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Post-harvest processing, storability and quality attributes of Indigenous vegetables among producers and consumers in Kenya

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Abstract

Indigenous vegetables form a key component of farming systems in most communities in Africa including Kenya. Its increased awareness and utilization has been attributed to its reported superior nutritional quality, medicinal value and ecological adaptability to existing weather conditions. Utilization of these vegetables among low, middle and high income earners in Kenya has improved tremendously and this calls for high quality vegetables to maintain confidence. Improved information on production methods has resulted in high production volumes hence the need for processing and storage techniques. Objective of this research was to evaluate the consumer quality attributes associated to indigenous vegetables as well as processing and storage methods being used. Structured questionnaires for producers, wholesalers and retailers were used for data collection among different categories of consumers. Storage among producers is based on natural weather conditions by use of shade and no specialized storage facilities are used. Processing of these vegetables by retailers is minimal with a few cutting the vegetables in to ready to cook product. Majority of the consumers had preference for fresh vegetables that had minimal or no blemishes. Pesticide and chemical fertilizer use was not considered much by consumers when buying these vegetables. The pertinent quality aspect of these indigenous vegetables that has a direct influence on health of consumers seems to be overlooked. The production of IVs in towns has to be monitored to avoid use of sewage water and other industrial wastes for health reasons.

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Introduction

Customers are increasingly influencing agrifood markets through product choice, shopping patterns and preference of different types of retail outlets (Vermeulen *et al.*, 2008). In developing countries, the growth of urban populations and growing middle class is dramatically reshaping demand. In all countries, media attention and lobbying groups are bringing issues of health, fair trade, and environment to consumer's attention. This creates new market opportunities, affects standards, product differentiation and marketing strategies (Vermeulen *et al.* 2008). Companies' interest is to become market oriented by continuously creating superior customer value. This requires understanding consumers' preferences and requirements, and effectively deploying satisfying skills and strategies (David *et al.* 2009). Currently, companies are interested in knowing consumers' attitudes toward their products because this influences consumer purchase and consumption intention.

Several local studies including; Auma, (2007) and Chepyegon, (1996) show the importance of understanding consumer attitude towards product quality. Attitude of an individual towards some quality attributes, help predict consumer behavior, which is a basis for expressing their values and help supply standards and frames of reference that allow people to organize and explain world around them. The more favorable a consumer's attitude toward a product is, the higher the usage rate and vice versa. Vegetables quality attributes are classified into three namely; external (appearance, feel and defect), internal (taste, internal texture), Hidden (nutritive value, food safety). External attributes play an important role in a consumer's purchasing decision, whereas internal or hidden attributes often affects a consumer's decision to repurchase a product. The combination of external, internal and hidden attributes determines the overall acceptability of a product. To tailor quality attributes according to consumer demands is an important vehicle to

increase consumer satisfaction, repeated purchase and higher margins.

Product quality is defined as the totality of features and characteristics of a product that bear on its ability to satisfy stated or implied needs (Kotler, 2003). Drewnowski and Popkin (1997) observes that designing and delivering a product that fully satisfies consumers' needs and want is a prerequisite for successful marketing, regardless of whether the product is tangible good, service or organization and is a prime criterion in gaining access to competitive markets.

Approximately 220 indigenous species are utilized by various communities in as vegetables, reflecting the rich diversity of cultures and agro-ecological zones (Maunduet *et al.*, 1993). Indigenous vegetables (IVs) in the past contributed significantly to the nutrition of communities. However, since the onset of the market economy, official agricultural policy has concentrated on promoting crops with potential for export, which effectively relegated indigenous crops and traditional farming to negligence. This, coupled with pressure to bring more land under cereals, commercial crops (e.g. tea, coffee) and human settlement, has greatly contributed to the current state, whereby most indigenous vegetable species have not only fallen into disuse, but are also under threat of extinction due to genetic erosion occasioned by habitat loss (Chweya & Eyzaguirre, 1999). In effect, the above scenario not only reduced biodiversity in farming systems and natural habitats, but also dietary diversity, leading to increased prevalence of micro-nutrient malnutrition.

The most nutritionally vulnerable population segments are the resource-poor rural communities who derive their livelihoods from subsistence farming. Also vulnerable are the urban poor, where over-consumption of high-energy foods and low intake of micronutrient-rich foods have led to increasing prevalence of cardiovascular diseases, diabetes and obesity. Dietary diversification is widely

perceived as an important factor in providing quality nutrition; whereby focusing on increased consumption of vegetables, fruits and legumes is proposed as the most sustainable intervention to control micronutrient deficiencies as well as generate employment and incomes through labour-intensive production. Recent studies in Kenya and Tanzania have reported increased use of IVs at the expense of exotic vegetable species, citing availability, cost and cultural value as reasons for this trend (Weinberger and Msuya, 2004).

Following reawakened interest in IVs and their commercial and nutritional potential, as well as subsequent promotion campaigns, notable increase in commercial production and marketing of several IVs has been reported, mostly in the fresh produce rural and urban markets. In addition, the profile of IVs has risen so significantly that nowadays, it is possible to find IVs being marketed by major retail outlets, including supermarket chains.

It's on this basis that documentation of consumer preferences, attitudes and quality attributes of African Indigenous Vegetables in urban and peri-urban regions of Kenya is important for promotion and utilization of the vegetables.

Materials and methods

Nairobi is the capital and largest city of Kenya and also the capital of Nairobi Province. The city is located at 1°17'0"S, 36°49'0"E, lies along the Nairobi river, and has an elevation of 1661 m (5450 ft) above sea level. It is the 4th largest city in Africa and the most populous city in East Africa, with an estimated urban population of between 3 and 4 million occupying approximately 684 km²; translating into a population density of 4230/ km². the climate is fairly moderate, with daytime average temperature of 25°C of mid-twenties during most of the year. Kisumu is the administrative headquarters of Nyanza Province, and the main commercial center in western Kenya. It has a population of 504,000 and a land area of 919 km². The main industries are subsistence agriculture and fishery on Lake Victoria. Kisumu is located in a humid agro-ecological zone, with average rainfall of 1150mm, and minimum and maximum temperatures 18°C and 29°C respectively.

A survey of selected urban and peri urban markets in Kisumu and Nairobi cities was conducted. This was done between October and December 2006 in Nairobi and Kisumu. 210 respondents were targeted in each city. To aid in sampling, a comprehensive list was made of all markets and potential IV production areas in both cities (Table 1).

Table 1. Survey areas in Nairobi and Kisumu Cities.

<u>KISUMU</u>		<u>NAIROBI</u>	
Markets	Production areas	Markets/production areas	
Kibuye (U)	Nyamasaria-Dunga (U)	Githunguri (PU)	Kenyatta market (U)
Jubilee (U)	Kiboswa (PU)	Githurai 44/45/ (U)	City market (U)
Nyamasaria (PU)	Kanyakwar (LBDA area) (U)	Wangige (PU)	Retail market (U)
Rabuor (PU)	Ahero (PU)	Kitengela (PU)	Dandora (U)
Ahero (PU)	Kisian-Kombewa (PU)	Ngong (PU)	Village market (U)
Maseno (PU)	Kibos-Chiga area (U?)	Kiserian (PU)	Uchumi (U)
Ojolla (PU)	Maseno (PU)	Kiambu (PU)	Buruburu (U)
Otong'lo (U)	Mamboleo-Wathorego area (U)	Kahawa West (PU)	Eastleigh (U)
Kiboswa (PU)		Kibera (U)	Lang'ata (PU)
Kondele (U)		Adam's Arcade (U)	Rongai (PU)
Nyalenda (U?)		Dagoretti corner (U)	Banana (PU)
Gambogi (PU)		Kikuyu (PU)	Mathare (U)
Kombewa (PU)		Kinoo (PU)	Gikomba (U)
Nakumatt (U)		Uthiru (U)	Kariokor (U)
Uchumi (U)		Kawangware (U)	Kenyatta University (PU)
Manyatta (U)		Runda (U)	Juja (PU)

Markets and production areas to be surveyed were then selected from the list based on a stratified approach, whereby 70 respondents of each type (i.e. farmers, retailers and middlemen) were targeted in each city. Each respondent category was further stratified by defining high and low intensity production areas and markets in each city, and further into urban and peri-urban areas. To ensure

equal distribution of survey areas, a maximum of 10 respondents was targeted initially per production area/market. However, if more than 10 respondents were present in a particular production area/market it was re-visited to make-up the shortfall in other target areas/markets. Table 2 shows respective numbers of each respondent type interviewed in each city.

Table 2. Number of IV farmers, retailers and wholesalers interviewed in Nairobi and Kisumu.

<i>Respondent category</i>	<i>Kisumu</i>	<i>Nairobi</i>
Farmers	77	64
Retailers	76	80
Wholesalers/collectors/transporters	63	75

Data were entered into a MS excel sheet and analyzed descriptively

Results

Quality attributes and food safety of IVs

Generally, food safety parameters such as fertilizer residues, pesticide residues, presence of food-based pathogens, certification schemes, sorting and grading were not important for customers buying IVs from Kisumu farmers and wholesalers in both cities. However, they were important for customers buying from farmers in Nairobi, as well as retailers in both cities (Table 3); indicating a higher degree of awareness about food safety issues among customers buying from retailers.

Considering that consumers would normally buy IVs from retailers, it may be inferred here that food safety is an important issue for most consumers. However, the fact that majority of wholesale customers (retailers) seemingly do not think that such aspects are important might be cause for concern. Generally however, only a few respondents indicated ignorance of issues such as origin, sorting and packaging of IVs, particularly customers buying IVs from retailers in Nairobi. It may therefore be inferred that most customers of IVs were actually aware of the various food safety issues, but didn't think that these issues are really important such that, for example, presence

of pesticide residues in IVs wouldn't essentially affect a customer's decision whether to buy or not.

Quality attributes including color, shape, size, origin of IVs and, particularly freshness, were considered important by majority of customers buying IVs from farmers in Kisumu, retailers in Nairobi, and wholesalers in both cities; but were not considered important for majority of customers buying from farmers in Nairobi and retailers in Kisumu (Table 3).

Value addition and processing

Farmers in Kisumu do not process IVs. Similarly in Nairobi only a few farmers process amaranth (Table 4). But retailers and wholesalers do some processing of the IVs in both cities. In Kisumu 22.1% of both retailers and wholesalers process while in Nairobi 21.3% and 13.3% process IVs respectively (Table 4). Among retailers in Kisumu, cowpea was commonly processed, followed by slenderleaf and amaranth respectively, and nightshades were most processed in Nairobi by retailers.

Table 3. Quality attributes and food safety issues important to customers in Kisumu and Nairobi.

	Kisumu									Nairobi									
	No (%)			Yes (%)			Don't know (%)			No (%)			Yes (%)			Don't know (%)			
	F	R	W	F	R	W	F	R	W	F	R	W	F	R	W	F	R	W	
colour	10.4	90.9		84.4	7.8	100.0	1.3			8.7	2.5	5.3	12.8	97.5	94.7				
price	7.8	92.2		85.7	7.8	100.0				23	2.5	4.0	10.4	97.5	96.0				
shape	14.3	92.2	1.6	80.5	7.8	98.4				7.5	6.7	16.8	92.5	93.3					
size	14.3	96.1	3.2	80.5	2.6	96.8	1.3			66.8	1.3	4	16.8	97.5	96.0			1.3	
freshness	1.3	96.1		93.5	3.9	100.0				32.5		2.7	3.2	100.0	97.3				
origin	42.9	67.5	33.3	60.0	28.6	66.7	3.9			33.6		9.3	45.2	36.3	90.7			63.8	
fertilizer	83.1	19.5	92.1	9.1	72.7	8.0	7.8			13.2		82.7	82.1	86.3	13.3			13.8	4.0
pesticides	79.2	14.3	87.3	16.9	76.6	9.5	9.1	3.2	2.1			89.3	77.2	87.5	8.0			12.5	2.7
pathogens	74.0	5.2	85.7	20.8	79.2	6.3	15.6	7.9	25.8			86.7	77.2	87.5	8.0			7.5	5.3
certification	71.4	3.9	90.5	23.4	79.2		16.9	9.5	71.2			86.7	68.9	87.5	1.3	5.9	2.5	12.0	
sorting	58.4	49.4	58.7	36.4	42.9	38.1	7.8	3.2	58.7			52.0	56.3	35.0	44.0			65.0	1.3
packaging	64.9	49.4	55.6	22.1	41.7	44.4	5.2	9.1		55.7		38.7	65.4	25.0	60.0			75.0	1.3

NB: F= farmer, W= wholesaler, R= retailer, IV= indigenous vegetable

Table 4. Processing of IVs in Kisumu and Nairobi.

	<u>Kisumu (%)</u>			<u>Nairobi (%)</u>			IV	<u>Kisumu (%)</u>		<u>Nairobi (%)</u>		
	F	R	W	F	R	W		R	W	R	W	F
Do not process (%)	97.4	77.9	77.9	95.3	77.5	86.7	Amaranth	13.0	14.3	16.3	12.0	4.9
Do process (%)	0	22.1	22.1	4.7	21.3	13.3	Spiderplant	15.6	12.7	16.3	12.0	3.1
							Pumpkin leaves	6.5	9.5	15.0	10.7	3.1
							Nightshade	10.4	12.7	18.8	12.0	3.1
							Cowpea	18.2	14.3	16.3	10.7	3.1
							Jute mallow	11.7	9.5	13.8	8.0	3.1
							African kale	6.5	1.6	12.5	4.0	
							Crotalaria	14.3	11.1	11.3	6.7	

NB: F= farmer, W= wholesaler, R= retailer, IV= indigenous vegetable

Wholesalers in Kisumu processed amaranth and cowpea to equal extent while cowpea and pumpkin leaves were most processed by wholesalers in Nairobi (Table 4). The vegetable processed varied with actors, but cowpea was most commonly processed in both

cities. Processing of IVs by different actors was purely to attract customers and no monetary value was attached to it.

Preservation methods

Table 5. Mode of preservation of IVs after harvesting by farmers in the two cities.

Mode of preservation	Kisumu (%)	Nairobi (%)
No storage	14.3	3.1
On the ground under a shade	49.4	50.0
On the ground under the sun	1.3	1.6
In baskets	18.2	1.6
In plastic bags	6.5	1.6
In plastic sacks	5.2	23.4
On ground unknown		3.1

Preservation of IVs before sale was done by farmers in Kisumu, majority of whom kept their IVs on the ground under a shade while others used baskets and plastic bags (Table 5); but others didn't preserve at all. In Nairobi, 50% of farmers kept their IVs on the ground under shade, 23.4% of used plastic bags. 3.1% did not preserve compared to 14.3% of farmers in

Kisumu (Table 5). Generally limited preservation of IVs is attributable to their perishability and widespread consumer preference for fresh vegetables, hence a ready market for fresh IVs at both retail and wholesale level.

Packaging

Table 6. Packaging (% respondents) of IVs by farmers, retailers and wholesalers.

Type of packaging	Kisumu			Nairobi		
	Farmers	Wholesalers	Retailers	Farmers	Wholesalers	Retailers
Plastic bags	72.7	9.5	7.8	81.5	4.0	2.5
Sacks		57.1	57.1		68.0	62.5
Bamboo baskets	7.8	4.8	1.3		1.3	
Bundles		15.9	19.5		38.7	60.0
Polyethylene bags	2.6			18.5		
Loose		14.3	16.9		9.3	12.5
Crates						1.25
No packaging	13.0					

Most farmers in Kisumu used plastic bags (73%), and only 7.8% and 2.6% used bamboo baskets and polythene bags respectively (Table 6) to package their IVs. In Nairobi plastic bags (81.5%) and polythene bags (18.5%) were the only packaging materials used. Preference for plastic bags could be due to their low cost relative to other packaging materials. Also, farmers characteristically transport IVs in small volumes for short distances, which do not require strong packing material.

bundles before putting them in the sacks (Table 6). Use of sacks is attributed to their large size which can contain bigger volumes of vegetables without much damage for longer periods and or distances.

Sacks were used by over 55% of both retailers and wholesalers in both the cities to package IVs (Table 6). Most retailers in Nairobi packed their IVs in

Over 60% of wholesalers in Kisumu repackage their IVs as compared to 70% in Nairobi; and many retailers (92%) in Kisumu repackage their IVs as compared to 80% in Nairobi (Table 7). The main form of repackaging by wholesalers were sacks and bundles (Table 7); while most retailers repackaged their IVs in bundles and only a few retailers in Nairobi repackaged their IVs in sacks.

Table 7. Percentage of actors repackaging their IVs and type of repackaging carried out.

	<i>Kisumu</i>		<i>Nairobi</i>		Packaging material	<i>Kisumu</i>		<i>Nairobi</i>	
	W	R	W	R		W	R	W	R
Don't repackage	37	8	29	20					
repackage	63	92	71	80	plastic bag	10.0	3.9		
					cartons				
					sacks	21.0		14.7	1.3
					wood boxes				
					bamboo baskets				
					poly bags				
					crates				
					plastic containers				
					bundles	51	87.0	69.3	88.5
					loose	6	14.3	5.3	15.0
					N/A			21.3	

NB: W= wholesaler, R= retailer

Over 60% of wholesalers in Kisumu repackage their IVs as compared to over 70% in Nairobi (Table 5.4). Many retailers (92%) in Kisumu repackage their IVs as compared to 80% in Nairobi (Table 7). The wholesalers mainly repackage the IVs in sacks and bundles (Table 7). Similarly over 80% of the retailers in Kisumu and Nairobi repackage their IVs in bundles. No retailers in Kisumu were found to repackage their IVs in sacks while in Nairobi they were very few (1.25%).

Production and commercialization constraints

Lack of capital was a common constraint to increased production and commercialization of IVs for majority of supply chain players in both cities, with over 50% of all respondents identifying it as a major constraint, except in peri-urban Nairobi and Kisumu, where 42% and 38% of respondents considered capital a constraint (Table 8). Lack of land was a major constraint for farmers, particularly in Nairobi, where 78% and 44% of respondents in urban and peri-urban identified it as a constraint, compared to 19% and 38% in Kisumu respectively.

Lack of quality seeds was only a major problem for farmers in peri-urban Kisumu (45%), while labor was identified as a major problem for 31% of farmers in urban Kisumu. Other constraints identified by

significant portions of respondents included competition, particularly for all retailers and wholesalers in urban areas of both cities (Table 8). Climatic reasons were commonly identified as a major constraint by considerable portions of the respondents. However the term was ambiguous and not easily definable. E.g. while climatic reasons for farmers might mean drought, it might take a totally different aspect for wholesalers and retailers, to whom it might mean too much rain disrupting trade in open air markets. Food taboos, poor infrastructure and pests and diseases were generally not considered as major constraints by most respondents. However, as commercialization of IVs increases, it might be expected that pests and diseases will become a more important constraint.

Summary and conclusions

Very limited value addition / processing of IVs s undertaken by all supply chain actors in both cities. The most common form of processing was sorting, de-stalking and shredding of IVs, particularly by retailers and other actors who sell their IVs directly to consumer. There is often no monetary value attached to the processing by most sellers. Rather, the processing is done to attract more customers by making it more convenient for them to prepare the vegetables. Furthermore, the limited

preservation/processing of IVs is largely attributable to the overwhelming preference of a great majority of consumers for the fresh vegetables over processed (e.g. dried) products. Most wholesalers and retailers repackaged IVs upon receiving them, most often into bundles, for easier selling. If IVs had been bundled, it

was common for the trader, especially retailers, to reduce the size of the bundle into two or three smaller bundles.

Table 8. Production and commercialization constraints in Kisumu and Nairobi.

	Kisumu						Nairobi					
	<u>Peri urban (%)</u>			<u>Urban (%)</u>			<u>Peri urban (%)</u>			<u>Urban (%)</u>		
	F	R	W	F	R	W	F	R	W	F	R	W
lack capital	37.9	63.3	63.3	58.3	70.8	72.7	41.8	50.0	60.0	55.6	58.3	54.4
lack quality seeds	44.8	3.3	16.7	25.0			14.5		4.0	11.1	1.4	1.8
lack manpower	10.3	3.3	6.7	31.3		3.0	7.3				1.4	
poor infrastructure	6.9	3.3	13.3	8.3	2.1	12.1	3.6	12.5	12.0	11.1	2.8	10.5
market price is low	6.9	10	26.7	2.1	10.4	12.1	9.1	37.5	4.0	11.1	18.1	8.8
Food taboos											1.4	
competition		26.7	16.7	2.1	20.8	33.3	3.6	37.5	12.0	11.1	33.3	28.1
climatic reasons	37.9	53.3	63.3	33.3	18.8	24.2	29.1	12.5	28.0	33.3	47.2	26.3
pests and diseases	3.5			10.4			1.8				1.4	
Lack of land	37.9	3.3		18.8	12.5	6.1	43.6	25.0	24.0	77.8	12.5	10.5

NB: F= farmer, W= wholesaler, R= retailer, IV= indigenous vegetable

Lack of capital was the over-arching constraint for majority of IV producers, wholesalers and retailers. In addition, lack of land was a major constraint for producers in Nairobi, while lack of good quality seed was a major constraint for producers in Kisumu. Pest and diseases were not major constraints for IVs, but it was quite surprising that few players identified poor infrastructure as a major constraint. Very limited contracting was practiced by IV producers and trader in both cities.

Despite a relatively high degree of awareness regarding food safety issues such as fertilizer residues, pesticide residues, the presence/absence of food based pathogens, and quality assurance issues such a certification, sorting and grading, these were not likely to be major factors for most consumers in making the decision whether to buy or not. Rather, freshness, color, shape and size of the IV product were important attributes for majority of customers.

Many customers in urban areas of both cities were, however, often interested in knowing the origin of the IVs, mainly because producers in certain areas are known to use untreated sewage effluent to irrigate vegetables.

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