Let Them Eat Cake: Food Quality and Acceptance in Africa

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Professor Keith Tomlins
LET THEM EAT CAKE: FOOD QUALITY AND ACCEPTANCE IN AFRICA

by
Professor Keith Tomlins
Natural Resources Institute, University of Greenwich

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Keith Tomlins is a Food Scientist at the Natural Resources Institute, University of Greenwich and currently manages a number of research projects with partners in the UK, Netherlands, France, Portugal, Nigeria, Ghana, Uganda, Malawi, Tanzania, Thailand and Vietnam.

Keith read Food Science and Nutrition at the University of Surrey. He joined the Tropical Products Institute (predecessor of the Natural Resources Institute) in 1982. In the early years, he developed new methods of mycotoxin analysis. He left TPI in 1986 to become a Research Associate at the School of Pharmacy, University of Portsmouth where he continued the work and successfully defended his MPhil in mycotoxin analysis. Some of the rapid methods developed at this time were routinely used in Thailand and Africa.

In 1987 he joined the Natural Resources Institute as a food scientist where he worked on food flavours and post-harvest processing of tea, coffee and cocoa in Africa; this include living for two and half years in Malawi as a processing scientist in an experimental tea factory. During this stage in his career he began to take an interest how we can maintain food quality and in how we perceive foods, particularly in developing countries. This led to the development of an electronic sweet potato for remotely monitoring handling of the crop and development of methods for measuring consumer acceptance of food and drink products, particularly by people on low incomes and or with minimal education. Since 1998 he also has had an interest in root and tuber crops because they are important to people on low incomes for food security and income generation. In 2012, Keith became the President of the International Society for Tropical Root Crops, a body with over 360 members from over 30 countries worldwide.

His career has resulted in over 100 co-authored publications and over 120 overseas assignments to more than 25 countries worldwide in Europe, Africa, Asia, South America and the Pacific.
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INTRODUCTION

‘Let them eat cake’ is supposedly a quotation attributed to Marie Antoinette\(^1\), who uttered it during one of the famines that occurred in France during the reign of Louis XVI. It acquired great symbolic importance as an indication of people in power being out of touch with the reality of life faced by poor people. I think we should revisit this question and ask ourselves if she was really so out of touch with poor people as history suggests? We could interpret Marie Antoinette’s quotation differently by saying that poor people have the same right of access to food that is plentiful in supply, is nutritious, safe and acceptable as rich people. In a wider sense, as a scientist rather than saying “Let them eat cake” we could say “Let people have access to food that is plentiful, affordable, safe, nutritious and acceptable to their specific cultures”. My version of the quote does not roll off the tongue so easily as the original though!

In my presentation, I am going to present some of the work that I have been involved with over the years that seeks to help improve the quality of food in Africa and also to understand the food preferences of poor people so that we can find ways of offering foods that are both acceptance, affordable and meet cultural preferences.

My research concerns food and drink and this has been a passion for me. Eating food and drinking is both a necessity and a pleasure in our everyday lives but many millions of people (this includes children) in our world still sadly lack access to nutrients in sufficient quantities to meet all of their daily needs. They say that “we are what we eat”. Our nutritional status, health, physical and mental faculties depend on the food and drink we eat. Food quality and acceptability can be considered as a complex set of characteristics that determines its value or acceptability to consumers. Quality attributes include: nutritional value; organoleptic properties such as appearance, colour, texture, taste; and functional properties and whether we perceive the food is safe to eat.

Food systems in developing countries are having to meet the challenges of growing populations, increasing urbanisation, the need of resources to deal with pre- and post- harvest losses in food and address concerns over environmental and food safety.

The challenges are enormous. Between 2011 and 2050, the world population is expected to increase by 2.3 billion, from 7.0 to 9.3 billion (United Nations, 2011). Most of the growth will occur in developing countries and will be concentrated in cities and towns. The population living in urban areas is projected to increase from 3.6 billion to 6.3 billion 2050. This overall increase in population and rapid urbanisation in particular, poses great challenges to food systems. Intensification of agriculture; more efficient food handling, processing and distribution systems; introduction of newer technologies including appropriate application of biotechnology will all have to be exploited to increase food availability to meet the needs of growing populations. Ensuring food quality is maintained and food is acceptable will become increasingly important in both rural and urban areas while meeting these demands.

It is has been said that the poor will consume “anything” to mitigate their hunger. We will explore some of these issues. On the one hand, survival may depend mainly on access to nutritious food that is safe to eat. On the other hand, food not eaten because of poor quality and acceptability, has zero nutritional value (as my Lecturer at the University of Surrey would tell us during her lectures when I was an undergraduate).
When I began my interest in food quality and acceptance, the focus of research in developing countries was rightly focused on ensuring there was enough food to eat. This is still the case. However, food is acceptability for poor people with minimal education has been largely neglected and understanding more about acceptance can help ensure a greater chance of people having access to foods that not only need their nutritional requirements but are also acceptable. This is important because success rates for new food products are low. For example, in developed countries such as the USA, 72% of new food products marketed fail while 55% of products that were similar to existing ones failed. Figures for new food products marketed in developing countries are not available but assume they would not be any different. A challenge for developing countries is that, resources and funding for new product development are scarce so better information about quality and acceptance can help improve success. This way, new varieties of food crops developed by national and international research organisations, new products and new nutritious foods can have better chance of success to the benefit of people in developing countries and I will provide two examples of this phenomenon collated into two themes.

The subsequent discussion is divided into two sections. The first section is about maintaining quality during handling and transport and the second section relates to consumer acceptance of foods in Africa.

\footnote{However, there is little evidence that Queen Marie-Antoinette spoke this phrase. It was first attributed to her by Alphonse Karr in “Les Guepes” in 1843 while Lady Antonia Fraser, wrote in 2002 that it was probably said 100 years before Marie Antoinette by Marie-Thérèse, the wife of Louis XIV. The attribution is also erroneous in English, because the word “cake” is a mistranslation. In the original French the alleged quote reads, “Qu’ils mangent de la brioche,”. Broche is an enriched bread made with egg and butter.}
SECTION 1. USE OF SENSORS TO HELP MAINTAIN SWEET POTATO PRODUCT QUALITY DURING HANDLING AND TRANSPORT IN TANZANIA

ELECTRONIC SWEET POTATO: HELPING TO REDUCE LOSSES DURING TRANSPORT FROM FARMS TO MARKETS IN TANZANIA

Sweet potato (Ipomoea batatas (L) Lam) is a traditional crop for subsistence farmers in Tanzania, but is now increasing being marketed as people increasingly migrate from rural to urban cities and within the cities there is an emerging middle class. The marketing system for sweet potato, however, was poorly developed with significant losses in quality such that roots were broken, the skin of the roots were often scuffed and such roots attracted a significant discount (10 to 30%) when shrivelled, cut or broken.

Fresh sweet potatoes for local markets are transported in sacks weighing between 100 and 250kg in Tanzania. In contrast, for export, partitioned fibreboard cartons filled with between 14 and 18 kg roots were recommended. But little was known about the handling, transport and quality of sweet potatoes in East Africa, in particular Tanzania. Roots were transported for distances of up to 300 km and often overnight so it would be difficult to track them.

An example of a consumer purchasing sweet potato in a market in Tanzania is illustrated in figure 1.

Monitoring the damage during handling was key to understanding the causes of the losses and developing means of overcoming them. Objective techniques for monitoring the handling of fruits and vegetables had been developed for other crops but these were often quite expensive and difficult to obtain. These devices were called ‘instrumented or electronic spheres’ ‘electronic tubers’, ‘pressure balls’ and ‘artificial fruits and vegetables’. At the time, it was felt we could make an electronic sweet potato from off-the-shelf components from UK suppliers and hence the idea of a low cost electronic sweet potato was born. The electronic sweet potato comprises dataloggers that were used to monitor impact, temperature and humidity (figure 2). They were fitted inside a plastic pipe (16 cm long and 6.5 cm diameter), that was approximately the same size as a sweet potato root, and were positioned at the centre of sacks. The pipe prevented unrepresentative movement of the datalogger when inside a sack.

The purpose of this research was to use the low cost electronic sweet potato was determine if we could identify the critical stages in the handling and transport system that led to reduced returns for sweet potato growers. In this study, commercial consignments of sweet potato sacks (100 kg), using two local sweet potato varieties (cv. Polista and SPN/0), were surveyed, over two seasons, from harvest to markets at Mwanza, a city on Lake Victoria, and Dar es Salaam, Tanzania’s capital situated on the East
African coast. The purpose was to identify where the greatest reductions in quality and value occurred and to determine the type of handling that caused the losses.

Examples of poor handling due to transport method, sack size and people walking or sitting on sacks of sweet potato in Tanzania are given in figure 3 (Tomlins et al., 2002). This is probably the first time that the handling of consignments of sweet potato has been investigated this way. An example output from an impact sensor with annotations is shown in figure 4, which illustrates impacts experienced when a sack of sweet potatoes that was transported 300km by truck from a rural farm at Gairo to Tandale market, Dar es Salaam. Analysis of the impacts indicated that the most severe impacts occurred during unloading and loading from road vehicles and ships. Root damage (skinning injury and broken roots) was correlated more strongly with a large number of minor impacts rather than a smaller number of large ones. An example is given for the relationship between skinning injury and minor shocks of between 0.2 and 2 g in intensity (figure 5). In general, the greater the number of minor impacts (up to 1400), the greater the extent of skinning injury. A similar pattern was noted for breaks but the correlation was not as good. We measured temperature and humidity in the sacks but this did not increase to unacceptable levels or show correlations with root injury.

In conclusion, this appeared to be the first time an electronic sweet potato has been reported in the literature and the first time such a device has been used in an African / developing country context where the basic infrastructure can make it difficult to track consignments of sweet potato from the farm to the market over large distances.

Partly because of the results of this research, a wholesale market in Dar es Salaam (Tandale) has since recommended that the maximum weight of sacks containing sweet potato should be reduced to 100kg.

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Figure 2. Electronic sweet potato design showing the shock, temperature and humidity dataloggers fitted inside a plastic pipe.
a) Truck carrying sacks of sweet potato on poor quality roads in Tanzania.

b) People sitting and stepping on sacks of sweet potato in Tanzania.

c) Porter carrying a sack of sweet potato that was so heavy it had to dropped, not lowered to the ground.

**Figure 3. Examples of poor handling of sweet potato in Tanzania.**
Figure 4. Example graphical output from a shock datalogger for a sack of sweet potatoes that was transported 300km by truck from a farm at Gairo to Tandale market, Dar es Salaam, Tanzania (in Tomlins et al., 2000).

Figure 5. Effect of number of impacts between 0.2 and 2 g on skinning injury for sweet potatoes transported in 100kg sacks in Tanzania (in Tomlins et al., 2000).
SECTION 2: SENSORY TESTING AND CONSUMER ACCEPTABILITY OF FOOD PRODUCTS IN DEVELOPING COUNTRIES

To a food scientist, sensory evaluation and consume acceptability mean different things.

Sensory evaluation of food relies upon objective evaluation by our senses (odour, taste, colour, tactile, temperature, pain etc). Only by applying exact scientific testing or analytical methods can reproducible results be obtained and analysed statistically (Jellinek 1985).

Sensory testing has been undertaken for as long as humans have been consuming products and trading them. Trading in food and drink products gradually led to more formal sensory testing. Grading systems were developed which were based on testing a small sample of the consignment. Grading subsequently gave rise to the professional taster in food, beverages and cosmetics. Sensory and consumer acceptance started to become formalised in the 1940’s.

There are four factors we need to consider in sensory and consumer testing being the food/drink product, the people, the testing environment and finally the methods. The advantage of sensory and consumer testing is that it can give an answer regarding consumer quality provided the methods we use are relatively cheap (depending on how it is done), rapid, can apply to many products and are objective, reliable, accurate and reproducible. There can be disadvantages if the methods are too expensive, difficult to run and analysis and interpretation of the results is complex.

Applications of sensory evaluation and consumer acceptance include new product development, product matching, product improvement, monitoring the effect of a change in the process, cost reduction, quality assurance, storage stability and relating to instrumental methods.

The sensory properties of foods are related to three major attributes being the appearance (colour, size, shape), flavour (odour, taste) and texture (mouth feel, viscosity and hearing). These attributes are expressed as a continuum and not as finite properties. It is often not impossible to rate each one individually unless special precautions are taken, e.g. blindfolds, nose clips, coloured lights, purees etc.

Humans possess about 30 different senses but the sensory properties of foods are perceived through the senses of sight, smell, taste, touch and hearing. Considering how we interact with food and drink we can consider the stimuli. A stimulus is any chemical or physical activator that causes a response in a receptor; for example the eye is a receptor for light, the ear is a receptor for sound etc. An effective stimulus produces a sensation, the dimensions of which can vary by intensity/strength, extent/separation, duration/retention and hedonics/like-dislike.

The senses of the human body, the characteristics of the food and our culture interact to form our perception. Perception is the psychological interpretation of sensations determined by comparison with past experiences, e.g. the sour taste of lemons is the perception of the sensation received by the receptors (taste buds) from a chemical stimulus (citric acid).

When we eat food we perceive a whole range of different characteristics relating to the appearance, flavour and texture of the food. These characteristics are called the sensory characteristics of the food and play an important role in attracting people to food and in the regulation of food intake.
Ethics and Sensory Evaluation and Consumer Acceptance Research

Research at the University of Greenwich that involves the ingestion of food and administering questionnaires to consumers is evaluated by the University of Greenwich Research Ethics Committee and has to be approved before the research can be undertaken.

Sensory Evaluation

When evaluating properties of foods using people as measuring instruments it is important to control the methods and conditions of testing as rigidly as possibly. This helps to eliminate the numerous errors or biases that can be caused by psychological and physiological factors. A number of people are used to reduce errors and these are sometimes referred to as ‘taste panels’.

The panellists normally receive training from the sensory scientist and test the food and drink panels using controlled methods and by sitting separately in booths. An example of a panellist testing a food product in a booth is shown in figure 6.

Samples to be tested are coded with random numbers to reduce bias by the panellist. While the use of a specially built laboratory with neutral coloured walls, controlled lighting, controlled temperature, separate kitchen and testing areas can improve the performance of panellists we have adapted the approach for use in African institutions where special facilities are not available and still get reliable results. Typically between 5 and 20 panellists are used in sensory evaluation. We can use this to measure differences between food products or measure attributes using a scale. In our work at the Natural Resources Institute, University of Greenwich, we usually prefer to use scales because we can measure several different things at the same time and allow us to compare the size of the differences.

The advantage and use of sensory evaluation is that the approach can give quantitative or precise information about the food and drink products. The limitation is that because the panellists are trained and small in number we cannot measure how acceptable the food and drink products are. To do this we need other methods.

Consumer acceptability

Consumer acceptability is often referred to as liking, preference, enjoyment, selection and consumption of a food or drink or food quality. It is also known as ‘affective testing’. It is more subjective than sensory evaluation since food acceptability represents different forms of behaviour by people to food products. It is therefore vital that the objective of any consumer study is clearly defined in advance and the experimental design and questionnaires are carefully designed. For example, “How much do you like” is not the same as “how much do you eat” because consumption is influenced by price, availability, whether the consumer is on a diet etc.
The selection and choice of food by an individual are determined by factors resulting from the food product, the environment and the individual. Factors influencing food choice include:

- individual energy and nutrient needs (age, gender, activity level);
- health concerns (can exclude some foods);
- food preferences (age, frequency of eating);
- ethical, cultural or religious practices;
- cost (preparation, basic foods);
- food availability (location);
- social considerations (fairtrade, human welfare, animal welfare etc);
- environmental considerations (organic, GMO etc);
- advertising and other point of sale information;
- packaging (appearance, labelling, brand);
- Source of information (government, retailer, food manufacturer etc).

In consumer testing reliable results can only be obtained if we interview greater numbers, typically at least 60 people and preferably more. An example of consumers being interviews in Senegal is shown in figure 7. We rely on the use of hedonic scales to measure liking and by asking participants to fill in a questionnaire to obtain information about the consumer’s attitudes to the product. Consumer acceptance methods were primarily developed in the USA and Europe and for consumers who have a reasonable level of education and there was a concern that such methods might not be appropriate to consumers who have minimal education, speak many different languages or on low incomes and hence do not have the ability to choose different foods. A literature search indicated that little information was available; therefore, simple methods were initially tested.

Figure 7. Consumers acceptance testing
EVALUATION OF CONSUMER ACCEPTANCE METHODS APPROPRIATE FOR USE IN DEVELOPING COUNTRIES

Consumer acceptance methods were developed for use with consumers in industrialised countries and little was known about how these methods could be applied to people who may have minimal education and speak differing languages.

Initially we tested very simple methods for measuring acceptance with low income consumers in rural areas of the lake zone of Tanzania. These were:

a) Simple ‘First Choice’ method. Consumers were presented with several sweet potato samples and chose the sample they preferred the most.

b) Ranking. Consumers ranked the sweet potato samples in order of increasing acceptance.

Because most consumers had minimal education, we used trained enumerators who were familiar with the local languages to work with each consumer on a one-to-one basis.

We interviewed over 600 people. The research found that consumers were actually able to use both methods provided the trained enumerator carefully explained the method and translated it into the local languages for them. The correlations we got for the ranking method and first choice are shown in figure 8. The strong correlation indicates that the simpler method was comparable to the more complex ranking method (correlation coefficients varied between 0.872 and 0.953) and hence could facilitate simpler and more rapid methods for consumer testing.

Figure 8. Relationship between first-choice acceptance and rank sum acceptance for sweet potato cultivars evaluated by consumers at Meatu, Tanzania (in Tomlins et al., 2004).
The positive result encouraged us to consider exploring more complex scales with consumers from rural areas with minimal education. An example is given below.

9 = like extremely  
8 = like very much  
7 = like moderately  
6 = like slightly  
5 = neither like nor dislike  
4 = dislike slightly  
3 = dislike moderately  
2 = dislike very much  
1 = dislike extremely

It should be noted that we could only use these methods if we employed enumerators who spoke the local languages and had received training in how to administer the questionnaire on a one-to-one basis.

Initially we tested hedonic scales which had pictures of faces to illustrate degree of liking (figure 9). (Tomlins et al., 2004).

![Hedonic scale with faces](image_url)

Figure 9. Hedonic scale incorporating verbal and graphical ratings used for acceptance of sweet potato cultivars by school children and mothers in Tanzania (Tomlins et al., 2007a).
Hedonic scales can be more complex to use because the scale has to be conceptualised in the mind of the consumer and in addition, the trained enumerator had to translate the English version of the scale into the local language. An advantage of scales, however, is that it is possible to determine how much a product is acceptable, not just its rank order or if it was the first choice. The graphical scale was tested with both adults and children. It was concluded that the graphical ‘faces’ were not appropriate because the enumerators reported that the children found the faces confusing.

Conclusion
In conclusion, both simple and complex scales can be used with consumers who have minimal education and may speak many different languages provided enumerators are trained to administer them and can speak the local languages. Therefore the determinants for the test approach were the methodology, cost and time available.
EXAMPLES OF CONSUMER ACCEPTANCE RESEARCH UNDERTAKEN IN AFRICA

DEVELOPMENT OF SIMPLE ACCEPTANCE METHODS TO HELP PLANT BREEDERS AND FARMERS DECIDE WHICH VARIETY OF SWEET POTATO THEY WANT TO GROW?

Plant breeders seek to develop new varieties of sweet potato have improved benefits to consumers such as higher yields, better disease resistance, better nutritional and health benefits, etc. Breeding initiatives for sweet potato in much of Africa are at a relatively early stage compared with other staple crops. Varieties grown in many regions are low yielding and the potential for improvements through breeding are high. While the main objectives of breeding programmes have traditionally been an increase in yield and improvement of other production characteristics, the importance of postharvest characteristics for the acceptance of new varieties is being increasingly recognised. The majority of sweet potato varieties presently grown in Tanzania are low yielding compared with average world yields. Introduction of improved varieties from other regions is limited by local virus pressure. However, there is an enormous diversity of sweet potato germplasm in East Africa and hence great potential for rapid improvements in varietal characteristics through breeding within the region.

The success of any newly introduced variety will depend not only on production characteristics but also on its acceptability to consumers in terms of both sensory and utilisation characteristics. Consumer preferences appear to differ greatly between regions; for example, in North America and South Africa low dry-matter varieties are grown, while in East Africa only higher-dry-matter varieties are preferred. From surveys of preferences of consumers and traders conducted in the Lake Zone of Tanzania, a fairly consistent picture has emerged. Both consumers and traders considered that high dry matter content (also expressed as starchy or floury) and good taste was the most important criteria.

A challenge is that many new varieties need to be screened and therefore direct consumer testing of new sweet potato varieties would be very expensive and time-consuming, usually involving the interviewing of at least 60 or more consumers. There was a need to develop a means of screening new sweet potato varieties that also took into account regional and seasonal differences. In the first consumer trial, 300 consumers at three locations in the Lake Zone consumers ranked samples of cooked sweet potato cultivars in order of acceptability while in the second trial a further 300 consumers used a simpler method which was to say only which was their most acceptable cultivar. In total, 600 consumers were interviewed.

A sensory panellist testing sweet potato is illustrated in figure 10. The sensory results were used as a platform to compare locational and seasonal differences in consumer acceptability along with providing a more detailed sensory profile of the samples. Cluster...
analysis (Hierarchical Cluster Analysis, Wards Method, Euclidean distance) of the combined years identified three clusters of varieties with differing sensory properties and these clusters are illustrated in the principal component plot in figure 11. Cluster 3 was comprised of the most preferred cultivars and cluster 1 the least. Those cultivars in cluster 2 had different sensory attributes suggesting a locational effect. Some cultivars were consistently in the most preferred cluster (SPN/0 and Polista) while others were in the least preferred (Mzondwa and Serena). Location seemed to have an effect in one year only (2000). Other cultivars varied in preference from year to year and with location (Sinia B).

Figure 11. Principal component plot showing the separation of clusters of sweet potato cultivars in Tanzania over two seasons and different locations (in Tomlins et al., 2004).
While many sensory attributes were measured, discriminate models indicated that the most important were starch and stickiness. Action levels, based on the mean intensity scores of these attributes were suggested and are illustrated in figure 12. Therefore, it may be possible to screen varieties for acceptance using a less costly and more rapid sensory panel rather than interviewing many consumers.

Figure 12. Scatter plot of starch and stickiness to illustrate limits for starch and stickiness when selecting sweet potato cultivars that are preferred by consumers in Tanzania (in Tomlins et al., 2004).

Where $C_1 = \text{cluster 1}$, $C_2 = \text{cluster 2}$ and $C_3 = \text{cluster 3}$, dotted lines illustrate boundaries for cluster 3 (most preferred cultivars).

Conclusion

More research is necessary to understand why some cultivars are not consistently preferred from one year to another because this can influence breeding trials. This also implied that results based on one year only are insufficient; ideally trials should be conducted over several seasons. This research focused on consumer preference in the selection of sweet potato cultivars. Other factors, however, are also important and could be incorporated in future models that would assist plant breeders. These could include yield, disease resistance, storability, cookability, susceptibility to damage during transport, etc.
Traditionally the sweet potato varieties produced and sold in Africa contain little or no carotenoids but newer biofortified orange fleshed sweet potato varieties (OFSP) contain high concentrations of the carotenoid β-carotene (pro-vitamin A) and hence can contribute to reducing vitamin A deficiency (VAD) if people switch to eating them. This is important because in sub-Saharan Africa, VAD is a leading cause of tens of thousands of childhood deaths each year and a major risk factor for pregnant and lactating women. Therefore, replacing the pale-fleshed varieties with new high β-carotene OFSP varieties could benefit an estimated 50 million children under age 6 who are currently at risk.

A challenge in using OFSP to control VAD is that it has a different flesh colour due to the carotenoids and lower dry matter content. This is important because changes in appearance, taste and texture may be a barrier to acceptance, particularly when it is a primary staple. Acceptance of new nutritionally beneficial foods is critical because taste is consistently rated as the most important factor that drives sustainable consumption and repeat purchase of consumers.

Sensory evaluation has shown that a wide range of sensory attributes of sweet potato (odour, taste and textural characteristics) and the dry matter content has been reported to correlate with the logarithm of the total carotenoid (pro-vitamin A) content (Tomlins et al., 2012). The relationship between intensity of perceived orange colour of sweet potato and carotenoid content is shown in figure 13. We can see that it is logarithmic and hence small changes at low concentrations of carotenoid content lead to large visual changes but these diminish at higher concentrations.
To evaluate what consumers thought we interviewed (475) consumers from rural and urban areas of Uganda who tested four different sweet potato varieties with differing carotenoid contents (figure 14). Overall the acceptance of OFSP was high (82%) but the acceptance of OFSP is more complex.
If we were to consider only the mean acceptance figures for all 475 consumers we find that while all varieties were acceptable, that the deep orange and yellow were most accepted followed by the orange and then lastly the traditional white coloured variety (figure 15).

Figure 15. Mean overall acceptability scores for the four sweet potato varieties tested. Where error bars = standard error; Ejumula = deep orange; Naspot 8 = orange; Tanzania = yellow and Nakakande = white.
We can then divide the consumers into group who view the four varieties in a similar way. We found four different groups being All likers, orange-likers, orange-dislikers and deep orange-dislikers (figure 16). This view suggests that decisions based on the global average might not be that helpful in trying to decide if the product is liked or not.

![Figure 16](image_url)

**Figure. 16. Mean consumer acceptance of sweet potato varieties by group type (orange/yellow/white-likers, orange-likers, orange-dislikers and deep orange-dislikers).**

Where: error bars represent the standard error of the mean; deep orange = Ejumula; orange = Naspot 8; yellow = Tanzania; white = Nakakande sweet potato varieties; O/Y/W = Orange/Yellow/White.
What would be desirable is to find a relationship between acceptance by consumers and the carotenoid (pro-vitamin A) content. Where a relationship was identified the indications are that it is not linear but logarithmic for a small proportion (23%; orange-likers) of consumers (figure 17).

The logarithmic relationship suggests that acceptance initially increases rapidly when the carotenoid content is low but increases less when the content is high. This was also the only consumer group whose acceptance was directly related to the sensory attributes.

For the largest group of consumers (59%), they liked all types of sweet potato tested regardless of the level of the carotenoid content and there was no relationship with the sensory attributes. A minority (18%) of consumers did not like the orange varieties (either orange or deep orange fleshed) and it is assumed that they might not benefit from a nutrition intervention to alleviate vitamin A deficiency involved OFSP.

The proportion of these categories of consumers varied with location with the majority of rural consumers, for whom sweet potato is a staple liking sweet potato regardless of the carotenoid content (figure 18). Urban consumers on the other hand, were more varied in their acceptance. It should be noted that this was based on only four cultivars but the constraint was the limitation in the number of samples that consumers could test at any one time.
Conclusions
The acceptance of sweet potato containing pro-vitamin A in Uganda is more complex than previously indicated with their being differing categories of consumer acceptance and the proportion of these categories varied with location, particularly whether it was rural or urban. Overall the acceptance of OFSP was high (82%) but the relationship between increased carotenoid content of sweet potato and acceptance differed. Where a relationship was identified the indications are that it is not linear but logarithmic for a small proportion (23%; orange-likers) of consumers. For the largest group of consumers (59%), they liked all types of sweet potato tested regardless of the level of the carotenoid content and there was no relationship with the sensory attributes. A minority (18%) of consumers did not like the orange varieties (either orange or deep orange fleshed) and it is assumed that they might not benefit from a nutrition intervention to alleviate vitamin A deficiency involved OFSP. The proportion of these categories of consumers varied with location with the majority of rural consumers, for whom sweet potato is a staple liking sweet potato regardless of the carotenoid content. Urban consumers on the other hand, were more varied in their acceptance. It should be noted that this was based on only four cultivars but the constraint was the limitation in the number of samples that consumers could test at any one time.
DIFFERENCES IN ACCEPTANCE OF BIOFORTIFIED SWEET POTATO BETWEEN MOTHERS AND CHILDREN

Nutrition programmes funded by development agencies are keen to target children under the age of six since replacing the traditional white-fleshed varieties with new high β-carotene OFSP varieties could benefit an estimated 50 million children under age 6 who are currently at risk.

The acceptability of OFSP cultivars to school children and mothers with preschool children was assessed. Young children are capable of learning to like and accept a wide variety of foods, and this learning occurs rapidly during the first few years of life. It has been reported that mothers’ and children’s food preferences are significantly but moderately related. Foods disliked by mothers tend not to be offered to children. Since mothers influence children via their own preferences, this may limit foods offered to children. A further factor is that preferences can vary within a population.

This study aimed to compare consumer acceptability of nutritionally improved OFSP with that of traditional white-fleshed varieties that do not contain significant levels of provitamin A. Children are susceptible to vitamin A deficiency and were therefore targeted. Mothers of preschool children were selected because their acceptance of OSFP can influence which foods they feed their children. The study sought to determine whether school children living in rural areas of Tanzania find the new OFSP varieties acceptable. Because mothers feed sweet potato to children below school age, their acceptance and their perception of how their children liked the OFSP varieties were also measured.

Figure 19: Enumerator interviewing a mother with a pre-school aged child for acceptance of sweet potato containing pro-vitamin A.
To test this, a consumer acceptance study involving school children and mothers with pre-school children in the Lake Zone of Tanzania reported that OFSP is acceptable but also that there were different types of acceptance profile within the consumer population (Tomlins et al., 2007a). An example of a project enumerator interviewing a mother with a child of preschool age is shown in figure 19.

The acceptability scored by the school children (n=94) and mothers (n=59) indicated that they scored the orange-fleshed cultivars as being more acceptable than pale-fleshed ones (figure 20). The mothers, however generally gave slightly higher acceptance scores than the school children. Since evidence suggests that, if mothers find food acceptable they are more likely to feed it to their children, this was encouraging.

Where: error bars represent the standard deviation; although the scale used by consumers was from 1 to 7, the scale in this graph has been extended to 8 so that the error bars can be shown. Resisto and Karote are orange in colour, Polista is yellow and Sinia is white.

Figure 20. Mean acceptability scores for school children (n = 94) and mothers (n = 59) when assessing cooked sweet potato cultivars (in Tomlins et al., 2007a).
MEASURING THE VARIABILITY OF CONSUMER ACCEPTANCE OF RICE IN WEST AFRICAN COMMUNITIES WITH RESPECT TO LOCATION, ETHNIC GROUP AND SOCIO-ECONOMIC FACTORS (TOMLINS ET AL., 2005)

In Ghana, the acceptability of a prototype parboiled rice was compared with existing rice products for sale in the markets that were produced locally or imported. A total of 300 consumers were interviewed in three urban areas (Accra, Kumasi and Tamale). A plot of accumulative acceptance confirmed that at least 100 consumers needed to be interviewed at any one location such that a reliable indication could be obtained (figure 21). Analysis of results indicated that acceptability was not related to ethnic group but was influenced by age and gender. Acceptance also varied by location with consumers tending to prefer the rice sold at their own location (figure 22). Segmentation indicated differing perceptions of the rice samples; most consumers preferred all of the samples while smaller segments of consumers were more discriminatory.

Where: PB = parboiled, US = United State, UE = Upper East, A = Accra, K = Kumasi, T = Tamale

Figure 21. Cumulative mean consumer acceptability plotted against the number of consumers (Accra) (in Tomlins et al., 2005).
Figure 22. Mean consumer acceptability with rice and location (in Tomlins et al., 2005).

Where US = United States, PB = parboiled, UE = Upper East, A = Accra, K = Kumasi and T = Tamale; error bars = standard error.
Models were developed to enable a sensory panel to estimate consumer acceptability for developing improved low-cost parboiled rice processing in Ghana where the imported rice was suggested as a reference standard. A sensory panel could be used for screening rice samples and it more cost effective and less time consuming than consumer testing. Significant linear regression models were developed for either the sensory panel score for brown colour of the cooked rice (figure 23) or the score for unshelled paddy on the uncooked rice. The scores were inversely related to consumer acceptance with respect to three consumer segments that represented 86% of the consumers. Suitable models could not be developed for the smallest (14%) segment of consumers.

Figure 23. Consumer acceptability and brown colour of cooked rice (in Tomlins et al., 2005).

Where:

Segment 1 acceptability = (-0.0936 x brown score) + 7.967; $R^2 = 0.947$
Segment 2 acceptability = (-0.0716 x brown colour) + 7.9185; $R^2 = 0.766$
Segment 4 acceptability = (-0.0469 x brown score) + 8.154; $R^2 = 0.957$
Conclusion
This research suggests that consumer acceptability of parboiled rice could therefore be predicted either from the sensory scores of the uncooked rice or from the cooked product. While using sensory attributes of the uncooked product was the most rapid, the use of the cooked rice is important to confirm the absence of taints and off-flavours. This is also the first time that consumer acceptance of rice among consumers in different locations in Ghana or elsewhere in Africa appears to have been explored using this approach and the first time a more complex multi-modal distribution of acceptability reported. The absence of an ethnic affect might also be because rice is not considered to be a traditional staple product. The models that correlated consumer acceptance and sensory attributes are also reported for the first time for rice and appeared to be linear.
CONSUMER ACCEPTANCE OF STRONGLY TASTING FERMENTED CASSAVA PRODUCTS IN WEST AFRICAN COMMUNITIES WITH RESPECT TO LOCATION, ETHNIC GROUP AND SOCIO-ECONOMIC FACTORS (TOMLINS ET AL., 2007B)

A similar approach used for evaluating the consumer acceptability of rice in Ghana (Tomlins et al., 2005) was applied to fermented cassava products (fufu) in Nigeria (Tomlins et al., 2007b). In contrast to rice, fermented food products are traditional and have strong flavours but little is known about how their acceptance varied. In addition, there was interest in evaluating the acceptance of a newly developed fufu made with a method that produced less environmental waste. Segmentation of the acceptability scores of 300 consumers at three different locations indicated that a wide variation in consumer acceptability and this was influenced by whether fufu was made from pastes or flour. The new paste produced using the more environmentally acceptable method was overall the most preferred. Acceptability was also related to the demographic profiles of the consumers and a non-parametric test (Kruskal-Wallis) was used as a test. Demographic factors that were important were gender, age, occupation and form in which it was purchased. This was summarised by a PCA plot (figure 24). Acceptability was not influenced by location or ethnic group of consumers. The relationship between consumer acceptance and the sensory attributes appeared to be non-linear in many instances (figure 25). It was speculated that the relationship might be non-linear because fufu is an acidic product with a strong odour and flavour. Non-linear relationships between sensory and consumer parameter have been reported elsewhere.
Figure 24. Principal component plot showing the relationship of social and economic profiles of consumers of cassava fufu for each liking segment (in Tomlins et al., 2007b).

<table>
<thead>
<tr>
<th>Sensory attribute</th>
<th>Segment 3 (66% of consumers)</th>
<th>Segment 2 (21% of consumers)</th>
<th>Segment 1 (14% of consumers)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soft texture</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Creamy appearance</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Where: curves illustrate trends only. Curves significant (P<0.05) for soft texture and creamy appearance for segment 1 consumers only.

Figure 25. Graphical relationships between consumer acceptability and sensory attributes (soft texture and creamy appearance) for samples of fufu made from either paste or flour (in Tomlins et al., 2007b).
Conclusion
Acceptability did not differ with respect to where the consumers were located but did vary with age, gender and frequency of eating. Acceptability of fufu, however, was not uniform within the population but was segmented and these segments had differing socio-economic profiles. The publication was also the first to suggest that the relationship between consumer acceptance and intensity of certain sensory attributes was non-linear and might be because fufu is an acidic product with a strong odour and flavour.
SENSORY TESTING AND CONSUMER ACCEPTABILITY TO EXPLORE THE EFFECT OF PROCESSING OF PEANUT BUTTERS

Peanut butter is an established part of the diet in Zimbabwe as a high protein and fat addition to stews, as an important infant food and, in urban communities, as a spread with bread. Groundnuts (Arachis hypogaea) are extensively grown throughout Zimbabwe and peanut butters are increasingly being processed by rural low-income women’s groups involved in small-scale manufacture for home consumption and for sale in either their local areas or urban centres. A constraint to their ability to increase market access for their product is a lack of knowledge of consumer preference with respect to roasting conditions and storage of the product.

Consumer acceptance was explored with respect to peanut butters of varying roasting time and shelf-life. With respect to roasting time, increasing the roasting time from 40 to 55 min was associated with the sensory attributes brown colour, roasted taste and burnt taste. The research into consumer acceptance (n=103) indicated that the optimal roasting time was multi-modal and depended on whether the consumers were considered as a whole (figure 26) or segmented to take into account widely differing acceptability profiles (figure 27). When consumers were considered as a whole, the optimum was 50 min, whereas segmentation suggested two preferred times, with 67% of consumers preferring 40 min (or possibly less) and 23% preferring 50 min. If the whole group had been considered, the roasting time would not have reflected the majority of consumers. During a 48-week shelf-life study of five butters, consumer acceptance did not vary with storage time, but the sensory panel was more sensitive and detected changes in several sensory attributes (especially sticky texture and stale odour).
In conclusion, this appears to be the first time that a multi-modal model has been reported in the literature for acceptability of roasted products with roasting time and that consumer acceptance has been explored using this approach for peanut butters in Zimbabwe.

Figure 26 Consumer acceptability of peanut butters with differing roasting times (40 to 55 min; n=103) (in Tomlins et al., 2007e).

Where: error bars = standard error of the mean

Figure 27. Variation in consumer acceptability with roasting time (Valencia variety) for four differing segments of consumers (in Tomlins et al., 2007e).
SENSORY EVALUATION, CONSUMER ACCEPTABILITY, AFFORDABILITY AND MARKET PRICE OF RICE (TOMLINS ET AL., 2007C)

While descriptive sensory evaluation and central location testing are commonly used to evaluate consumer acceptability the approach was extended to provide information on the affordability and market price of a prototype parboiled rice when compared to other rice samples of known market value (Tomlins et al., 2007c). Promotion pathways were explored during the interviews that explored consumption of rice, purchasing behaviour and how consumers received information (TV and radio). Rice was evaluated by 109 consumers Accra, Ghana for acceptability and affordability. The results suggested that the prototype rice was very acceptable to consumers and had a similar flavour profile to a high value imported parboiled rice. Consumers were segmented with respect to acceptability and then with respect to affordability and this revealed different profiles. With respect to affordability, acceptance differed but not markedly while affordability varied greatly (figure 28). This suggests that consumers, regardless of income have a similar concept of acceptability. The study suggested the market price of the prototype parboiled rice lay within a range from US$0.59 to US$1.00 kg⁻¹ and was influenced by affordability and to a lesser extent acceptability (figure 34). Compared to the products of known market price, consumers appeared to have discounted the prototype parboiled rice and size of the discount depended on the affordability given by the consumer. When, consumer acceptability scores were considered, insights into the perceived market price was possible but not with affordability. Sensory attributes associated with quality were positively correlated with market price but inversely with affordability. Demographic profiles of consumers segmented according acceptability and affordability also differed. Acceptability was more strongly associated with attitudes to consumption and rice purchased whereas affordability was more strongly related to income, gender and uptake of promotion strategies based on rice quality, nutrition and price. The lowest income groups had the least knowledge about rice.
a) Segment 1 (33% of consumers)

b) Segment 2 (24% of consumers)
c) Segment 3 (33% of consumers)

\[ \text{Where: } LP = \text{local parboiled rice}, \ LM = \text{local raw-milled rice}, \ IM = \text{imported raw-milled rice}, \ P = \text{prototype parboiled rice}. \ LP, \ LW \text{ and IM were reference samples, dotted line = acceptability, full line = affordability.} \]

**Figure 28.** Variation in consumer acceptability and affordability of rice with market price for Segments 1 to 4 of consumers with differing affordability (prototype rice is shown as a separate point) (in Tomlins et al., 2007c).
Conclusion

It had been speculated that consumers in the lowest affordability segment might have a different concept of acceptability of rice to those in the highest affordability segment. However, the result of this research suggests that urban consumers in Ghana had a similar concept of acceptability of rice regardless of affordability. This information was useful to the project because it meant that the product was acceptable to consumers with widely differing income levels. There were also gender issues because the lowest income groups comprised a greater proportion of women and they also had the least knowledge about rice. This has implications for policymakers wishing to promote locally produced rice.
EXPLORATION OF HOW MUCH CONSUMERS ARE WILLING TO PAY FOR FOOD PRODUCTS, ESPECIALLY WHEN THEY ARE ALSO GIVEN INFORMATION ABOUT THE POTENTIAL BENEFITS OF THE FOOD PRODUCT

The concept of consumer acceptance can be further extended to include how much consumers might be willing to pay for a food product. Willingness to pay will include additional consumer orientated factors such as their income status and will be influenced by factors such as the price difference, their familiarity with the product, how often they might consume it, what qualities they attach to it, how unique the product is, what the end-benefit it has, how fair they perceive the price to be, whether they think the product is likely to go up or down in price in the short run, and the perceived price when the item is purchased separately rather than as part of a bundle etc.

We have explored willingness to pay with newly developed biofortified crops (sweet potato and maize/corn) that have a potential health benefit because they contain significant amounts of pro-vitamin A and hence can help alleviate vitamin A deficiency. For orange sweet potato (Chowdhury, et al., 2011), we estimated consumers’ willingness to pay (WTP) for biofortified beta-carotene–rich varieties in Uganda and compared their WTP with that for traditional sweet potato varieties. The biofortified sweet potatoes offer the potential of a relatively cheap intervention in reducing the prevalence of vitamin A deficiency; however, the success of this intervention depends largely on the profitability of the biofortified varieties in the local marketplace and on their acceptance by consumers.

Hence, understanding their relative prices has important implications for the design of any large-scale dissemination effort. In our study, respondents tasted the varieties prior to the valuations and valuations were incentive compatible, since respondents had to spend real money depending on the choices they made. Our study shows that consumers in Uganda are willing to pay for biofortified (deep orange) varieties as much as they are willing to pay for the currently consumed traditional (white) varieties. Even in the absence of a promotional campaign, the deep-orange variety can, on an average, compete on par with the traditional white varieties in the market. To the extent that sweet potato is produced and consumed on farm, provided the agronomic properties are acceptable to farmers, there may not be any significant discount in the market. Given that no significant discount is associated among rural as well as urban consumers, the biofortified varieties that we evaluated should be accepted in large scale, and a market for biofortified sweet potatoes in Uganda seems feasible.

The impact of nutrition information is sizable. When informed about the nutritional value of OSP, consumers were willing to pay a substantial premium for the biofortified sweet potato. Although (given the one-to-one nature of the nutrition communication) the possibility of experimenter demand effect on the subjects cannot be entirely ruled out, our results suggest that an information campaign that translates into a premium may be the key to rapid dissemination of the deep-orange sweet potato variety. Since nutrition information given to subjects in our experiment was similar to the one planned for the actual dissemination, NGOs and government bodies interested in promoting OSP can immediately use it for wider dissemination. Other factors that positively influence consumers’ WTP include landownership—a proxy for income and years of schooling. The presence of children under five years old also influences WTP positively, which is an important finding, since children under the age of five in Uganda and in other developing countries suffer the most from micronutrient
deficiency. Taste factors are important, and significant premiums and discounts are associated with tastes. This implies that in addition to agronomic properties, plant breeders need to pay attention to taste as well; a factor that has already been incorporated into international breeding efforts. This will ensure that biofortified sweet potatoes are not only accepted for production by farmers but will also become a part of consumers’ diet in Uganda, and thus contribute to the reduced prevalence of vitamin A deficiency.

A primary motivation in the use of hypothetical treatments and cheap talk scripts was to see if they could substitute the need for real product trials. Given the upward bias found in hypothetical treatments with and without cheap talk, it is apparent that the introduction of new biofortified foods needs to go through real trials. Our results confirm the presence of hypothetical bias. The introduction of a cheap talk script does result in a significant reduction in valuations, even when the script does not mention the direction of possible bias. However, the estimated WTP and marginal WTP are higher than those obtained in the real treatment, suggesting that while the bias is reduced, it is not eliminated. The additional expense of working with real incentives and products appears justified.

We also explored how much consumers in rural Zambia will pay for orange maize which contains pro-vitamin A (Meenakshi et al., 2012). Recently, plant breeders have developed biofortified varieties of maize that contain higher concentrations of provitamin A and are therefore orange in colour (figure 29). Since maize is a staple food in Zambia, as in much of Sub-Saharan Africa, the successful introduction of biofortified provitamin A maize could have a significant impact on reducing the prevalence of vitamin A deficiency in these areas. However, its success will depend on whether it is accepted by the target populations. This may be a particular problem if orange maize is confused with yellow maize. In Southern Africa, yellow maize is believed to have inferior taste, perceived as “drought” food and associated with bad times (survey of 478 respondents in two provinces of rural Zambia formed the basis of analysis. We compared the following scenarios:

a) Location when the consumer was interviewed and length of time they interacted with the new product (short time in a market or longer time at home)

b) The giving of nutrition messages and by different methods (radio or community leader)

Conclusions:
The main empirical findings were as follows:

• The WTP for orange maize equals or slightly exceeds that of white maize even in the absence of a nutrition campaign.

• Nutrition campaigns translate into improved acceptance and willingness to pay for orange maize.

• These results are robust to choice of setting (market vs home testing).

• There is no appreciable difference in the impact of information received from community leaders versus information received from the radio, which has significant cost implications.

In interpreting these results, it is important to note at least two caveats: first, the results may have been influenced by the presence of an endowment and other effects, which the econometric specification could not account for completely.
This may be one reason that the WTP magnitudes are higher in absolute terms in the HUT arms, than in the CLT arms. However, irrespective of the absolute magnitudes of WTP, there is no reason to expect that the marginal WTP would be influenced by the presence of an endowment effect. Second, the length of time that consumers had to try the different maize’s may not have been long enough to overcome a novelty or experimenter effect on the orange maize. With these caveats in mind, the primary implication of the results is that there is no reason to believe that any negative connotations associated with yellow maize will necessarily carry over to orange maize; orange maize carries no discount even in the absence of nutrition information. Provision of nutrition information translates into a premium for orange maize over white, while yellow varieties continue to suffer a discount. This result may seem counterintuitive given the substantial literature documenting the discounts on yellow maize in southern Africa. However, the fact that the willingness-to-pay estimates replicate the expected discount for yellow maize, suggests that the favourable findings for orange maize is likely robust and not an artefact of the methods used. Moreover, the taste tests, which were conducted by food scientists prior to the choice experiment, indicate that the scores for orange and white maize’s are similar for all attributes (in the absence of information) which in turn are higher than those for yellow maize. Finally, it is worth noting that historically, traditional maize varieties in Africa were multi coloured, as detailed by McCann (2005) who devotes an entire chapter titled “How Africa’s Maize Turned White.” Thus a non-white maize would not automatically be equated with the inferior yellow maize. An intriguing result relates to the near equivalence of mass media and community-level communication strategies in influencing consumer acceptance. While it is not the intention to posit these as “either–or” strategies, these results suggest that the role of mass media in communicating and reinforcing messages is likely to be significant. In sum, subject to the caveats noted above, our study suggests that biofortified orange maize may not be confused with yellow maize in rural Zambia, and may fare well compared to white maize. With an appropriately designed nutrition campaign, it has the potential to have a significant public health impact.

![Figure 29: White, yellow and orange maize/cornia.](Photo Keith Tomlins, NRI, University of Greenwich)
ACCEPTANCE OF TRADITIONAL AFRICAN FOODS BY AFRICAN AND NON-AFRICAN CONSUMERS

Taking novel traditional foods from viable local markets to high value international markets in Europe is attractive because of the potential for income generation. While some African products are sold in small quantities to the African Diasporas in EU countries, few indigenous foods have been sold in any volume outside their countries of origin. Consumer acceptance is important in marketing strategies and in product development in both the EU and Africa. Along with product development and economic viability, this will give food companies confidence to adopt these products in the EU and Africa. While consumers seek convenient and healthy products, taste is consistently rated as the most important factor that drives consumption and repeat purchase of consumers. However, little is known about how food and drink products that are indigenous to Africa will be accepted both in Africa and in Europe. The research will seek to primarily explore the factors that influence consumer acceptance from a taste perspective for the indigenous products. Rural and urban consumers in the EU and Africa appear to readily accept new products with distinctly different sensory characteristics. However, the distinct sensory differences can have implications in product development.

In this research, African and non-African consumers tested a selection of traditional African foods. These were products that were quite different.

- Hibiscus drink (bissap) in Senegal. Infusion made from the flower calyx (juice or syrup) (figure 30)

- Kenkey in Ghana – popular traditional fermented food made from maize and is a staple for most of the peoples in the coastal regions of Ghana. It is a sour tasting cooked stiff porridge of elastic consistency made from fermented whole meal maize (Figure 31)

- Akpan from Benin - yoghurt-like product prepared from a partially fermented cooked maize gruel, named ogui. It is usually mixed with condensed milk, ice and sugar by street vendors just before consumption. It is the most commonly consumed beverage in Benin. (figure 32)

Figure 30: Hibiscus drink
We interviewed both African and non-African consumers who tasted the Kenkey in Ghana, Akpan in Benin and Hibiscus drink in Senegal and scored for acceptability. They also answered questions about how they use the products. In each country we classified each consumer according to their preference characteristics regardless of where they were from as follows:

- Hibiscus drink in Senegal = all-likers, infusion-likers and syrup-likers (figure 33)
- Kenkey in Ghana = all-likers, white-likers and banku-likers (figure 34)
- Akpan and Benin = ogui-likers, sweet & milk-likers, Akpan-dislikers and Akpan likers (figure 35)

Hibiscus drink – no difference between EU and African. Both are familiar with the drink.
We applied a simple chi-squared test to explore how the African and non-African consumers might differ.

**Figure 34.** Acceptance by African and non-African consumers in Ghana of Kenkey

**Figure 35.** Acceptance by African and non-African consumers in Benin of Akpan
A trend we noted is that when the consumption of the product was high in both African and non-African consumers, the acceptance in both groups was similar but when one group consumed it more frequently than the others, in this case the African consumers, the acceptance between the groups differed. However, in all cases the form of purchase and place of purchase can differ.

<table>
<thead>
<tr>
<th>Product and Country</th>
<th>Difference in acceptance between African and non-African consumers found?</th>
<th>Consumer characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>African</td>
</tr>
<tr>
<td>Hibiscus in Senegal</td>
<td>No</td>
<td>Consumption</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Form of Purchase</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Place of purchase</td>
</tr>
<tr>
<td>Kenkey in Ghana</td>
<td>Yes</td>
<td>Consumption</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Form of Purchase</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Place of purchase</td>
</tr>
<tr>
<td>Akpan in Benin</td>
<td>Yes</td>
<td>Consumption</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Form of Purchase</td>
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<tr>
<td></td>
<td></td>
<td>Place of purchase</td>
</tr>
</tbody>
</table>
A exploration of the relationship between sensory attributes and consumer acceptance indicated that many African consumers of kenkey had a more complex non-linear relationship with changes in sourness, the main characteristic of the product. It is anticipated that this is because they are more familiar with the product (figure 36)

**African consumers**

![Graph showing the relationship between acceptance and sour taste of Kenkey for African consumers.](image)

**Non-African consumers**

![Graph showing the relationship between acceptance and sour taste of Kenkey for non-African consumers.](image)

*Figure 36: Relationship between acceptance and sour taste of Kenkey for African and non-African consumers*
Conclusion

We can conclude that where African and non-African consumers were both familiar with a product they tended to have similar acceptance patterns. However, when the non-Africans were not familiar with the product, acceptance patterns differed. In all cases, regardless of whether African or non-African consumers were familiar with the product, the form of consumption and place of purchase can differ. When we explored the relationship between acceptance and sensory attributes for fermented foods, it was more complex for many African consumers and may be because they are more familiar with the product. This information can help with marketing strategies and approaches for product development.
IMPACT ON DEVELOPMENT

Understanding food quality and acceptance is important for contributing to the Millennium Development Goals and the Post 2015 agenda. It is a cross cutting area of research that involves donors, the public sector, NGO’s, farmers, householders, academia and the private sector. Food quality and acceptance is important along the food chain from the development of new food crops, food processing, food handling and transport and marketing and promotion to people in rural and urban areas.

Considering the research on food acceptance led by researchers at NRI, the research that used the ‘electronic sweet potato’ to understand the effect of handling on quality and price has led to a reduction in sack weight and size in some markets in Tanzania and this may not only lead to an improvement in quality and price but also had a health benefit for the porters. A report by DFID regarding the introduction of orange sweet potato into Uganda and Mozambique stated in the lessons learned that ‘Conducting a consumer acceptability study of OFSP as a new product was essential to the project success’. For orange maize in Zambia harvestplus recently reported ‘Results from the study show that the orange colour of the provitamin A maize is not a hindrance to consumer acceptance. Consumers who received nutrition information, whether through radio or community leaders, were more likely to accept the new variety of maize, suggesting the importance of mass media and interpersonal communication in encouraging consumer adoption. Within two years, provitamin A maize should be released in Zambia, where it has the potential of being a life-changing crop for many.’ Regarding traditional African foods, based on our research, EU and African partners are using the results to work together to develop improved products for both African and EU markets.

THE FUTURE

Significant progress has been made over the past 30 years in understanding food quality and acceptance and ensuring that poor people can achieve their right to food that is acceptable to them. NRI, in collaboration with partners overseas has made a major contribution to this and will enable poor people to have better access to CAKE, or rather foods that are more appropriate to them and at a price they can afford. There remain several major challenges:

a) Further develop improved handling and transport because this is still a major cause of food wastage and loss in developing countries. Continued research is needed and the availability of cheaper and more powerful sensors can help researchers to advise industry and policy makers.

b) Improve the capacity and skills in sensory and consumer research facilities in developing countries. Without this capacity, the capability of research and development specialists to develop new crops and products that meet the needs to consumers and those who produce the products and advise policy makers will be limited.

c) More closely link consumer acceptance research with market research and socio-economics. This is important so that new products and crops developed as well as being acceptable meet market requirements and at an affordable price (local, regional and international markets).
d) Further develop the ability of sensory evaluation and consumer acceptance to help poor people by linking this to understanding consumer behaviour with respect to purchase decisions, decisions to grown, context of eating and how promotion information is understood.

OVERALL CONCLUSIONS

In this lecture I have tried to give a taste of the breadth of research that has been carried out in food quality and acceptance with a specific focus on the Natural Resources Institute, University of Greenwich activities. Food chains are complex and I have described how food and quality and acceptance can be important at all stages as this can influence access to nutrition, livelihoods and food security.

Much of the research has been applied and applied to specific crops and situations, but research that explores consumer behaviour and marketing related to poor people would also be immensely beneficial.

Food quality and acceptance involves a wide range of challenges because of the diversity of food and drink products and situations in which they are grown, handled and transported, processed, consumed and marketed. Researchers are only just beginning to understand many of these issues. Investing in research on food quality and acceptance will provide a means for making an impact on the health and wellbeing of low income consumers as well as improving the livelihoods and incomes of those who produce the products.

This lecture has focused on food quality and acceptance related to people on low incomes. As indicated at the start of the presentation, I agree with Marie Antoinette and I too believe that poor people have a right of access to food that is of good quality and is acceptable. Myself, and my colleagues at the Natural Resources Institute, University of Greenwich and other organisations in the UK and overseas intend to continue to make an active contribution towards this goal.
ACKNOWLEDGEMENTS

I would like to thank the many colleagues in the UK and overseas in Ghana, Nigeria, Tanzania, Zimbabwe, Malawi, India, Australia, Zambia, Benin, Senegal, Portugal and France (many of whom are mentioned as co-authors of the publications I have cited) and with whom it has been a pleasure to collaborate with during my professional career. I would specifically like to thank Emeritus Professor of Food Safety at University of Surrey for suggesting that as a recent graduate, I apply for a job at the then Tropical Products Institute, London, Professor Andrew Westby who has been a constant source of encouragement over the years, David Baker for introducing me to consumer research and Professor Ray Coker and Dr Ken Jewers who taught me much about the scientific approach and discipline early in my career.

My acknowledgement would not be complete without mentioning my wife, Mary, who has been a constant support, my children who put up with me being away much of the time and my parents who gave me such a good start in life.

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