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Full Length Research Paper

Consumers' preference for quality in three African indigenous vegetables in Western Kenya

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African Indigenous Vegetables are an important source of income generation for smallholder farmers in Western Kenya. Though grading of produce and investment in post-harvest handling is limited, these results show a strong market for high quality African Indigenous Vegetables at a premium price. A choice experiment approach was used to evaluate consumer preference for high quality in three Kenyan cities for three vegetable species: nightshade (*Solanum spp.*), spider plant (*Cleome gynandra*), and amaranth (*Amaranthus cruentus*). Female consumers and those who generally spent more on produce were more likely to select high quality vegetables, but the market for these vegetables differed greatly by species. Consumers were significantly more likely to choose high quality nightshade if they had a home garden while preference for high quality spider plant was more variable from city to city than either of the other two vegetable species. Overall, 71% of consumers surveyed chose at least one high quality product at a premium price; this is a strong indication that consumers in Western Kenya are willing to pay slightly more for African Indigenous Vegetables of the best quality.

Key words: Consumer preference, indigenous vegetables, Kenya, market access, market linkages, smallholder farmers, traditional vegetables, urban consumers.

INTRODUCTION

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; Okeno et al., 2003; Omiti et al., 2005). 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). AIVs are often a more sustainable alternative to exotic crops such as kale or cabbage, as they can be pest-resistant, require fewer inputs, and are well adapted to local agroecological conditions (Ekesa et al., 2009). Though their economic potential is yet to be completely realized, AIV production value in Kenya exceeded 30 million USD in 2010 (Ministry of Agriculture, 2010). AIVs 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 (Orech et al., 2007; Uusiku et al., 2010). A highly nutritious diet is important in an area of the world where daily intake of fruits and vegetables is well below dietary recommendations and affordability of vegetables remains a challenge for the poor (FAO, 2012).

AIVs are especially important to Kenyan smallholder farmers, as over 90% of them grow horticultural crops of some kind (Muendo and Tschirley, 2004). In 2002,

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Abbreviations: African Indigenous Vegetable (**AIV**).

smallholder farmers together produced 3.2 million tons of fruits and vegetables which contributed 3% of the Kenyan GDP (Neven and Reardon, 2004). AIVs in particular are especially important to women, who are involved in all aspects of the AIV supply chain and dominate both intermediary and retail activities, providing an important income generating opportunity (Weinberger et al., 2011). Farm gate prices of AIVs increased 30% between 2003 and 2006, and the current supply of AIVs in Nairobi is estimated to meet only 60% of the demand (Mwangi and Kimathi, 2006). The AIV market promises to keep growing with the rapidly expanding population of Kenya.

Meeting urban consumers' demand provides both opportunities and challenges to Kenyan farmers as the urban population of Kenya is expected to triple between 2005 and 2030 (Tschirley and Ayieko, 2009). Increasing urbanization has allowed for the dramatic expansion of the formal sector in food markets, as represented by supermarkets and specialty stores. Supermarket sales have grown by 18% annually since 1995 as supermarket chains spread to smaller cities (Neven and Reardon, 2004). Even though more than 90% of consumers continue to purchase their fresh vegetables in informal open air markets (Ayieko et al., 2005), supermarkets are increasingly offering diverse produce selections in their stores. In Western Kenya, where several growing urban centers are located, many supermarkets still source their produce from Nairobi which is 300-500 km away, reducing shelf life and increasing the price of the vegetables. Long-distance shipping of produce often results in poor quality vegetables in terms of freshness and appearance by the time they reach more distant cities, a consequence of the still-developing supply chain infrastructure.

Currently, the urban supply of AIVs is not meeting consumer demand and quality is low (Mwangi and Kimathi, 2006). Increased AIV production by smallholders would be ideal for meeting this demand, but accessing the market can be a challenge. Access to capital is limiting investment in appropriate postharvest handling, agricultural production inputs, and technology. Refrigerated transport is prohibitively expensive for most and poor infrastructure (from roads to vehicle availability) means that even short distances to markets can take a long time to travel (Ayieko et al., 2005). Most smallholder growers sell their produce to middlemen and are only paid an average of 17% of the final retail price which is much less than producers who sell directly to supermarkets and receive 57% of the retail price (Neven et al., 2009). If smallholder farmers were able to enter this growing market, there is excellent potential for not only increased profit but also for improved distribution and supply of these important crops to consumers.

Insufficient information about the market dynamics of AIVs limits smallholder farmers' access to markets. Though AIVs are widely consumed, some species are more popular than others and the popularity of specific AIVs can vary greatly from region to region. If specific information on these market and supply dynamics were available to growers, they would be better positioned to target their produce to the most receptive market and plant according to the highest value crop for their area. Growers can gain a competitive edge by investing in postharvest handling so that fresher produce reaches the market. To justify making this investment, growers would need to expect a higher profit to recover this cost. Grading produce by separating out top quality and charging a premium for it can help growers boost profits, but buyers have to be willing to pay a premium. If a large market exists for higher quality AIVs in the formal or informal urban market, growers would have a reason to improve the quality of the AIVs produced and thus achieve higher profits. A greater understanding of consumer demand and market dynamics of AIVs would help address the market gap that developing supply chains have yet to fill. Bringing market information to smallholder farmers on the vegetables that consumers demand will enable them to take advantage of this opportunity.

To address the lack of information about AIV market dynamics and the potential of this sector, this study used a choice experiment survey approach to identify potential determinants of consumer preference regarding quality of AIVs in Western Kenya with a focus on three species: nightshade (*Solanum spp.*), spider plant (*Cleome gynandra*), and amaranth (*Amaranthus cruentus*). These are three of the top five AIV species in terms of production value (Ministry of Agriculture, 2010) and are widely available across cities in Western Kenya. Information generated is important for developing agricultural policies for improving production methods, postharvest handling, and infrastructure. By connecting actors in the market chain (for example, farmers, wholesalers, and retailers) and providing them with accurate market information, the outcomes of this study will promote improved availability of high quality AIVs for urban consumers.

MATERIALS AND METHODS

This study used a choice experiment approach to measure consumer preference for quality in three AIV species in Western Kenya: nightshade, spider plant, and amaranth. Consumer data were collected from 340 customer interviews at the point of sale between June and August 2013. Questionnaires were validated through pre-testing and conducted in six locations (three supermarket locations and three open air markets) in three cities of varying size in Western Kenya: Busia, Kakamega, and Eldoret (Figure 1, Table 1).

Survey cities

Survey cities were selected to represent different sizes

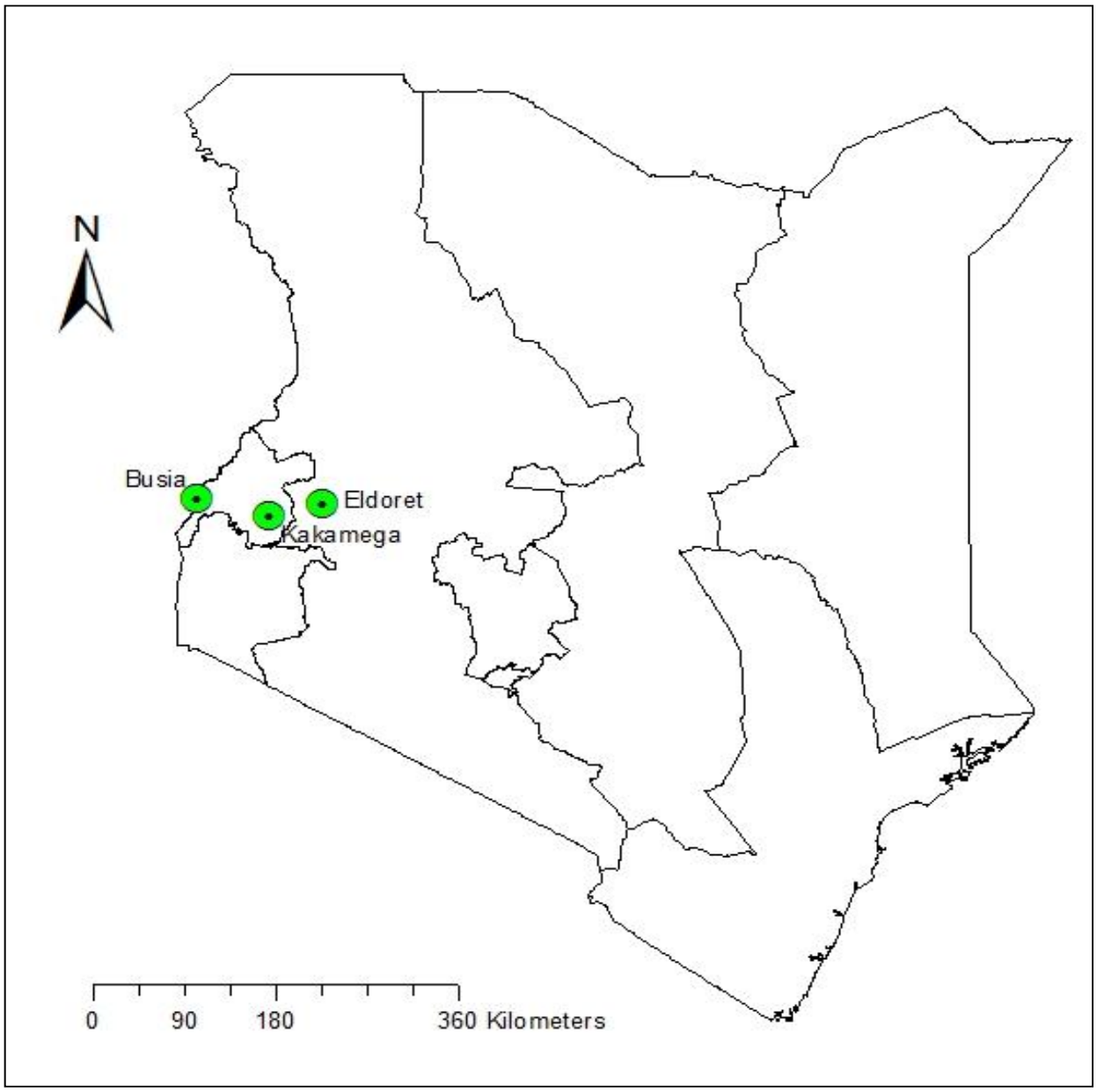

Figure 1. Map of survey sites in Western Kenya: Busia, Kakamega, and Eldoret. Survey locations were concentrated in Western Kenya but selected to represent a wide urban population range and availability of supermarkets.

Table 1. Survey locations and demographics of Busia, Kakamega and Eldoret. Though open air markets were available in each city, supermarkets varied in their number and the availability of produce sections. No supermarkets were surveyed in Busia as none offered fresh produce.

City	Busia	Kakamega	Eldoret
Population†	51,981	91,768	289,380
Supermarkets selling fresh produce	0	3	8
Supermarkets surveyed (sample size)	0	Tusky's (62)	Nakumatt (60) Uchumi (60)
Informal markets surveyed (sample size)	Open air (54)	Open air (50)	Open air (54)
Total sample size	54	112	174

†Source: 2009 Kenya Census.

and stages of supermarket expansion in Western Kenya as documented by Neven and Reardon (2004). Busia, Kakamega and Eldoret each represent a different stage in the progression of supermarket presence but all have local open air markets (Table 1). Busia has only small, independent supermarkets that do not sell fresh produce, representing the very first stage of supermarket development and expansion. Kakamega has two of the larger national chains and only a few supermarkets that sell produce, while Eldoret has a full array of national chains and smaller independent outlets with most offering fresh produce. This allowed us to assess consumer preferences across a range of representative cities in Western Kenya.

Surveys were conducted in the main open air market of each city to represent the informal market sector. Roadside stalls were not included as Lagerkvist et al. (2013) found these two types of markets not to be significantly different. Surveys were conducted in supermarkets carrying AIVs from the top three national chains (Uchumi, Nakumatt, and Tusky's), which together represent 52% of supermarket sales (Neven and Reardon, 2004). Though surveys were only conducted in stores where the management gave permission, these stores represent the largest of the national chains in Kenya with very similar produce sections and prices. Supermarket consumers in Busia were not surveyed, as these locations do not carry fresh produce. Surveys were conducted on multiple days throughout the week and times throughout the day.

Consumer surveys

Consumers over 18 years of age who indicated they were willing to participate in the survey were shown pictures of low, medium, and high quality bundles of nightshade, spider plant, and amaranth (Figure 2). All bundles were the same size within each species, but low quality bundles showed limp leaves, a crushed appearance, and severe wilting. Medium quality bundles were slightly fresher with less physical leaf damage and top quality bundles had crisp, non-wilted leaves and no physical damage. Prices were set in intervals of 5 KSH, from slightly below current market price to slightly above current market price based on the most recent prices quoted by multiple formal and informal vendors. Consumers were asked to select one bundle for each vegetable that they would be most likely to purchase and a series of demographic questions about their age, family size, and education level (Table 2).

Models

Four separate dependent variables were used to construct four probit models; one for each vegetable species and one for consumers who chose all three AIVs at the highest quality. Based on their stated preference for quality, consumers were divided into two groups for each vegetable. Those that chose the highest quality were modeled against all others for each AIV separately, while consistent consumers who chose all three AIVs at the top quality were modeled against all others. Variable definitions and descriptive statistics are shown in Table 2. Respondents who did not complete all questions were not included in the final models.

Data were analyzed with a probit model using the following specification:

$$Y_n^* = \beta' z_n + \varepsilon_n$$

Where Y_n^* = the latent and continuous dependent variable; β' = a vector of parameters to be estimated; z_n = a vector of explanatory variables describing the consumer; and ε_n = a random error term assumed to follow a normal distribution.

The observed consumer response, Y_n, is coded as:

$$Y = \begin{cases} 1 \; if \; the \; respondent \; chooses \; the \; highest \; quality \; bundle \\ 0 \; if \; the \; resondent \; chooses \; one \; of \; the \; other \; two \; bundles \end{cases}$$

The determinants of consumer preference used in the model were selected based on previous research in this area. Purchase location is thought to be associated with consumer preference for high quality produce. The three cities represent distinct levels of supermarket expansion and cultural diversity which may lead to differences in consumer preference and expectations of quality. The type of market at which consumers shop was considered important, as supermarket consumers have been shown to have a higher willingness to pay for both AIVs and their common substitute, kale (Chelang'a et al., 2013; Lagerkvist et al., 2013).

The gender of the respondent was also included as AIVs are largely considered the domain of women in Kenya (Weinberger et al., 2011), though gender was not shown to be significant in willingness to pay a premium for AIVs in general (Chelang'a et al., 2013) or in Nairobi consumers' willingness to pay for cleaner 'safe' certified kale (Lagerkvist et al., 2013). Chelang'a et al. (2013) found income to be positively associated with willingness to pay for AIVs, but consumers' average weekly produce budget is more specific to a consumer's spending on the vegetables of interest and their substitutes. Higher levels of education were found to be positively associated with consumer willingness to pay for both AIVs in Eldoret (Chelang'a et al., 2013) and 'safe' kale in Nairobi (Lagerkvist et al., 2013); and this pattern may extend to preference for quality even at a higher price. AIVs in general are considered 'traditional' foods (Adeka et al., 2009; Figueroa et al., 2008) and therefore, may be more valued by the elderly. In fact, Chelang'a et al. (2013) found that age was positively associated with willingness to pay for AIVs. All of these variables were considered potentially relevant explanatory variables in determining

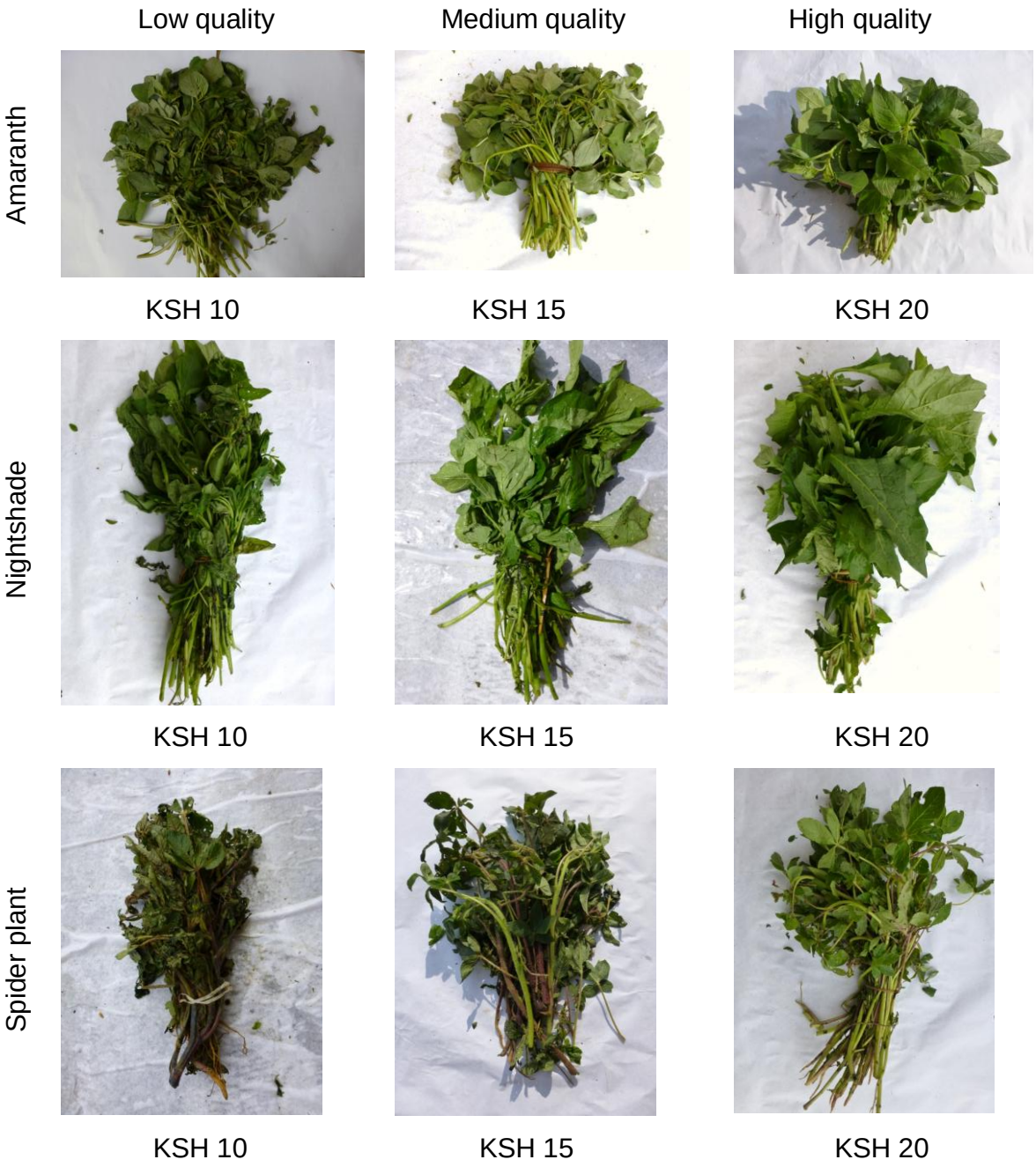

Figure 2. Pictures and prices shown to consumers for bundles of amaranth, nightshade, and spider plant of varying quality. All bundles were the same size within each species, but low quality bundles were selected for their limp leaves, crushed appearance, and severe wilting. Medium quality bundles had slightly fresher appearance with less physical leaf damage. High quality bundles had crisp, non-wilted leaves and no physical damage. Prices were set from slightly below current market price to slightly above current market price based on the most recent prices quoted by multiple formal and informal vendors. Consumers were asked to select one bundle for each vegetable that they would be most likely to purchase.

consumers' preference for higher quality in nightshade, spider plant, and amaranth.

Household characteristics may also influence consumer preference for high quality. Household size may influence a consumer's purchasing habits, as Chelang'a et al. (2013) found that the presence of children under 18 was positively associated with willingness to pay for AIVs. Household involvement in

Table 2. Descriptive statistics of the variables used in the four AIV models (N=311).

Variable name	Definition	Mean	Standard deviation
Nightshade	1 if respondent chose nightshade of the highest quality, 0 otherwise	0.482	0.500
Spider plant	1 if respondent chose spider plant of the highest quality, 0 otherwise	0.628	0.484
Amaranth	1 if respondent chose amaranth of the highest quality, 0 otherwise	0.457	0.499
Consistent	1 if respondent chose the highest quality for all three vegetables, 0 otherwise	0.294	0.457
Busia	1 if respondent is interviewed in Busia, 0 otherwise	0.159	0.364
Kakamega	1 if respondent is interviewed in Kakamega, 0 otherwise	0.329	0.471
Eldoret	1 if respondent is interviewed in Eldoret, 0 otherwise	0.512	0.501
Market type	1 if respondent is interviewed at a formal market, 0 if at an informal market	0.549	0.498
Gender	1 if female, 0 if male	0.579	0.494
Log budget	Log (Average spending on all produce in one week)	5.224	1.457
Garden	1 if respondent has a garden or farm at home, 0 otherwise	0.680	0.467
AIVs	1 if respondent grows AIVs at home, 0 otherwise	0.871	0.336
Primary	1 if respondent has completed primary school, 0 otherwise	0.138	0.346
High S	1 if respondent has completed high school, 0 otherwise	0.409	0.492
College	1 if respondent has completed post-secondary training, 0 otherwise	0.453	0.499
Age	Age of respondent	34.491	11.252
HH size	Number of people in respondent's household	4.859	2.835

AIV production could also affect purchasing preferences. Torjusen et al. (2001) found that consumer and producer perceptions of quality can differ based on the traits that each group considers most important in making up produce quality. The presence of a home garden and specifically growing AIVs may indicate that a customer is more likely to value fresh, high quality produce and regularly consume AIVs.

RESULTS AND DISCUSSION

Consumer preference for the three AIVs differed dramatically between nightshade, spider plant, and amaranth. Though some consistent patterns emerged, it is clear that the market for high quality nightshade, spider plant, and amaranth should target distinct consumer bases. The expanding urban centers of Kenya will form an important market for AIV producers, and this information can be used to better connect farmers and retailers with the most receptive consumers.

Nightshade

Several factors significantly influenced consumer preference for high quality nightshade (Table 3) including gender, budget, and presence of a home garden. Women had an increased probability of choosing high quality nightshade compared to men, even at the higher price ($p = 0.044$). Being female increased the probability of choosing high quality amaranth by 15%. Customers accustomed to spending more on vegetables in general (as represented by their weekly produce budget) had a greater probability of choosing high quality nightshade ($p = 0.072$); for every 1% increase in consumers' weekly produce budget, the probability that consumers would choose the highest quality bundle increased by 4%. A stronger predictor was the presence of a home garden ($p = 0.01$), which increased the probability that consumers would purchase high quality nightshade by 57%. Conversely, the presence of AIVs in home gardens significantly decreased the probability that consumers would choose high quality nightshade by 27%. This could be because consumers with gardens valued access to fresh produce and are more likely to pay for fresh vegetables when they could not produce enough for their own consumption. However, consumers who grow their own AIVs are less likely to pay for high quality nightshade, perhaps because they are already producing enough to meet their needs. The majority of surveyed consumers (68%) did have a home garden but not all grew AIVs, which suggests that there is still a market for high quality nightshade at a premium.

Spider plant

Several factors influenced spider plant consumers' decisions that were distinct from the other two AIVs (Table 4). Consumers who chose high quality spider plant showed much stronger regional patterns than did consumers for either amaranth or nightshade. Keller et al. (2005) show that even within the same region of Tanzania a huge diversity of traditional vegetables exist

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Nightshade	1 if respondent chose nightshade of the highest quality, 0 otherwise	0.482	0.500
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Amaranth	1 if respondent chose amaranth of the highest quality, 0 otherwise	0.457	0.499
Consistent	1 if respondent chose the highest quality for all three vegetables, 0 otherwise	0.294	0.457
Busia	1 if respondent is interviewed in Busia, 0 otherwise	0.159	0.364
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Eldoret	1 if respondent is interviewed in Eldoret, 0 otherwise	0.512	0.501
Market type	1 if respondent is interviewed at a formal market, 0 if at an informal market	0.549	0.498
Gender	1 if female, 0 if male	0.579	0.494
Log budget	Log (Average spending on all produce in one week)	5.224	1.457
Garden	1 if respondent has a garden or farm at home, 0 otherwise	0.680	0.467
AIVs	1 if respondent grows AIVs at home, 0 otherwise	0.871	0.336
Primary	1 if respondent has completed primary school, 0 otherwise	0.138	0.346
High S	1 if respondent has completed high school, 0 otherwise	0.409	0.492
College	1 if respondent has completed post-secondary training, 0 otherwise	0.453	0.499
Age	Age of respondent	34.491	11.252
HH size	Number of people in respondent's household	4.859	2.835

Table 3. Parameter estimates and marginal effects for factors influencing consumer preference for the highest quality nightshade (N = 311, R^2 = 0.101, AIC = 281.54).

Parameter	Estimate	Standard error	t Value	Marginal effect
Intercept	-1.324	0.660	-2.01	
Busia	0.440	0.328	1.34	0.159
Kakamega	0.148	0.219	0.68	0.054
Market type	0.009	0.235	0.04	0.003
Gender	0.402	0.200	2.01**	0.146
Log budget	0.256	0.142	1.80*	0.040
Garden	1.573	0.632	2.49**	0.569
AIVs	-0.758	0.379	-2.00**	-0.274
Primary	-0.167	0.341	-0.49	-0.061
High S	-0.057	0.219	-0.26	-0.021
Age	-0.014	0.009	-1.55	-0.005
HH size	-0.003	0.038	-0.09	-0.001

* indicates $p < 0.10$, ** indicates $p < 0.05$.

with a low degree of overlap between communities only a few hours away from each other. These distinct regional preferences for AIVs are also seen in Western Kenya, as consumers in Busia and Kakamega had an increased probability of purchasing high quality spider plant compared to those in Eldoret by 27% and 19%, respectively. Unlike nightshade and amaranth, spider plant may have an ingrained regional appeal in cities outside of Eldoret. Consumers in Busia and Kakamega may have a stronger traditional background of eating spider plant that increases their probability of paying more for high quality spider plant. Though consumers in Eldoret have the widest array of options in terms of the number of supermarkets and informal markets, they were the least likely to choose high quality spider plant. This may indicate that they would rather find a substitute for spider plant than pay the higher price.

The gender of the consumer was also significant (p=0.099). Female consumers had an increased probability of choosing high quality spider plant than

Table 4. Parameter estimates and marginal effects for the factors influencing consumer preference for the highest quality spider plant (N = 298, R^2 = 0.110, AIC = 258.23).

Parameter	Estimate	Standard error	t Value	Marginal effect
Intercept	-1.837	0.641	-2.87	
Busia	0.807	0.333	2.42**	0.278
Kakamega	0.552	0.232	2.38**	0.190
Market type	0.250	0.244	1.03	0.086
Gender	0.340	0.206	1.65*	0.117
Log budget	0.270	0.138	1.96*	0.040
Garden	1.033	0.606	1.70*	0.356
AIVs	-0.368	0.403	-0.91	-0.127
Primary	-0.259	0.338	-0.77	-0.089
High S	-0.039	0.224	-0.17	-0.013
Age	0.014	0.010	1.40	0.005
HH size	-0.029	0.039	-0.73	-0.010

* indicates $p < 0.10$, ** indicates $p < 0.05$.

Table 5. Parameter estimates and marginal effects for factors influencing consumer preference for the highest quality amaranth (N = 300, R^2 = 0.040, AIC = 282.69).

Parameter	Estimate	Standard error	t Value	Marginal effect
Intercept	-0.423	0.624	-0.68	
Busia	0.293	0.322	0.91	0.111
Kakamega	0.168	0.218	0.77	0.064
Market type	0.195	0.242	0.81	0.074
Gender	0.251	0.202	1.24	0.095
Log budget	0.148	0.142	1.05	0.024
Garden	0.008	0.590	0.01	0.003
AIVs	-0.064	0.371	-0.17	-0.024
Primary	0.075	0.325	0.23	0.028
High S	-0.111	0.216	-0.51	-0.042
Age	-0.012	0.009	-1.32	-0.005
HH size	0.014	0.036	0.40	0.005

* indicates $p < 0.10$, ** indicates $p < 0.05$.

males by 12%, similar to the pattern for nightshade consumers. A higher budget allotment for produce was a good predictor of consumers' quality preference; an increase of 1% in produce budget corresponded with a 9% increase in consumers' probability of choosing high quality spider plant. The presence of a garden was another positive and significant predictor of consumer preference for spider plant. Having a garden at home increased the probability that a consumer would choose high quality spider plant by 36%, but in this case, there was no significant effect of growing AIVs at home on consumer preference for spider plant. This indicates that whether or not AIVs are grown, if a consumer has a home garden they will be more likely to select high quality spider plant, perhaps because they value fresh produce enough to grow it themselves.

Amaranth

Parameter estimates and marginal effects for the amaranth quality model are shown in Table 5. Location, market type, gender, produce budget, presence of a garden, age, education level, and household size were not statistically significant for predicting the probability of consumer preference for amaranth of the highest quality. Age, education, market type, and number of children were significant in predicting consumer willingness to pay for AIVs (over other kinds of available vegetables)

Table 6. Parameter estimates and marginal effects for the factors influencing consumer likelihood of consistently purchasing all three vegetables at the highest quality (N = 282, R^2 = 0.032, AIC = 317.80).

Parameter	Estimate	Standard error	t Value	Marginal effect
Intercept	-1.394	0.491	-2.84	
Market type	0.081	0.198	0.41	0.027
Gender	0.395	0.185	2.13**	0.132
Log budget	0.288	0.149	1.93*	0.096
Primary	0.013	0.274	0.05	0.004
High S	-0.099	0.192	-0.52	-0.033
Age	-0.001	0.008	-0.18	-0.001

* indicates $p < 0.10$, ** indicates $p < 0.05$.

(Chelang'a et al., 2013) but none of these parameters significantly impacted consumer preference for high quality amaranth. Our results show that amaranth did not follow the consumer choice patterns of other AIVs like nightshade and spider plant and that treating AIVs as a homogenous unit may overlook critical differences in AIV quality preferences. Consumer preference for high quality amaranth at a premium may be different because unlike other AIVs, amaranth has broad appeal that transcends demographics or amaranth quality may not be as important to consumers. Though other high quality AIVs appeal to specific sections of consumers, amaranth does not follow this pattern. This could indicate that investing in postharvest handling to bring amaranth to market at the highest quality may not be as important, as there is no clear market incentive.

Consistent high quality purchasers

Despite differences in consumer preference for the three AIVs, 30% of surveyed consumers consistently chose bundles of the highest quality for all three. These consumers represent an important market for AIV retailers in both informal and formal markets because they regularly prefer quality produce even at a premium price. Identifying and marketing toward these consumers will help AIV growers realize a higher profit by grading their produce or investing in postharvest handling.

Parameter estimates and marginal effects used to model consumers who consistently chose high quality AIVs are shown in Table 6. To capture this consistency in purchasing patterns, gender was identified as the most significant predictor of consumer consistency across all three AIVs. Compared to men, women had an increased probability of 13% to consistently choose high quality AIVs. There was a positive association between consumers' produce budgets and likelihood of consistently choosing high quality AIVs as well; for every 1% increase in consumers' weekly produce budget, the probability that they would consistently choose all three highest quality bundles increased by 10%. These data suggest that farmers should target their highest quality produce to consumers who are female and who tend to spend more money on produce as these are the most consistent determinants of consumer preference for high quality AIVs.

The variables that did not have a significant effect on consumers' probability of choosing high quality vegetables are also meaningful when looking at consumer trends. The most surprising result was the lack of significant differences between open air markets and supermarkets. Even though formal market consumers were willing to pay more for AIVs in general (Chelang'a et al., 2013) and 'safe' kale (Lagerkvist et al., 2013) these consumers did not display significant differences in their preference for quality. Supermarkets generally charge more for produce than open air markets (Chelang'a et al., 2013), but sometimes carry produce of inferior quality compared to open air markets due to the long travel time from their source locations in Nairobi. Formal market consumers may value the convenience of supermarket shopping (even at higher prices) and be willing to accept slightly lower quality produce. This could lead to the lack of relationship found between consumer preference for quality and the type of market outlet.

The estimates of coefficients for education levels were not significant in any model ($p > 0.40$) suggesting that the probability of consumers choosing high quality AIVs does not change with education level. This is despite the positive relationships between education level and willingness to pay for organic vegetables, 'safe' kale, and AIVs (Chelang'a et al., 2013; Lagerkvist et al., 2013; Probst et al., 2012). Consumers aware of the hazards of pesticides, benefits of good sanitary practices, and nutritional qualities of AIVs may reflect this in their willingness to pay for these vegetables, respectively, but this does not necessarily translate to vegetable quality in terms of appearance. Fresher leafy vegetables may have improved taste and nutrition, but vendors in open air markets commonly keep vegetables looking fresh by moistening them with dirty water kept in a bucket (Lagerkvist et al., 2013). This may deter customers

interested in cleaner, safer produce, which Lagerkvist et al. (2013) have shown tend to have higher education levels. However, if an alternative method of postharvest handling was used to keep leafy vegetables' appearances fresh then it is likely that this would appeal to a broader consumer base.

Consumer age was not a significant factor in any of our models, suggesting that high quality AIVs are preferred by people of all ages. Though there is a positive association between age of the consumer and willingness to pay for AIVs (Chelang'a et al., 2013), our result may indicate that this pattern does not translate to consumer preference for high quality AIVs. Older consumers are more likely to have young children at home, which have been shown to be positively associated with a higher willingness to pay for AIVs, but the number of people living in the consumers' household did not significantly affect their likelihood of purchasing a higher quality bundle. AIVs are perceived as 'traditional foods' (Adeka et al., 2009; Figueroa et al., 2008) and may be less appealing to younger consumers, but perhaps awareness of the high nutritional content increases parents' willingness to pay for them. The number of people living in the consumer's household does not necessarily have any association with preference for quality, but because our study did not distinguish between children living at home and other family members, no association was found. Our result does show that people across age groups and family sizes are no more or less likely to prefer high quality AIVs and may make up a large market for this produce.

Conclusions

The expanding market for AIVs in Kenya's growing cities (Mwangi and Kimathi, 2006) creates opportunities for AIV growers that they can best address only with the most current market information. Currently, informal markets still hold the vast majority of the AIV market, but supermarkets are growing and developing rapidly and will be an important part of the market for AIVs in the future. By improving and disseminating up-to-date market information, growers can maximize profits, retailers can fill market gaps, and consumers can consistently access high quality AIVs.

Consumer preferences differed among AIV species as did the parameters that significantly influenced their likelihood of purchasing high quality vegetables. Consumers in open air markets and supermarkets show no significant differences in preference for high quality nightshade, spider plant, or amaranth, which suggests that there could be a market for top quality AIVs at both market outlets. With the expanding urban market, this confirms the presence of opportunities for higher profit for AIV growers at both outlets. None of the parameters found to significantly influence consumer willingness to pay for 'safe' kale (Lagerkvist et al., 2013) were also found to significantly impact consumer preference for high quality AIVs, suggesting that the markets for exotics (like kale) and AIVs are governed by very different patterns.

Although previous research has focused on AIVs as a whole (Adeka et al., 2009; Chelang'a et al., 2013; Okeno et al., 2012), our findings suggest that studying them as a homogenous group may gloss over critical differences between unique species. Nightshade preference was strongly influenced by the gender and budget of the consumer as well as the presence of a home garden and growing AIVs, while spider plant was highly regionally-dependent in consumer preference. Amaranth consumers followed none of these trends, as indicated by the lack of significance for any of the parameters. Consumers who consistently chose high quality nightshade, spider plant, and amaranth did show some common patterns (being female and spending more on produce in general) but most variables differed greatly in significance for each species.

Overall, 71% of the consumers surveyed chose at least one AIV in the highest quality category, a strong indication that consumers in Western Kenya are willing to pay slightly more for AIVs of the best quality. Producers supplying these markets could make a higher profit by either grading their produce or investing in postharvest handling practices to deliver top quality AIVs to formal or informal markets. This result has policy implications for linking farmers to markets and connecting better market information to those who stand to benefit. These policies could include encouraging local and regional governments to invest in the physical infrastructure and agricultural extension capacity necessary to bridge the gap between growers and consumers. This would allow all stakeholders to benefit from better addressing consumer demand and compensating farmers fairly for producing a high quality product.

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