

Full Length Research Paper

Development of market opportunities through post-harvest processing of the African indigenous vegetables in Tanzania

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African indigenous vegetables (AIVs) have gained prominence in the recent past due to nutritional and health benefits. The low requirement for high value inputs has enabled low resource farmers to practice AIVs production. There have been improvements in the production of high quality AIVs seeds as well as more production of the AIVs leaf and fruits. As a consequence, there are occasional gluts of the AIVs leaf and fruit especially during the main production season. This study examined the challenges associated with production of processed AIVs and possible market opportunities using data from 10 AIVs processing groups and 21 key informants that were purposively selected. Data were analysed using descriptive statistics and thematic analysis. It was established that processors did not have the necessary skills, knowledge and training required for processing of AIVs in more economically attractive ways. There was no diversity in the processing methods and processed products. Types and sources of packaging materials were restricted in various respects. Processors did not have special storage facilities for the AIVs. The share of processed AIVs in the total consumption of the vegetables was 25%. Sixty percent of those interviewed stated that the demand for all types of processed AIVs was increasing. Many institutions were supporting processing of AIVs. Quality of processed AIVs was perceived to be same as that of the fresh AIVs. Consumers were willing to pay more money for better quality processed AIVs. In order to increase sales of processed AIVs there should be informal agreements, partnerships or contracts depending on the degree of relationship between processors and consumers to guarantee target markets. Tanzania Bureau of Standard (TBS) and Tanzania Food and Drugs Authority (TFDA) need to create awareness regarding the specific quality requirements for processed AIVs. Training should be provided on different processing methods and the range of products that could be produced for different consumers. There should be financial support and/or linking of processors with the different credit institutions. It is necessary to provide processing infrastructure and training on marketing of the processed products. Specific requirements for the premises, processing rooms and standards should be explained to the processors to assure the requisite quality. Product branding has to be undertaken especially at two levels, which are indicating the key attributes of AIVs on the packages and certification by TBS and TFDA as well as having their labels on the containers of the packed products.

Key words: Vegetables, processors, quality, storage, demand, target markets.

INTRODUCTION

African indigenous vegetables (AIVs) have gained prominence in the recent past (Abukutsa-Onyango et al., 2006). Among the key reasons for this have been the recently documented nutritional and health benefits (Lotter et al., 2014). The low requirement for high value inputs has been one other reason, which has enabled low resource farmers to practice AIVs production (Rajendran et al., 2015).

Previous studies indicate limited access to high quality seeds (Karanja et al., 2014). This was addressed by CABI, World Vegetable Center, HORTI-Tengeru and other collaborators. Several approaches have since enabled the growers to have access to good quality seed. Contract farming, research mediated approaches and quality declared seed are the key mechanisms that now facilitate farmer access to improved seeds of AIVs (Rajendran et al., 2016). Production practices have also been improved through facilitation by the extension officers of different government entities and other organizations.

These endeavours have led to improvements in the production of high quality AIVs seeds as well as more production of the AIVs leaf and fruits for the consumers. Following on these have been situations where there were occasional gluts of the AIVs leaf and fruit especially during the main season of production (that is the rain season). In some instance there have been good sales of the fresh AIVs by the producers but sometimes there are wastages. AIVs are perishable and have high price fluctuations, which makes them risky to produce. One key opportunity to avoid unnecessary losses is by increasing the shelf life of the AIVs through processing.

Habwe et al. (2008) argue that the purpose of traditional food processing is preservation to maintain a supply of wholesome, nutritious food during the year and especially for the time of scarcity. Such an approach would expand the market opportunities for the AIVs.

This is because it would be possible to store for relatively longer than in the case of fresh vegetables and sell at prices that allow adequate profits for continuity of the business, and also during times of limited supply. The expectation is that the existing and prospective processors would upgrade their production processes or diversify their product range in order to reach new markets.

Processed AIVs are important cash crops that can be produced in small amounts by the small scale traders (Okado, 2000). These could also work as part of the commercialization of the smallholder AIVs farms. It could also help the farmers to diversify their agriculture and

increase cash incomes. Based on the foregoing, a few groups were trained on vegetable processing in Arusha and Dodoma Regions of Tanzania. The intention was to assure sustainability in production of fresh and processed AIVs.

Success indicators in this endeavour have not been isolated hence the need to examine the possible market opportunities and challenges associated with processing of the AIVs. This study addressed these issues by achieving two objectives which were;

1. To examine AIVs processing scenario and
2. To identify and document challenges and opportunities for trained vegetable processing groups.

LITERATURE REVIEW

AIVs have been part of the food systems in sub-Saharan Africa for generations (Gilbert et al., 2011). AIVs have gained prominence in the recent past due to consumer appreciation of their health and nutritional benefits (Lotter et al., 2014; Takemore et al., 2014; Abukutsa-Onyango et al., 2006).

Attitudes about AIVs consumption have also changed and as a consequence there are increases in quantities consumed by the different categories of consumers (ESRF, 2010; Shazia et al., 2007). Activities and efforts to promote the production and consumption of AIVs have as result been undertaken by different stakeholders (Rajendran et al., 2015; Rajendran et al., 2016; Karanja et al., 2011; Shiundu and Oniang'o, 2007). These efforts have been accompanied by increases in production of AIVs. However, most farmers depend on rain fed farming and all harvest at the same time. This results in overproduction and difficulties to sell all produce and as a consequence a lot of the produce rots (Marg et al., 2008; Edmond et al., 2008).

Vegetables are highly perishable; they start to lose their quality right after harvest and continue throughout the process until it is consumed. This poses major challenges in distribution and marketing. For this purpose elaborate and extensive marketing channels, facilities and equipment are vital. This behaviour of vegetables makes the commodity not to be held for long periods and fresh produce from one area is often sent to distant markets without a firm buyer or price (Osano, 2010).

According to Putter et al. (2007) another dynamic of fresh fruit and vegetable sub-sector in Tanzania are spot markets whereby it is estimated that 80% of the produced vegetables in Tanzania is sold by the farmers at farm gate to commissioners.

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Moreover, the traditional supply chains in the fresh fruit and vegetable sector are long, involving an array of many subsequent stages and actors, un-coordinated flow of produce, no transparency and generating very small margins per actors. In this market environment farmers are in a disadvantaged position, lacking assets (social capital, financial capital, human capital) to improve their positioning (Marg et al., 2008).

Given these scenarios it is important for measures to be taken that address market gluts, wastage and the associated output and income losses. Suffice to note that selling agricultural products is the main source of cash income for most rural household's farmers in Tanzania. Farmers are no longer not only interested in high yield or even in high prices per se, but in more remunerative marketing outlets (Scott, 1995).

Developing marketing opportunities is a key success factor that can facilitate the production of AIVs. Processing is vital to unlock AIVs marketing barriers, minimize losses and to assure availability of AIVs throughout the year (Van den Berge et al., 2005).

Takemore et al. (2014) reported that processing is lacking in AIVs vegetable marketing chains and therefore the high perishability of traditional vegetables poses major challenges for marketing and distribution. Hence, improvement of packaging and processing standards is an important step for increased competitiveness of AIVs vegetables products along the entire value chain (Takemore et al., 2014).

Food processing which is preservation of food is an important manufacturing step that is used to provide food safety, maintain quality, extend shelf-life and prevent spoilage (Wiley, 1994; Shazia et al., 2007). Other purposes of traditional food processing are to maintain a supply of wholesome, nutritious food during the year, preservation for the time of scarcity and generate wealth for the producer and seller (Habwe et al., 2008).

Wiley (1994) argue that preserving foods could be reduced to two principal methods, "one in which desiccation is employed and the other in which more or less of a characteristic foreign substance is added to prevent fermentation and putrefaction". Other processing methods include canning, thermal and heat processing. Wiley (1994) did not extend use of the identified processing methods by creating the requisite linkages for processed products to generate more returns.

This study addressed the omission by indicating a need for the formation of effective and functional groups for processing and collective marketing as well as linkages with different AIVs value chain stakeholders. Part of this approach is shared by Ngugi et al. (2007) who advocates for formation of groups albeit at the producer level.

Osano (2010) argued that identifying different actors and roles played along the market chain would assist institutions in formulation of policy intervention that may stimulate smallholders' farmers' profitability in AIV marketing. Institutions such as non-governmental

organisations (NGOs) or cooperatives were to be established to promote farmers to work together in order to have a strong voice and unity as they need to negotiate for favourable prices for their produce. Our study builds on this recommendation by establishing methods for growth of processing groups and linkages necessary for improved processing efficiency that would assure trust among consumers.

A study conducted by Marg et al. (2008) reported two value chains for fresh vegetables. That is institutional marketing and collective marketing. This study is based on integration of the two chains led by the second value chain that presupposes capacity building for effective operation of the groups. This is because group action can generate economies of scale and improve bargaining power of the participants. This study stresses the need for information sharing especially from regulatory authorities for enforcement of quality standards amongst the processors for collective marketing. In this quest it identified institutions and stakeholders in African indigenous vegetables, and their expected roles to facilitate profitable processing.

Ngugi et al. (2007) reported that the factors attributed to successful participation of the farmers/groups in the dynamic markets include good governance; an ingrained culture of farming; commitment; access to technical advice; integration into necessary support services; regular and predictable incomes; transparency and accountability; support and backstopping by a an agency.

This study encapsulates these views by indicating the need for training and priority key training needs for effective marketing of AIVs. It is appreciated that farmers need to be continuously trained on the new requirements or standards of the high value dynamic markets. Further the role to be played by different stakeholder in AIVs marketing chain is underscored.

A study conducted by Gilbert et al. (2011) established that profitability of AIVs enterprises was hampered by lack of transport, exploitation by middlemen and lack of market information. In an effort to address these weaknesses producer groups were linked to both formal and informal markets through designed marketing models relevant to all value chain players.

However, the issue of seasonal gluts in the markets was not addressed. This study moves a step higher by identifying opportunities that arise from all year round access to markets and AIVs. In addition, propositions are made for the use of group transportation by AIVs processing partners.

In a study conducted on leafy vegetables in Ghana by Vivian et al. (2016), marketing of leafy vegetables was found to be inefficient although benefit-cost ratios showed that it was profitable. To remedy this anomaly, the study recommended that farmers and traders should form co-operatives to enable them bargain for prices, obtain loans and purchase storage facilities as groups. The study further noted that the fundamental problems of



Figure 1. Map of Tanzania showing the study regions of Arusha and Dodoma (Source: https://en.wikipedia.org/wiki/Regions_of_Tanzania)

perishability among traders had to be addressed. However, no specific solutions for perishability and market gluts were adequately addressed. This study provides explicit measures to address perishability and linkage to market opportunities.

METHODOLOGY

This study was conducted in Arusha and Dodoma Regions of Tanzania, which were the key areas that were identified for promotion of contract and quality declared seed production of the AIVs (Figure 1). The study was undertaken in May and June 2015 in specific locations in Arusha and Dodoma Regions that were considered critical for the production of AIVs.

Purposive sampling was used to select 21 key informants (KIs) and 10 groups of farmers involved in processing AIVs. The key informants were selected based on experience, knowledge and extensive involvement in processing of agricultural products, especially vegetables. The KIs were categorised according to the institutions they belonged to.

At least one respondent was selected from each of the institutions to provide expert information. The key informants were categorized as follows:

Researchers and academicians: World Vegetable Center, Nelson Mandela University, HORTI-Tengeru and Selian Agricultural Research Institute (SARI). Government and Regulatory bodies: Ministry of Agriculture, Food Security and Cooperatives (MAFSC (Dept. of food processing, Agricultural Extension Officers, District

Subject Matter Specialists), Tanzania Food and Drugs Authority (TFDA), Small Industry Development Organization (SIDO), Market Infrastructure, Value Addition And Rural Finance (MIVAF) and Centre for Agriculture Mechanization and Rural Technology (CAMARTEC). SIDO supports small scale processors. MIVAF is a World Bank funded project supporting infrastructure development. NGOs: Oikos, INADES Formation and FARM CONCERN International Centres. Associations: Tanzania Horticultural Association (TAHA). TAHA supports exporters and private sector involved in processing.

In addition, it supports the whole horticulture sector in general. MED Foods (a local processing company) and AFRILISHE Company were also selected to participate in the study. Ten farmers' groups involved in processing were selected to participate in focus group discussions (FGDs). These groups were distributed equally between Arusha and Dodoma Regions (Table 1).

Arusha Region included Arusha and Moshi Districts while Dodoma Region covered the larger Dodoma District. Data collected from the FGDs included types of AIVs processed, quantities processed and processing methods, reasons for the selected methods, challenges encountered, storage and marketing of the AIVs.

RESULTS AND DISCUSSION

Types of AIVs processed and methods used

Many types of AIVs were grown in the study regions.

Table 1. Names of the groups involved in the FGDs.

Name of the group	Location (District/Region)	No. of FGD participants
Alnjavutian Group (in Sokoni One area)	Arusha	12
Arusha Widows	Arusha	15
Kilimanjaro Natural Food Cooperatives	Moshi	17
Ndefoni	Arusha	13
UMANGO women group (under WODSTA)	Arusha	15
Azimio group	Dodoma	11
Jikomboe Handcraft Group (Ukunjali)	Dodoma	16
Onjama	Dodoma	14
Tumaini Group	Dodoma	11
Tumaini Jitegemee Group	Dodoma	16

Source: Survey data (2015).

Table 2. Magnitude of processing different AIVs (%).

Major AIVs processed	Percentage (%)
Amaranthus	20.0
Cassava leaves	20.0
Cowpea leaves	30.0
Ethiopian mustard	10.0
Jute mallow	10.0
Night shade	10.0

Source: Survey data (2015).

Table 3. Processing methods as reported by the groups (%).

Processing method	Percentage (%)
Blanching and Solar drying	10.0
Solar drying	40.0
Sun drying	50.0

Source: Survey data (2015).

They include African nightshade (*Solanum scabrum*), spider plant (*Cleome gynandra*), vegetable amaranth (*Amaranthus hybridus*), slenderleaf (*Crotalaria brevidens*), jutemallow (*Corchorus olitorius*), cassava leaves (*Manihot esculenta*) vegetable cowpea (*Vigna unguiculata*) pumpkin leaves (*Curcubita muschata*), African kale (*Brassica carinata*) and Ethiopian Mustard (*Brassica carinata*) (Abukutsa-Onyango et al., 2006).

Those that were processed to a greater extent were cowpea leaves, amaranthus and cassava leaves (Table 2). This is because they were more readily available and farmers preferred being involved in production of these types of AIVs. Farmers grow cowpea as intercrops with their main food crop maize and hence don't have to allocate a different land and labour for its production.

Cowpea is also dual purpose because farmers can consume the fresh vegetable and keep the crop for grain production. Amaranthus were preferred over AIVs because processors perceived them to be more profitable. This finding is consistent with results of Lotter et al. (2014) who established that amaranthus were more profitable than AIVs (Table 2).

Processing and preservation treatments lead to high convenience and nutritional value which is advantageous to consumers and food services (Wiley, 1994). Three main processing methods were used but sun drying was the most preferred processing method (Table 3).

Sun drying was preferred because of less energy requirement as well as its low demand for equipment/infrastructure to use. Sun drying was undertaken after harvesting and cleaning by drying the AIVs directly in the sun. In special circumstances, the AIVs were harvested cleaned (washed), sorted and boiled for a few min using low heat and thereafter sundried.

In this case, the AIVs were wrapped in a piece of cloth and dipped in boiled water as indicated earlier then they were removed and dried in the sun for 2 to 3 days. There was no specified time for boiling but some group members reported 3 min.

Solar drying was also done after cleaning the AIVs. Using this method, the AIVs were not exposed to direct sunlight but were placed in solar driers. Different reasons were given for the selection of the processing methods. The main reason for selection of the technology was that the group members were familiar with the technology (Table 4). Selection of the technology also indicates that there was limited access to other alternative options. This is ideally depicted in the types of technologies that were used for processing.

Studies have established that solar drying retained more of the nutrients than sun drying and could be a better method of processing because it is relatively hygienic with reduced microbial load compared to sun drying (Ukegbu and Okereke, 2013).

Table 4. Reasons for choice of processing approaches (%).

Reason for the method used	Percentage (%)
Cultural practice	20.0
Easily available and easy to use	10.0
Easy to use and is also cheap	10.0
It is easiest to use and safe	20.0
It is the available technology and is known	10.0
The technology is familiar to the group members	30.0

Source: Survey data (2015).

Table 5. Quantities of the different AIVs processed per year (kg)

Type of AIV	No. of groups involved	Mean	Total
Amaranthus	2	85.0	170.0
Cassava leaves	2	17.5	35.0
Cowpea leaves	3	70.0	210.0
Jute mallow	2	10.0	20.0
Night shade	1	40.0	40.0

Source: Survey data (2015).

In addition, solar drying of vegetables facilitates micronutrients retention and product diversification to enhance accessibility of nutrients for improved health through micronutrients supplementation (James and Matemu, 2016; Hassan et al., 2007)). This means that efforts to facilitate the use of solar driers would enhance efficiency of AIVs processing. The Centre for Agriculture Mechanization and Rural Technology (CAMARTEC) is promoting solar driers for different categories/scale of processors. This study provided information to processors about possible sources of funds for processing equipment.

Key informant interviews and observations revealed that the key participants in processing of the AIVs were women. This was explained by the fact that those who facilitated the processing activities in the initial instance were trained women. Since women were the ones doing kitchen work, they found themselves doing more vegetable processing work.

Currently, men have also started being involved in the processing of AIVs for income generation. Specifically, some middle aged men now go for the training in processing of the AIVs. On average, more women are involved in the processing of AIVs.

Additionally, women spend more time in processing of the AIVs compared to the men. Members of the focus group discussion estimated that women spend about 90% of the time in processing of the AIVs while men spend about 10% of their time in processing of the AIVs. Women also decide who buys the processed AIVs and as a consequence receive money for the proceeds of

processed AIVs sales. In the event that a decision is to be made on how to spend the money in the household the women make the decisions.

Quantities and quality of AIVs processed

The highest quantity processed was 210 kg of cowpea leaves per year by three groups (Table 5). There were no major differences in the quantities processed by the different groups. The amount of AIVs processed depended mainly on what was produced during the rain season.

During the dry season very small quantities of AIVs were produced and also relatively less was processed. Although there were relatively large quantities of fresh AIVs during the rain season relatively less was processed. This is against the backdrop of bumper harvests of fresh AIVs that occasionally led to gluts in the markets, low prices, spoilage and loss of the expected income from sale of AIVs.

Processors purchase small quantities meaning that they have to do the purchases many times to be able to get reasonable quantities of processed AIVs. Some of the processors reported that it is limited purchasing capacity that conditions them to make small and frequent purchases, which lead to increased transaction costs.

FGDs and KIs revealed that there is high potential for increasing quantities processed and the corresponding incomes. This is due to increasing awareness and changing customs which lead to increasing use of



Figure 2. Dried pumpkin leaves (Source: Survey data, 2015).

convenience foods at home and in the food outlets (Habwe et al., 2008).

There were varied views about the quality of processed AIVs. FGDs revealed that there were no differences in quality of fresh and processed AIVs. Key informants on the other hand had the view that there was a need for Tanzania Bureau of Standards to reinforce quality requirements especially with respect to processing infrastructure and hygiene conditions.

Challenges to AIV processing

The processors do not have the necessary skills, knowledge and training required for processing of the AIVs in more economically attractive ways. It is therefore necessary to provide training at all levels of the processing chain. This means that more households should be given training on better processing methods and techniques.

These include different methods of processing of the AIVs, standards, packaging procedures, cleaning, sorting, and storage, business management skills, marketing training, platforms for exposure, construction of driers, hygiene in AIVs processing, modern techniques of processing, re-fresher courses in drying of the AIVs and food safety.

Indeed, during the FGDs there were requests by the groups for alternative methods for processing. The

processing methods were sun drying and solar drying. In a few instances, there were pre-drying treatments which involved cleaning/washing, wrapping in some clothing and dipping in hot water for a few minutes (blanching), followed by drying.

It was apparent that there was no diversity in the processing methods. Those involved in processing were restricted to only two methods; direct sun drying and solar drying. The different types of processed products need to be known by the processors to enable them make intelligent decisions based on market requirements. Processing methods that could be considered include oven drying, freeze drying and blanching depending on processor capacity.

The products were of two main types which included powder and dried whole leaf (Figure 2 and 3). In this respect again there was no diversity in the products that were processed. Other products that could be processed to diversify the product base include sauce, shredded, crisps and pickles.

The types and sources of packaging materials were restricted in various respects. The main sources of the packaging materials were the local shops/markets in the different regions, Arusha and Dodoma as well as Dar es Salaam in a few instances. Some processors reported that they obtained processing materials from non-governmental organizations, which included Women Development for Science and Technology Association (WODSTA), SIDO and World Vision.



Figure 3. Amaranthus and Avocado powder (Source: Survey data, 2015).

The groups involved in processing noted that they did not have free access to the packaging materials. The materials were in small quantities and in some cases difficult to find. Those involved in processing had to travel long distances to get the packaging materials. Availability of packaging materials was difficult in terms of quantity and quality.

Only 20% of those involved in processing reported to have had adequate supply of the processing materials. Some packaging materials were in larger quantities than the capacity of the processors. The costs of the packaging materials were relatively high and fluctuated frequently. A lot of time was spent moving to the source of the packaging materials such as local markets, Arusha, Dodoma or even to Dar es Salaam. This is underscored by the fact that there was a shortage or lack of appropriate packing materials. Some bottles that were used for packing had leaking seals while others had no seals at all.

The processors did not have special and/or organized storage facilities for the processed AIVs. The group members stored the processed AIVs in their own houses after processing of individual AIVs. The processed AIVs were distributed among the members to store on behalf of the group. This was usually in the normal stores at home and in the houses or in an open area that could be

considered appropriate. Sometimes the processed AIVs were stored in plastic buckets or gallons. There was as a consequence short length of storage and the need for quick and/or immediate sell of the processed products. Lack of storage facilities led to a reduction in the quantities of the processed AIVs as well as deterioration in quality (Table 6).

The equipment necessary for processing were either in small quantities or not available at all. The main equipment used for processing was the solar drier but it was not available in Ndefoni, Onjama and Jikomboe groups. Funds to facilitate processing were not available in the required amounts. The shortage lowered the capacity of the processors to be involved in large/economic consignments.

The share of processed AIVs in the total consumption of the vegetables was 25%, which is much lower than that of the fresh vegetables. This is, however, an increase from the 20% reported by Ambrose-Oji (2012). The low share is because there is greater availability of the fresh vegetables and only part of the fresh vegetables is processed.

AIVs processors were not aware of suitable markets for the processed products. This was due to lack of training on how to market their products. Processing of AIVs was not undertaken as a commercial activity in most of the

Table 6. Problems associated with storage of the processed AIVs

Description of the problem	Number of groups reporting the problem	Percentage (%)
Congested area because the store is small and not specifically designed for the processed AIVs	1	14.3
It is difficult to keep the products for a long time	1	14.3
Lack of funds to construct a store	1	14.3
Molds	3	42.9
Theft of the processed products	1	14.3

Source: Survey data (2015).

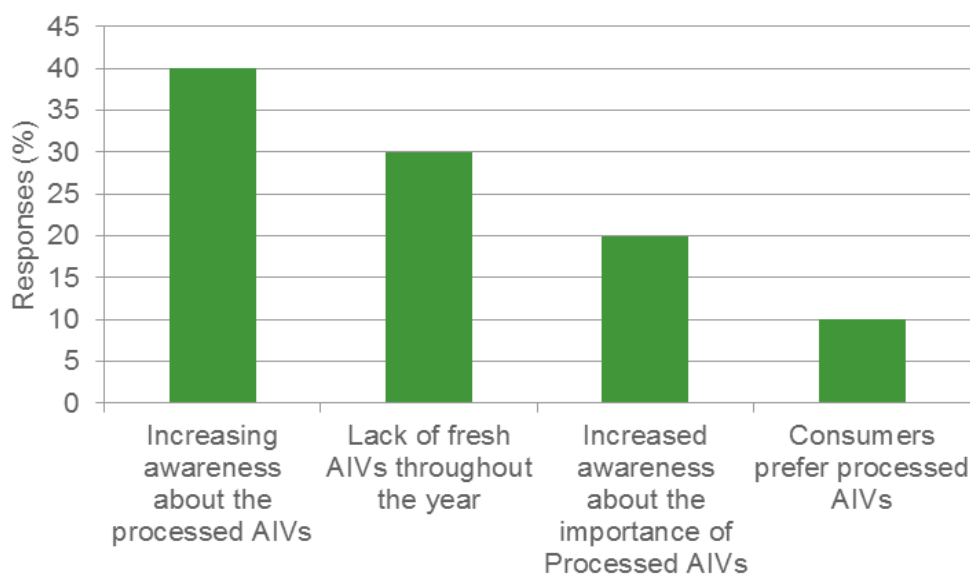


Figure 4. Reasons for the increasing demand for the processed AIVs (Source: Survey data, 2015).

cases. It was instead considered as a subsistence or side activity.

Opportunities for AIVs processing

60% of those interviewed noted that the demand for all types of processed AIVs was increasing. The main factors that contribute to the increase in demand were found to be increased awareness about processed AIVs and the importance of consuming AIVs (Figure 4). Consumers have become increasingly aware of the nutritional and medicinal value of African indigenous vegetables.

This has caused a rise in demand especially in major urban centres. The supply of these vegetables has however not matched this growing demand (Ngugi et al., 2007). With increasing urbanization and population, there is a potential market for the indigenous vegetables. The marketing infrastructure is enhanced by the diffusion of supermarkets and grocers from big towns to smaller ones

and also by the improving hygiene of wet markets that could serve as outlets for the vegetables (Ngugi et al., 2007). Fresh vegetables were not available throughout the year and the situation was worse during the dry season.

Processed AIVs were available throughout the year and more importantly during the dry season. Awareness creation was through agricultural shows, educational institutions and research centres such as World Vegetable Center and HORTI-Tengeru, as well as institutions such as TAHA and SIDO.

In addition, there was sharing of information about the importance of the processed AIVs. Limited efforts were required for the preparation of the processed AIVs. Key informant interviews revealed that the AIVs offer health and nutritional benefits just as the fresh vegetables. The processed AIVs have a relatively good taste compared to the fresh AIVs, which are easy to cook, readily available and easy to handle. They expand during cooking and are therefore able to serve many members of the family

(Figure 4).

The highest demand for the processed AIVs was usually during the dry season. The key reason for this was that during the dry season there was a shortage of fresh AIVs, and hence the proportionate share of processed AIVs was higher. It is important to note that there was still adequate demand during the rain season but relatively less amount of processed AIVs were consumed compared to the large amounts of the fresh vegetables in the market places. FGDs and key informant interviews revealed that the major buyers of the processed AIVs were the women although consumption was by men, women and the youth.

Many institutions are involved in supporting processing of the AIVs. The support is in different forms ranging from provision of technical knowledge/skills, and financial support to capacity building for group formation. These include the Ministry of Agriculture, Food Security and Cooperative (MAFS&C – Extension officers), AFRICARE, World Vegetable Center, CABI, KNFC, SIDO, TFDA, TBS, Community Banks (for example, Meru Community Bank), SACCOs and WODSTA. World Vegetable Center and WODSTA provide training for groups involved in processing of the AIVs. TAHA helps with the supply of raw materials and linking processors to the funding institutions.

The government should enact policies that enable the AIVs yield maximization, and enhance their local and international market-share. This should involve government provision of technology advancements and know-how to the AIVs processors.

In addition, it should provide education on AIVs processing procedures including gathering, treatment, package, storing and distribution to the end-users. The government should fund central AIVs treatment-units and advanced storage facilities. These include machinery for processing and storing AIVs. It is expected that this would enable purchase of municipal merchandize and increased AIVs at regional and family levels that would lead to accomplishment of economies of scale by national agriculture-based SMEs' extroversion and internationalization. Such an approach would assure smooth operation of the processing infrastructure and improved quality of the end products launched by the local families in the market that are hitherto hampered by the high cost and technical limitations of the processors.

FGD participants and key informant perceived the quality of processed AIVs to be the same as that of the fresh vegetables. Consumers were willing to pay more for better processed AIVs. The reasons in support of this view were that the consumers need better quality products. The consumers were keen on good quality. The processed AIVs are easy to store and prepare.

Processing removes water thereby leading to a reduction in bulkiness and microbial activities. Processed AIVs are also available throughout the year and especially during the dry season. It is also more attractive and easy

to store/ transport processed AIVs. There is increasing appreciation of the processed AIVs by the consumers and as a consequence increased consumption by different categories of the consumers. The FGDs and key informants noted that there is an overall perception change in favour of the consumption of the processed AIVs.

Conclusion

Post-harvest processing of AIVs provides market opportunities for the farmers. Instead of relying only on fresh vegetable sales, they can tap into larger markets outside their area by providing alternatives to fresh vegetables. Value addition occasioned by increased shelf life provides better chances for farmers and processors to get good prices and better farm incomes.

Value addition can also help alleviate potential wastage during times of bumper harvest when the market cannot clear the available vegetables. Instead of farmers selling at giveaway prices or losing the product, the surplus can be processed and sold later thereby reducing losses. There is high potential demand for processed AIVs. The richer households tend to consume more fruits and vegetables than poorer households. Urban households consume more than rural households; that is twice the volume of vegetables as rural consumers (Bawden et al., 2002; Okado, 2000). In addition, there are opportunities for supplying other outlets such as wet markets and institutions such as hospitals, schools, and hotels (Ngugi et al., 2007).

Even with the opportunities offered by processed AIVs there are some challenges that require further investment to better tap into the new market opportunities for farmers. A key approach to improve processing and consumption of the processed AIVs would be creation of further awareness through promotion and advertisements of the processed AIVs products.

The promotions could be effected through the Agricultural Shows (for example, NANE NANE), plant clinics, market places and other organizations. Among the issues to be promoted are nutritional and health benefits, ease of cooking, long shelf life, ease of transportation and availability throughout the year. It is also easy to store AIVs for use at own convenience not dictated by given market availability. Alongside awareness creation it is necessary to practice target marketing.

Hence, the need for providing marketing training to the groups involved in processing of the AIVs. Following training, groups of processors need to identify amongst themselves persons that would be involved in the search for markets as well as getting the requirements for the various consumers who would eventually purchase the processed AIVs. The understanding here is that the AIVs would be processed for an already identified market (target market). There should therefore be arrangements

in place regarding the association between the processors and the prospective buyers.

These could include informal agreements, partnerships and contracts depending on the degree of understanding among the two groups. Extension officers and other parties involved in processing of the AIVs need to help in group formation (say by-laws) and crafting of rules of association. The initial approach would be to target the supermarkets, schools, hospitals and prisons.

Some processors did not want the regulatory authorities (TFDA and TBS) to know that they practiced processing due to poor understanding of the regulatory requirements. Other processors were not even aware of the existence of the TBS and TFDA requirements. This means that TBS and TFDA need to create awareness regarding the specific requirements and the need to meet the requirements. The standards need to be made known to the prospective processors. The laws and regulations on the processed AIVs are not yet developed for example, the Global Standards (GS), TFDA and TBS. This calls for fast and effective measures to develop the laws to facilitate effective processing. In principle, the regulatory requirements have to be clearly made known to the processors plus efforts to help the processors to meet the regulatory requirements.

There is need for training on appropriate and affordable processing methods as well as the range of products that could be produced for the different markets. The methods may include electric/oven drying, canning and freeze drying.

These should be complemented with support for the supply of inputs, which include the processing equipment and the packaging materials. Help in the construction of storage facilities is therefore necessary. Given that all activities as of necessity require financial resources linking the processors to financial institutions is warranted.

SACCOs and community banks could provide financial resources to those involved in processing of the AIVs. It is also necessary to guide the processors on how to access transportation services. Product development through different processing methods is a requirement and consideration of sensory evaluation is another avenue. Organizations like TAHA and WODSTA are already working with some groups of processors to facilitate access to the inputs and other equipment but it will be necessary to expand the coverage as well as the persons involved. It is also necessary to promote and/or advertise AIVs processing as a commercial activity. Accordingly, there is need for training on marketing of the processed products.

Quality considerations and assuring consumers that the necessary standards have been met is a key requirement. This calls for improvements in quality of the products. In this case, product branding at two levels is necessary. This should include indicating the key attributes of the AIVs on the packages. Of special concern would therefore be certification by TBS and TFDA as well as having their labels on the containers of the well packed

products alongside the characteristics of the products.

Proper packaging should be associated with good storage to avoid spoilage. It is necessary to create awareness amongst the processors regarding the need for high quality AIVs products, roles of the regulatory organizations and the importance of operating within the required legal framework. Pamphlets, brochures, and other forms of communication should be made available to the processors in addition to the training about the required quality of the AIVs.

Limitation

This study was based on a qualitative assessment. It is appreciated that having more quantitative data would have expanded the inferences. However, this was addressed by use of detailed key informant information.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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