily intake of fruits and vegetables is well below the dietary recommendations and affordability of vegetables remains a challenge for the poor (FAO, 2012). Muendo and Tschirley (2004) observed

that the AIVs are important to Kenyan smallholder farmers, as over 90% of them grow horticultural crops of some kind. Spider plant is one of the most highly consumed AIVs in Kenya (HCDA, 2010). However, despite the immense benefits of the crop, the production levels cannot meet the demand especially in urban and peri-urban areas where population is high. The farm gate prices of AIVs increased by 30% between 2003 and 2006, and the current supply of AIVs in Nairobi and its surrounding, Kiambu included, is estimated to meet only 60% of the demand (Mwangi and Kimathi, 2006). It is therefore anticipated that the AIV market will keep on growing with the rapidly expanding population of Kenya especially in urban area where it is expected to triple between 2005 and 2030 (Tschirley and Ayieko, 2009).

Never the less, recent research activities on spider plant has focused on increasing production levels at the farmers' level with little or no attention to meeting consumer demand and quality requirement (Mwangi and Kimathi, 2006). Consumer purchase decisions for spider plant are determined by both extrinsic and intrinsic quality attributes which give utility of the good. Analysis of preference attributes in spider plant will divert attention of breeders and farmers to concentrate on the supply of the commodity which meets the utility requirements of the intended consumer. A greater understanding of consumer demand attributes of spider plant and market dynamics would help address the market gap that both breeders and farmers are yet to fill. To address the lack of consumer information about spider plant market dynamics and the potential of this sub-sector, this study employed a revealed preference survey approach to identify potential determinants of consumer preference regarding quality attributes of spider plant in Kiambu County. Information generated from this study is important for developing agricultural policies for improving spider plant breeding and production methods by both plant breeders and farmers through providing them with accurate market information. Recently, the food habits and dietary patterns of most consumers are changing and they are increasingly demanding food products that possess certain attributes relating to how the food was produced or processed. The current study fills this void in information.

Materials and Methods

The study area

This study was conducted in Ruiru Sub-County, Kiambu County of Kenya. Kiambu was selected for the study because vegetable production is a major economic activity in the area due to its proximity location to the Kenya's' capital city of Nairobi, which has large market for spider plant vegetable. The market serves consumers of diverse socio-economic status. Consequently, being the capital city, the population is therefore composed of consumers from different backgrounds and social status who are expected to have diverse preferences.

Sampling procedures

The target population for this study consisted consumers of spider plant in Kiambu County. Multistage sampling technique was used. In the first stage, Ruiru and Juja Sub-Counties were purposively selected from the county due to their proximity to the capital city and large producers of spider plant. Major market centres in the two sub-counties were purposively selected for the study based on availability of spider plant consumers.

Determination of the sample size was based on the formula below as specified by Cochran (1963) and used by Kothari (2004).

$$n = \frac{z^2 pq}{e^2} \qquad \text{Eq. (1)}$$

Where n is the sample size; p is the proportion of the population (50%) containing the major attributes of interest (consumption of spider plant) and it is chosen because the proportion of population consuming spider plant is unknown; Q is 1-p; Z is the standard variation of 1.96 given a confidence level of α=0.05; and e is the acceptable precision level of 10.2%. Since it is difficult to determine the population of people consuming spider plant in the study area due to continuous influx of people in urban areas, the assumption was that 10.2% of the population in the study area produce and consume spider plant. The acceptable precision of 10.2% was chosen because of the smaller sample size hence higher confidence level of the results. The calculation is: 1.96x1.96x0.5x0.5/0.102x0.102 = 100; which indicate systematic random sampling was used to select 100 consumers in the selected sub-counties.

Data sources and collection

Both primary and secondary data were used in the study. Primary data was collected by trained enumerators who were recruited from within the area of study due to their familiarity with local language. Data was collected with the aid of semi-structured questionnaire administered to spider plant consumers by enumerators. Data on spider plant attributes (leaf colour, number of leaves, height, stem and petiole colour, freshness and taste, among others), socio-demographic variables (age, income, gender, education level, marital status and household size of the respondents) were collected for the study. Enumerators strategically positioned themselves next to spider plant traders where they interviewed every second consumer who came to purchase spider plant vegetable. Secondary data was collected from Ministry of Agriculture annual reports in Kiambu County, government records and published journal papers.

Data analysis

Data collected was analyzed using both descriptive and inferential statistics with the aid of Excel and STATA version 11 software. The analytical technique based on the objectives of the study is described below:

Socio-economic factors of farmers and consumers of spider plant

Descriptive statistics were used to characterize consumption patterns and involved use of frequencies, percentages and mean. The results were presented in form of tables.

Attributes of spider plant in influencing consumer preference

To assess attributes of spider plant that influences consumption, hedonic pricing model was employed. Spider plant is represented as a bundle of characteristics or attributes which consumers consider while making their purchase decision (Lancaster, 1966; Becker, 1965). According to these theories, consumers choose spider plant that maximizes their utility based on consumption characteristics. The underlying

assumption postulates that products consist of utility-bearing attributes, and that the values of those attributes collectively contribute to the price of the product (Rosen, 1974). This approach is called the hedonic pricing method in which the price of spider plant is viewed as a composite of implicit values/prices of each individual attribute. The price of a good is a function of the number of attributes that it contains and of the values placed on them (Carman, 1997). This can be represented as:

$$P = \beta_0 + \sum_{j=1}^{m} (\beta_j Zj + \varepsilon) \qquad \text{Eq. (2)}$$

Where, the vector Z stands for a particular variable of spider plant, β_0is the intercept; β_j is the regression coefficient or the implicit price of the variable and is the random error term satisfying the classical regression assumption. The regression coefficient Bj indicates the marginal change of price with respect to a change in the jth characteristic; Zj changes by one unit when all other marginal effects are kept constant. For the spider plant, the following model was used:

$$lnp_i = \alpha_0 + \sum_{n=1}^{k} \beta texture + \sum_{n=1}^{k} \beta size\ of\ leaf + \sum_{n=1}^{k} \beta leaf\ colour + \sum_{n=1}^{k} \beta fresh \sum + \sum_{n=1}^{k} \beta SD + \varepsilon \qquad \text{Eq. (3)}$$

All attributes were expressed as dummies grouped into categories whose impact on price was sought by this study. The dummy categories were identified during a preliminary survey conducted in the study area and their expected signs on the dependent variable hypothesized. Overall variables described above are dummy variables. In a semi logarithmic functional form (adopted for this study), the effect of a dummy variable on the dependent variable is not equal to the first derivative of the regression function with respect of the dummy variable in question, unlike the effect of a continuous variable (Kennedy, 1981). In other words, the first derivative (β) is only a potentially imprecise approximation of the effect of the dummy variables on the dependent variable. Among the approaches available to correct this is the method suggested by (Kennedy, 1981). Following this method, the effect of a change of Xk is from zero to one on P, can be calculated as follows (Kennedy, 1981).

$$g_k = exp\left(\beta_k - \frac{1}{2} V(\beta_K)\right) - 1 \qquad \text{Eq. (4)}$$

Where, v (β_(k)) is the estimated variance of the estimated coefficient β_(k).

Hedonic model was estimated using ordinary least square method (OLS) of regression analysis. In empirical estimation, the theoretical foundation for hedonic models provides little guidance on appropriate functional form. This study adopted a log-linear functional form. The significant effect of each independent variable on the price was tested with a t-statistic. Insignificant coefficients of the variables suggested that consumers either do not have adequate information to incorporate the characteristics into their buying decisions or that they place no value on such attributes when they buy spider plant. The coefficients of attributes are interpreted as percentage changes with respect to the default dummies (Gujarati and Sangeetha, 2007). This

implies the presence of an attribute's dummy over the default dummy will bring about either a decrease or an increase in the price depending on the sign of the coefficient. Positive signs imply price premiums for the dummy in question, whereas a negative sign implies a price cut (discount).

Results and Discussion

Socio demographic characteristics of the sampled consumers

Socio economic characteristics of consumers are important in product market assessement since they influence consumption patterns of agiven commodity (Lee et al., 2012; Bett et al., 2011). *Table 1* shows the socio economic characterisitcs of spider plant consumers.

Table 1. *Socio economic characteristics of the sampled households.*

Variable	Category	Frequency (N)	Percentage (%)	Minimum	Maximum	Mean
Gender	Male	2	2	-	-	-
	Female	98	98	-	-	-
Marital/S	Married	63	64.95	-	-	-
	Single	20	20.62	-	-	-
	Widow/er	14	14.43	-	-	-
Education	No eduction	9	9.09	-	-	-
	Primary	13	13.13	-	-	-
	Secondary	27	27.27	-	-	-
	Diploma	28	28.28	-	-	-
	Degree	16	16.16	-	-	-
	Postgraduate	6	6.06	-	-	-
Income	<10,000	1	1.03	-	-	-
	10001-20000	8	8.25	-	-	-
	20001-30000	12	12.37	-	-	-
	30001-40000	20	20.62	-	-	-
	40001-50000	19	19.59	-	-	-
	50001-60000	17	17.53	-	-	-
	>60000	9	9.28	-	-	-
Price per KG of sider plant		-	-	25	45	33.65
Age		-	-	18	71	42.21
Household size		-	-	1	12	5.48

The majority of the spider plant consumers were women at 98% compared to their male counterparts at 2%. The results indicate that most of the decision making on spider plant purchases are made by women as compared to men. The average age for the spider plant consumers in the current study was 42.21 years (*Table 1*). The youngest consumer was aged 18 years whereas the oldest was aged 71 years (*Table 1*). This indicates that the majority of spider plant consumers belonged to the elderly age bracket as compared to the youthful age bracket (18-35). This finding connotes that youths don't prefer spider plant as a vegetable. These could be attributed to lack of cooking skills and the bitter taste of the plant which is not appealing to the youthful generation. With regard to marital status, majority of the spider plant consumers were married in the study area at 64% as compared to those who were unmarried.

The majority of the consumers had Diploma level of education at 28% with an illiteracy rate of 9%. The majority of the consumers (20%) in the study area earn between Ksh. 30,000 to Ksh. 40,000 per month (*Table 1*). Consumers who earn less than Ksh. 10,000 per month were only 1% of the sampled respondents. This connotes that spider plant consumers earn more income. These results indicate that spider plant is a luxury good in urban areas beyond the reach of poor households. The average household size in the study area was 5 members (*Table 1*). The minimum household size was 1 member while the maximum household size was 12 members (*Table 1*). The average retail price per kilogram of spiderplant leaves in the study area is Ksh.33.65. The maximum price is Ksh. 45 while the minimum price is Ksh.25 per every kilogram of spiderplant leaves sold.

Influence of spider plant attributes on price

The results of F-test for spider plant (F = 2.25 significant at one percent) indicates that the independent variables as a set significantly affect the dependent variable (Price of spider plant). The R-square (0.28) indicates that 28% of the variability in spider plant price is explained by the empirical model. *Tables 2* and *Table 3* show estimates of; coefficients, corresponding standard errors and t-values for attributes of spider plant. T-test was used to estimate the significant levels of individual independent variables. The influence of four spider plant attributes (leaf size, leaf colour, leaf texture and freshness) on price was thus estimated in Kiambu County. The hypothesis for a coefficient not different from zero was rejected for two variables; leaf size and freshness 10% significant level, while the other two spider plant attributes (leaf colour and texture) were statistically insignificant.

***Table 2**. Estimation of hedonic price model for spider plant.*

Variable	Coefficient	Std. Error	t-value	p-value
Leaf size	0.1205*	0.0620	1.94	0.055
Leaf teture	-0.0551	0.0482	-1.14	0.257
Leaf color	-0.0161	0.0664	-024	-.809
Freshness	0.1936*	0.0827	2.34	0.022
Gender	0.2088	0.3641	0.57	0.568
Education	0.2482	0.5882	0.42	0.674
Age	0.0029	0.0043	0.68	0.501
Household size	-0.0741*	0.0277	-2.68	0.009
Constant	1.7746	1.4457	1.23	0.223
R^2	0.2803	-	-	-
Adjusted R^2	0.1559	-	-	-
N	100	-	-	-

*Note: * mean significant at 10%; ** mean significant at 5%; *** mean significant at 1.*

***Table 3**. Estimation of hedonic price model for spider palnt specific attributes.*

Variable	Coefficient	Std. Error	t-value	p-value
Leaf size (large)	-0.0524*	0.0370	-1.41	0.061
Leaf texture (rough)	-0.0113	0.0591	-0.19	0.849
Leaf color (purple)	-0.0303	0.0564	-0.54	0.592
Freshness (preserved)	0.0822*	0.0936	0.88	0.082
Constant	4.4204	0.3736	11.83	0.000
R^2	0.1618	-	-	-

Adjusted R^2	0.0720	-	-	-
N	100	-	-	-

*Note: * mean significant at 10%; ** mean significant at 5%; *** mean significant at 1.*

The size of spider plant leaf statistically significantly influenced the price of spider plant (P<0.1) (*Table 2*). The results showed that ceteris paribus, the price of spider plant increased by 12% with a unit (1%) increase in the size of spider plant leaf. The results connote that consumer are willing to pay premium price for the spider plant vegetable if the size of leaves is large. These findings can be attributed to the high levels of satisfaction derived from leaves of spider plant by consumers which motivates them to pay high prices. The findings corroborate with those of Mauyo et al. (2008) who established that the number of marketable leaves, number of shoots and fresh yield were significant attributes in western Kenya. Onyango et al. (2013) established that the two most important reasons for preference of the spider plant was that it is tastier and nutritious hence a favorite of aged people which resonated with the privileged social position of the aged in the dominant ethnic groups that include the Abagusii, Luo and Luhya in the study areas (Omiti, 2005). Just like among the Abagusii people where the elderly is revered because they alternately wield curses and blessings (Omiti, 2005), the elderly is equally respected and cared for among the Luo and Luhya. This partly explains the widespread cultivation of their preferred vegetable, the spider plant.

Spider plant leaf texture and colour did not significantly influence the price of spider plant (P>0.1). The two attributes also had negative coefficients implying that their presence resulted in price cut (discounts) of spider plant. Freshness significantly influenced the price of spider plant (P<0.1). Holding other attributes constant, a unit changes in the freshness attribute, resulted in the price of spider plant increasing by 19%. The results indicates that consumers of spider plant prefer fresh leaves and are willing to pay price premiums in order to obtain fresh spider plant leaves. This can be attributed to believe that non fresh spider plant is inferior in quality with regard to nutrients and taste after cooking. Onyango et al. (2013) established that to ensure availability of spider plant vegetable during the dry season in western Kenya, the plenty vegetables available during the rainy seasons were sun-dried and stored in tightly closed gourds or pots.

Table 3 indicates that specific attribute parameters significantly influence the price of spider plant. Large leaves received premium price compared to small leaves (*Table 3*). The price of spider plant with large leaves was 5% greater than that of small leaves. Fresh leaves attracted price premiums compared to non-fresh spider plant. Ceteris paribus, the price of fresh leaves was 8% higher than that of non-fresh leaves of spider plant. The findings contradict Chataika et al. (2020) who found that farmers preferred preserving the spider plant for later use especially during dry spell in northern Namibia. There were no statistically significant different between the price of purple leaves and green leaves but consumers paid price premium (3%) for green leaves compared to purple leaves. The findings are in consistence to Chataika et al. (2020), who found that in northern Namibia, preference was given to green spider plant and it was the only morphotype domesticated in the area. However, in contrast with green accessions, purple accessions are reported to be associated with higher nutrient density which have health benefits, and also contain phytochemicals which confer resistance to insect pests (Omiti et al., 2005). There were no statistically significant differences between the price for rough textured and smooth textured leaves (*Table 3*). The present study also

sought to establish the influence of socio demographic characteristics on spider plant prices. Results revealed that household size had significant impact on the price of spider plant. The size of house hold significantly ($P<0.1$) negatively influenced the price of spider plant. The price of a kilogram of spider plant leaves increased by 7% (*Table 2*) for unit increase in the number of family members within the study area. The findings connote that families with large members paid price discounts to a kilogram of spider plant compared to families which had fewer members. These could be attributed to the economies of scale. Large families buy relatively large amount of spider plant leaves compared to small families hence enjoying price cuts. The age and gender of the consumers do not statistically influence the price of spider plant leaves ($P>0.1$). However, male consumers paid price premiums at 20% per kilogram higher than their female counterparts.

Conclusion

The present study has established that spider plant attributes influences the price that consumers pay. Consumers are willing and able to pay premium prices for a kilogram of spider plant leaves if they are large in size and fresh. Consequently, consumers will pay price cuts (discounts) for spider plant leaves that are small in size and non-fresh. Green spider plants were preferred compared to the purple stem-purple petiole spider plants. The study also established that families with large members will pay price premium compared to small families. The study therefore, recommends plant breeders to develop varieties of spider plants with large leaf sizes and green colour as opposed to purple colour. Farmers are encouraged to enhance consistence in their cropping calendar to ensure that they always supply fresh produce to the market for consumers.

Acknowledgement

I wish to acknowledge the National Council of Science, Technology and Innovation in Kenya for funding this research project, and Charles Ndenga for assistance with data analysis.

Conflict of interest

The author declares no conflict of interest in the outcome of this research.

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