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Analysis of Markets in the United States for Brazilian Fresh Produce Grown in Massachusetts

Raquel U. Mendonca
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ANALYSIS OF MARKETS IN THE UNITED STATES FOR BRAZILIAN FRESH PRODUCE GROWN IN MASSACHUSETTS

A Thesis Presented

by

RAQUEL UCHÔA DE MENDONÇA

Submitted to the Graduate School of the University of Massachusetts Amherst in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE

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Plant, Soil & Insect Sciences
ANALYSIS OF MARKETS IN THE UNITED STATES FOR BRAZILIAN FRESH PRODUCE GROWN IN MASSACHUSETTS

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To my family, parents, and grandparents.
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ABSTRACT

ANALYSIS OF MARKETS IN THE UNITED STATES FOR BRAZILIAN FRESH PRODUCE GROWN IN MASSACHUSETTS

MAY 2007

RAQUEL UCHÔA DE MENDONÇA, B.S., FEDERAL UNIVERSITY OF CEARÁ

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Directed by: Professor Francis X. Mangan

This study analyzes the distribution system of fresh fruits and vegetables used by Brazilian population in Massachusetts, which is estimated to be over 250,000. Maxixe (Cucumis anguria) and abóbora híbrida (Cucurbita spp.), vegetable crops popular among Brazilians were used as test crops to better understand the distribution system and to assess the most efficient way for local farmers to enter into the marketplace with their fresh produce. In person interviews with Brazilian consumers, and test marketing were used in this research to evaluate sales potential and pricing levels for abóbora híbrida produced in Massachusetts. The squash was sold at four locations during two weeks at specific pricing levels and results showed good sales potential for this crop. Yields and production practices were evaluated at the UMass Research Farm to test productivity and adaptability of this squash in local climate conditions. Results of this pilot study also underscored the importance of local farmers understanding the role of cultural characteristics of the Brazilian community in the United States, especially with regard to language and media, in order to fully capitalize on this market.
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INTRODUCTION

The composition of the population in the United States is changing rapidly as immigrant groups increase at rates not seen since the early 20th century. These communities desire products that are part of their cuisine and culture, and as results, the market demand for specific agricultural products bring opportunities for local farmers to produce the specific fresh fruits and vegetables desired by these expanding markets. The size of the market for these new products is substantial and growing proportional to the growth of the immigrant populations that desire them.

Brazilians started migrating to the United States during the 80’s. The Brazilian population in the U.S. represents a growing immigrant market and estimative shows that Massachusetts has the largest population, followed by Florida, California, New York, and New Jersey. In recent years, supermarkets have become more aware of these growing ethnic markets and are devoting more inventories to products desired by these groups. Additionally, they are putting resources into advertising and marketing campaigns with the intention of attracting these groups to their stores.

Brazilian consumers show a strong desire to purchase traditional fruits and vegetables, which they are familiar with origin and taste, if available in the US markets. Abóbora híbrida (Cucurbita spp.) is a popular variety of squash in Brazil. It has never been grown commercially or evaluated by researchers in the Northeastern US. Therefore, markets that cater to Brazilian consumers have been selling other varieties of hard squash as substitutes for abóbora varieties popular in Brazil. Some of these stores label these substitute varieties as “abóbora” in deference to their Portuguese-speaking customers.
Cultivars in the Cucurbita genus, which originated in the tropical Americas, are staples in many of the countries of origin of immigrants in the U.S., especially those from the Americas. It is essential to evaluate species and cultivars of crops for their adaptation to local growing conditions before growing them commercially. It is equally important that farmers understand the costs and returns for the agricultural products they grow on their farm in order to evaluate the viability of the specific product and their operation as a whole.

There are no studies that document the popularity of squash substitutes within the Brazilian community living in the United States, the demand for abóbora híbrida if it were available in U.S. markets, the production aspects, and the profitability of this crop. The goal of this project was to evaluate the marketing and production potential for abóbora híbrida grown in Massachusetts and tested in markets in the Northeastern US.

These are the objectives of this project:

1. Describe the distribution system of fresh produce used by the Brazilian population allowing farmers to maximize sales through specific channels, and understanding the differences between the different categories of business and the influence of ethnic media;

2. Access the substitution of abóbora híbrida by Brazilians living in the US and the price levels that consumers are willing to pay for the Brazilian squash variety rather than other types available in the market, and evaluate results from surveys and test marketing sales experiment;
3. Evaluate production practices and yields for abóbora híbrida conducting trials at the UMass Research Farm, analyzing the viability of production for this crop in Massachusetts.
1.1 Introduction

The demographics of the United States are changing rapidly as immigrant populations increase at rates not seen since the early 20th century. In 2005, 7.9 million immigrants came to the United States, the largest number in a single year in the U.S. history. In 2005, it was estimated that there were more than 35 million immigrants (both legal and illegal) living in the U.S. (Center for Immigration Studies 2005). The Hispanic population in the U.S., according to U.S. Census Bureau reports, estimated to be 38 million in 2003, is expected to jump to 49 million in 2015. The Asian population, estimated at 12 million in 2003, is expected to grow to over 17 million in 2015 (Bushnell 2004).

Massachusetts has also experienced a strong increase of immigrant groups in recent years. According 2005 Census estimates Hispanics are the largest ethnic minority in the state with 8% of the population, outnumbering African-Americans (7%). Asians represent 5% of the total population, a number which is increasing (Abraham 2006). Forty percent of the southeastern Massachusetts population is of Portuguese and Cape Verdean backgrounds. About 150,000 Brazilians live in greater Boston and Cape Cod, making Portuguese the second most spoken language in Massachusetts according to the U.S. Census (Rapoza 2000).

The Brazilian government estimates that there are 1.5 million Brazilians living in the U.S., both legal and illegal (The New York Times 2005). The major concentrations of
Brazilians in the U.S. are found in Massachusetts, New York, New Jersey, Florida and California. Exact numbers are difficult to quantify because the fact that a large percentage of the Brazilian population in the U.S. is not legal and therefore are not accurately counted by the U.S. Census. In 2000, the U.S. Census estimated that there were 36,669 Brazilians living in Massachusetts and in 2005 the U.S. Census updated this number to 84,836 (Levenson and Zheng 2006). The Brazilian Consulate in Boston and the Brazilian Immigrant Center in Allston, MA estimate there are at least 250,000 Brazilians living in the State (The Boston Globe 2006). This underscores the inability of the U.S. Census to estimate accurately the real numbers of new immigrant groups, especially those with questionable legal status. Penaloza (1994) also found similar discrepancies between the official and real numbers of a Mexican population being studied in California. They estimate that the undocumented Mexican population living in the United States, which is largely ignored by the U.S. Census, is two-thirds of the total Mexican population in the United States.

The dramatic increase in immigrant population has had a significant effect in the U.S. marketplace, including in markets carrying fresh fruits and vegetables. These immigrant groups desire products that are part of their culture, items that are readily-available in their countries of origin but historically rarely available or unavailable in U.S. markets. The U.S. marketplace has responded increasing important of specific products desired by these new markets, as well as from domestic producers where possible.

Cassava (*Manihot esculenta*) is an example of the increased importation of crops used by these growing immigrant populations. It is a staple in many countries located in
the tropics, including Brazil, the center of origin for this root crop. In 2000, the first year the USDA began tracking the imports of cassava, over 26 million pounds were imported into the U.S. This amount has risen to almost 100 million pounds in 2006 (Figure 1.1). Cassava is imported almost exclusively from countries in Latin America. The increase in cassava imports is not only due to increased market demand, but also decreased domestic production. Cassava production was in excess of 1,000 acres in Southern Florida in the early 1980’s, but production decreased dramatically because of quality issues and the lower cost of production in Latin American countries. In 2006, cassava acreage was estimated to be less than 30 acres in Florida (Lamberts 2007).

The size of the market for these new products is substantial and growing proportional to the growth of the immigrant populations that desire them. In 2002, Hispanics, Asian-Americans and African-Americans represented 31% of the U.S. population, yet they accounted for 37% of all sales in supermarkets (Grow with America 2002). In 2006, Hispanics had a buying power of $798 billion, and it is expected that by 2011 it will reach $1.2 trillion, accounting for 9.5% of all U.S. buying power (Humphreys 2006). In Hispanic grocery stores, 22% of total sales come from the produce department, which is over twice the national average (Produce Marketing Association 2006). These changes in the U.S. population and the resulting increased market demand for specific agricultural products bring opportunities for local farmers to produce the specific fresh fruits and vegetables desired by these expanding markets.

Starting in 1996, several research projects have been implemented under the leadership of University of Massachusetts (UMass) to investigate cultural requirements and market conditions for vegetable crops used by the growing immigrant population in
the state and region. Research began with crops popular with Hispanics, specifically Puerto Ricans and Dominicans, and subsequently with vegetable crops popular among other Latino groups, Asians and Brazilians. Although most of the recent immigrants to the United States are coming from tropical climates, most of the vegetable crops popular in these countries of origin can be grown in the Northeastern United States. More than 70% of the almost 20,000 acres of vegetables grown in Massachusetts are crops that have their center-of-origin in tropical climates such as sweet corn, pumpkins, squash, peppers, and tomatoes (USDA National Agricultural Statistics Service 2002). There are very few vegetable crop species that cannot be grown in the Northeastern United States. Following this research there are currently commercial farmers in Massachusetts growing vegetable crops desired by these growing immigrant groups. Examples are calabaza (Cucurbita moschata), ají dulce (Capsicum chinense), and water spinach (Ipomoea aquatica) (Rulevich et al. 2003; Casey et al. 2004; Mangan and Bunnell 2004).

Beginning in 2002, research and extension activities have focused on crops popular with the Brazilian population in the state and region (Extension News 2004). Crops investigated for local production have included jiló (Solanum gilo), maxixe (Cucumis anguria), abóbora (Cucurbita spp.), taíoba (Xanthosoma sagittifolium), and okra (Albemoschus esculentus). The most successful crop to be grown by commercial growers as of 2007 has been jiló (Mendonça et al. 2006). For this study, the market demands for abóbora and maxixe were evaluated at selected stores.

Abóbora híbrida (Cucurbita maxima x C. moschata) is the most important hard squash used in the Brazilian cuisine throughout the country, especially in the Southeast region. “Abóbora” is the generic name for hard squash in Portuguese and “híbrida”
means “hybrid” in Portuguese. This name is used, since it is one of the few hybrid pumpkin varieties used in Brazil. Other names for this squash in Brazil include *abóbora japonesa* (Japanese pumpkin) and *abóbora moranga*, a name commonly used for a popular open-pollinated squash in Brazil (Almeida 2007). The first commercial hybrid, ‘Tetsukabuto’, was developed in Japan and was introduced to Brazil in 1960. Abóbora híbrida is an important vegetable in many Brazilian recipes including salads, soups, and meat dishes. It can also be canned or used as a baby food. Consumers look for the deep orange flesh and because of this it is commonly sold halved and wrapped in plastic (Filgueira 2003).

Maxixe is a vegetable, similar to cucumber (*Cucumis sativus*), that is believed to have originated in Africa and to have come to Brazil with the slave trade. It is most popular in Northeastern Brazil; however, it is found in many other parts of the country where it is used in salads and soups, and cooked with beef dishes.

The focus of this paper is to describe the distribution system of fresh fruits and vegetables used by the large and growing Brazilian population in Massachusetts. Farmers in Massachusetts are interested in growing more fresh produce desired by this large and growing immigrant group, and it is critical to have an understanding of the established distribution system in order to be successful in this market.

1.2 Categories of businesses that sell fresh produce to Brazilians in Massachusetts

Massachusetts has more than 1,000 Brazilian-owned businesses. These include small markets, restaurants, butcher shops, clothing stores, bakeries, travel agencies, among others (Costa 2007). It is estimated that there are approximately 300 Brazilian
stores that carry at least some fresh produce in Massachusetts (Farias 2007). The focus of this study was on businesses that are involved in the distribution system of fresh produce to the Brazilian. These included non-Brazilian owned businesses (i.e. wholesale distributors, traditional supermarket chains, and farmers’ markets) that carry Brazilian products and locally-grown Brazilian produce. Figure 2 shows these businesses in the supply chain and their connections as well as how Brazilian consumers are getting fresh produce. It is estimated that the most important source of fresh fruits and vegetables are traditional supermarket chains. However, the overwhelming majority of fresh fruits and vegetables that are consumed by Brazilians in the state of Massachusetts are being produced outside the State. A central player in the distribution of fresh fruits and vegetables to all markets is the Terminal Wholesale Market in Chelsea MA. Except for farmers’ markets, the vendors based in the terminal market supply fresh produce to all of the businesses categories.

1.2.1 Brazilian Restaurants

There are more than 100 Brazilian-owned restaurants in Massachusetts (Vitorino 2007). The majority of these restaurants get their fresh fruits and vegetables from the Terminal Wholesale Market in Chelsea, MA (described below), either by buying directly or hiring jobbers that buy for them. Some restaurants will buy certain locally-grown vegetables that are popular in their cuisine and difficult to get wholesale directly from farmers. An example is jiló, a vegetable very popular in Brazilian cuisine, which at times is difficult to get through traditional channels. A very small amount of fresh produce, however, is bought directly from farms.
1.2.2  Brazilian Small Markets

The approximately 300 small Brazilian stores in Massachusetts carry specific products used by Brazilians on a regular basis and are located in areas with large concentrations of Brazilians. These stores carry a range of products that can vary tremendously from store to store and include Brazilian CDs and DVDs, cosmetics, clothing, and canned products, such as drinks, rice, beans and other processed products. A high percentage of the products in their inventory are from Brazil. Frequently there is butcher shop or a bakery. Fresh meats are a very important part of the Brazilian cuisine, and the cuts preferred are different than those found in traditional U.S. butcher shops. There are also types of bakery goods that are unique to Brazilian culture and not found in mainstream U.S. stores. The amount of fresh produce carried by these stores varies greatly and usually focuses on items highly desired by their clientele. Stores in this category carry fresh produce popular among Brazilians that do not require cooling facilities (e.g. onions, hard squashes, cassava). Some stores have more advanced cooling facilities and will carry a range of produce with shorter post-harvest lives (e.g. collards, jiló).

As with Brazilian restaurants, stores in this category get the majority of their produce from the Terminal Wholesale Market in Chelsea, either directly or from independent distributors (jobbers). Some wholesale companies based at the terminal market will deliver to individual stores for a service fee.
There are two “ethnic” supermarket chains in Massachusetts that carry Brazilian products. One is Brazilian-owned and caters directly to this community. It has four stores located in cities with large Brazilian populations: Framingham, Somerville, Hyannis and Shrewsbury. Each store carries a large inventory of processed products along with a meat department and a bakery, similar to the Brazilian small markets. The stores have a larger produce sections than those markets, including fresh fruits and vegetables used in the Brazilian cuisine. The majority of the produce comes from the Terminal Wholesale Market in Chelsea MA. Kaufman et al. (2000) describes a “chain” store as “operating 10 or more stores or outlets”. This business with only four stores would not fit their definition; however, for the purposes of this study we consider this a chain store in order to differentiate it from “small markets” in which one individual has control over sales. Kaufman et al. (2000) would refer to this business as an “Independent owned retail-store”.

The second “ethnic” supermarket is a Portuguese-owned chain with 17 stores in four states: New Jersey, Rhode Island, Massachusetts, and Florida. Traditionally these stores were located in areas with large Portuguese communities, but they are now expanding into areas with other immigrant and traditional customers. They currently have four stores in Massachusetts in the following cities: New Bedford, Fall River, Swansea and Attleboro. Because of the large and growing Brazilian populations in many of the cities where these stores are located, the amount of Brazilian products carried by these stores has increased dramatically. The percentage of Brazilian clientele at the 17 stores varies widely, ranging from as low as 5% to as high as 90% (Cadima 2006). The chain
has a main warehouse for fresh produce located in Newark, NJ, but also has warehouses in other states, including Massachusetts. They order their fresh produce from many sources, including terminal markets in New York and Miami. They will also buy directly from farmers.

1.2.4 “Traditional” Supermarket Chains

There are at least 10 “traditional” supermarket chains with stores in Massachusetts that are important sources of fresh fruits and vegetables for immigrant groups, including Brazilians. One supermarket chain, with 59 stores in Massachusetts and New Hampshire, has actively targeted these growing immigrant communities by offering many products, both fresh and processed, desired by these groups. Many of these stores have aisles with signs such as “Ethnic”, “Mexican”, “Asian” and “Brazilian” where they sell processed products used by these groups. This supermarket chain carries a line of Brazilian non-perishable food products (e.g. drinks, flour, candies) and frozen foods (e.g. okra, cassava) popular among Brazilians. The produce manager of one store estimated that Brazilians make up 40% of their customer base. This chain has a central warehouse from which the majority of the fresh produce is distributed to all their stores. The warehouse receives deliveries from farms, local and outside the State, and from brokers throughout the country. Only what they call “tropical products” such as cassava and bananas are delivered to individual stores from the Terminal Wholesale Market in Chelsea (Shea 2007).
1.2.5 Wholesale-Retail Fruit and Vegetable Markets

This category describes larger independent markets that carry significant amounts of fresh fruits and vegetables that are not chain stores and have a significant ethnic customer base. Kaufman et al. (2000) would refer to a store of this nature as a “green grocer”, in which at least 50% of the sales are from fresh produce. Stores in this category function as both retail and wholesale operations. They have a retail space but also sell fresh produce to independent businesses, ranging from restaurants to farm stands. In season, stores studied as part of this work buy a significant amount of their fresh produce from local farmers. These stores also get a significant amount of their fresh produce from other markets when not buying local. These include the Terminal Wholesale Market in Chelsea and other terminal markets and brokers outside the State.

1.2.6 Farmers’ Markets

There were over 120 farmers’ markets in Massachusetts in 2006. Annual sales at these farmers’ markets are estimated to be over $20,000,000 annually (Cole 2007). In Massachusetts, all agricultural products sold at farmers’ markets have to be produced in the state. Given the large number of Brazilians in the State, there are opportunities for farmers to draw these customers to these farmers’ markets by providing fruits and vegetables used in their cuisine.

1.2.7 Jobbers

These are small to medium size wholesale operations that buy products from larger wholesale operations and deliver them to retail businesses (Kaufman et al. 2000).
The largest source of fresh fruit and vegetables for these businesses are the Terminal Wholesale Market in Chelsea MA. One jobber company interviewed is Brazilian-owned and has over 30 accounts in Massachusetts, mostly made up of restaurants and small stores. Another term used at the Terminal Wholesale Market for people in this category is “peddlers”.

1.2.8 Terminal Wholesale Market in Chelsea MA

The New England Produce Center and the Boston Market Terminal, together referred to by many as “Chelsea Market” since it is located in Chelsea MA, play an important role for many farming operations in the State and region. The terminal market focuses on independent retailers and food service accounts (Cook 2001). Many farms in Massachusetts sell wholesale to Chelsea Market, but with the growth of farm stands in recent years, many local growers buy fresh produce from the Chelsea Market to augment their own produce sold at their farm stands. The Terminal Wholesale Market in Chelsea is a major source of fresh fruits and vegetables, either directly or indirectly, in all the categories described above, except for farmers’ markets. One growth area at the terminal market is of fresh fruits and vegetables popular among the growing immigrant populations, especially Hispanic and Asian produce (Mangan 2005).

1.3 Effects of ethnic media for promotion and marketing

According to the U.S. Census the percent of people five years old and over who speak a language other than English at home increased from 18.3% in 2002 to 19.4% in 2005. The rates are slightly higher in Massachusetts, from 18.7% in 2002 to 20.3% in 2005. Spanish-speakers are the largest group, with 12% in the United States. As the non-
English speaking populations have grown in the United States so have media outlets serving these communities. It is estimated that 51 million Americans, 24% of the adult population, are either primary or secondary consumers of ethnic media (Project for Excellence in Journalism 2006).

While mainstream print media is experiencing a downturn in readership, Hispanic media outlets are experiencing strong growth. Hispanic daily newspaper circulation rose from less than 200,000 in 1970 to over 1.6 million in 2005. Advertising dollars have increased in a similar trend to circulation, and were estimated to be $ 996 million in all ethnic media in 2005 (Project for Excellence in Journalism 2007). As a specific example, in 2003, Bank of America Corp., the third largest bank in the U.S., initiated a $50 million multicultural advertising campaign. The campaign, which represented 25% of the total marketing budget for that year, included advertisements in ethnic media in several languages, including $13 million for Spanish-language television advertising (Talcott 2004).

The Brazilian community in Massachusetts also makes great use of media specifically targeting their community. Perhaps the most important media outlet is the television station Rede Globo, which is the largest television station in Brazil, and the third most watched station in the world with 80 million people tuning in daily. The international channel of Rede Globo, which is available in 66 countries in 5 continents, reaches 5.5 million people outside of Brazil (TV Globo Internacional 2007). In the U.S., Rede Globo was first offered by Dish Network and now is also available from Comcast, the largest cable company in United States. A second Brazilian television station is now available in the U.S., called Rede Record (Rede Record Internacional 2007).
In 2004, a 30-second commercial was commissioned by researchers at University of Massachusetts to run on Rede Globo in order to promote the availability of Brazilian vegetables grown in Massachusetts for local markets. The vegetables highlighted in the commercial included jiló, maxixe, and an okra variety popular in Brazil. A phone number and email address were included in the commercial to allow people to get more information on the availability of these crops. Over 120 phone calls and emails were received from Brazilians desiring these products, demonstrating the impact of the commercial. A focus of the commercial was to emphasize the fact that these vegetables were grown locally and the seed was obtained from Brazil, confirming their authenticity. Many Brazilians contacting project personnel via email and phone relayed their excitement about being able to buy these vegetables in the United States for the first time.

In this same year project personnel from UMass were interviewed on a popular TV show on Rede Globo International, Planeta Brasil, about local farmers growing Brazilian vegetables and local markets that were carrying them. This is one of the few shows on Rede Globo that is not produced in Brazil and focuses on stories of interest among Brazilians living outside of Brazil, in particular in the United States. Both the commercial and the segment on Planeta Brasil played an important role in promoting the sales of these vegetables, not only in 2004 but in subsequent years. During the interviews with consumers many Brazilians mentioned that they had seen the commercial and segment on Planeta Brasil.

In May of 2005, an event was organized by UMass personnel to evaluate sales potential for vegetable transplants that can be sold as bedding plants to the Brazilian community. Specific vegetable transplants were produced and brought to the market.
These included transplants of maxixe, taioba, and okra. To promote the event, an article was published in a Brazilian newspaper called *Brazilian Voice* based in Newark, NJ because the store manager recommended this newspaper as the most popular one among the Brazilians in Newark. During the course of the event in person interviews were conducted with 30 Brazilians and results showed that 47% of the respondents saw the article in the Brazilian newspaper. This newspaper is written exclusively in Portuguese. Other examples of Brazilian newspapers produced in the United States that are exclusively in Portuguese are: A Notícia, Metropolitan, Brazilian Press, National Brazilian Newspaper, among others. They are all free and are available in the majority of the 1,000 Brazilian stores in Massachusetts.

1.4 Purchasing habits for maxixe and abóbora híbrida

In person-interviews were used to ascertain food habits for maxixe and abóbora híbrida of Brazilian consumers while living in the United States and in Brazil. Questions focused on their purchasing habits related to abóbora híbrida and maxixe. In particular, they were asked how much they purchased while in Brazil, since these vegetables were not available fresh in the U.S., and what products they buy as substitutes.

A total of 105 Brazilians were interviewed at four stores that are part of an ethnic supermarket chain in specific locations: 36 in Newark, NJ, 32 in Kearny, NJ, 21 in Fall River, MA, and 16 in New Bedford, MA. Surveys were conducted in August and September of 2006. (The focus of this chapter is the distribution system in Massachusetts; however, the information from the surveys in New Jersey, available in the next chapter, is
relevant to the popularity of these two vegetable crops among Brazilians in any state, including Massachusetts).

More than 40% of consumers bought at least 1 kg (2.2 lbs) per week of maxixe while living in Brazil (Figure 1.3). There was a strong relationship between the amount purchased and the state of origin in Brazil. Brazilians from states in Brazil where this vegetable is more popular had a tendency to buy more. More than 10% of those surveyed did not know what maxixe was since they came from states where it is not part of the local cuisine (data on states of origin not shown).

For those consumers that bought maxixe in Brazil, they were asked if they used any fresh vegetables available in the U.S. as substitutes for maxixe. Forty-two percent of those surveyed said that there were no substitutes for maxixe (data not shown), indicating its uniqueness to some consumers. However, 54% of those surveyed said that they buy cucumbers as a substitute. Four percent of customers said that they bought jiló and okra as substitutes, probably since they are both used in a Brazilian dish called cozido, which also has maxixe as a key ingredient.

For abóbora híbrida, consumers were also asked to quantify the amount they bought while living in Brazil (Figure 1.4) and the amount of other types of hard squash they purchase in the U.S. (Figure 1.5). Only 3% of those surveyed were not familiar with abóbora híbrida, emphasizing its popularity in Brazil (Figure 1.4). More than 60% of consumers surveyed bought more than 1 kg (2.2 lbs) per week of this squash when living in Brazil; however, less than 40% buy at least 1 kg (2.2 lbs) per week of a squash substitute in the U.S. (Figure 1.5). These lower purchases of hard squashes in the U.S. by Brazilians are thought to be due to three factors, based on comments by respondents. One
reason is that many respondents said that the substitute squashes available did not have the same taste as the abóbora híbrida. They stated that abóbora híbrida was superior to substitutes available in markets. A second reason stated by some people interviewed was that in Brazil, they were buying for an extended family while in the U.S. many Brazilian consumers were buying for 1 or 2 people in the household. A third reason, specific to Fall River, is that the most popular substitute, calabaza, was not available for sale at that store. Twenty-three percent of respondents in Fall River said that they do not buy any hard squash in the U.S. (data from individual stores not shown).

Calabaza, butternut squash and acorn squash were the most popular substitutes among the Brazilians (Figure 1.6). Calabaza was available in New Bedford, but unlike the stores in NJ, the calabaza was only available as whole squashes. This could have affected sales since Brazilians prefer to buy their abóbora híbrida cut so that they can see the orange flesh, indicating that it is mature. Mature calabaza also has deep orange flesh. As mentioned above, Brazilians in the U.S. appear to be buying for smaller size families compared to when they were in Brazil, and this could also adversely affect the purchase of a whole calabaza. Calabaza fruit can vary in size tremendously, but is often in excess of 10 pounds (Rulevich et al. 2003).

More than 50% of those surveyed said they would be willing to pay “any price” for abóbora híbrida. The answer “any price” shows the respondents’ enthusiasm and desire to purchase abóbora híbrida, and willingness to pay higher prices for this product if available at stores where they shop in the U.S. (Figure 1.7). In Newark, 32% of the respondents were buying calabaza as a substitute (data not shown). The retail price for calabaza during surveys at this store was $0.79/pound. Over 40% of the customers
surveyed at this store said they would pay between 1 and 2 dollars for abóbora híbrida, documenting the strong demand for this squash.

1.5 Dynamics of the distribution system: sales experiments & promotion effects

In order to evaluate the dynamics of some of the businesses categories listed earlier and confirm the results of the customer surveys, abóbora híbrida and maxixe were test marketed at several businesses in Massachusetts. Seed for the abóbora híbrida and maxixe was bought in Brazil (Agristar, Petrópolis RJ) and grown at the UMass Research Farm in South Deerfield MA. Harvested fruit were stored in the cooling facilities at the Pioneer Valley Growers Association (PVGA), a grower-owned cooperative in Whately, MA. Shipments to target stores were coordinated by UMass personnel and the PVGA staff.

Specific markets with large Brazilian customer bases were targeted in Massachusetts for this work. Media campaigns to promote these crops to the Brazilian community consisted of articles in Brazilian newspapers and flyers (mostly in Portuguese) distributed in Brazilian churches, restaurants, supermarkets and other locations to publicize the availability of the product. Point-of-sales materials in Portuguese and English were produced to draw attention to the products on the shelves in the markets.

1.5.1 Abóbora híbrida

The first sales of this hard squash were at a small Brazilian market based in Framingham, a city estimated to have the largest Brazilian population in Massachusetts. The store owner allowed the squash to be sold at a price 50% higher than the retail price
of the two types of hard squashes sold at this market, kabocha (*Cucurbita maxima*) and butternut squash (*Cucurbita moschata*). Within two days, 210 pounds of abóbora híbrida were sold at this store; more than twice the rate of sales of the kabocha and butternut squash. Promotion at this store was carried out almost exclusively by the manager of the store through word of mouth a week before the arrival of the squash. Point-of-sales materials in Portuguese, emphasizing the fact that the abóbora híbrida was authentic, were put with the squash on the shelf. The wholesale price for the abóbora híbrida was set at $0.75/pound, more than twice the wholesale prices of the major substitutes (listed in Figure 1.6). Deliveries of abóbora híbrida were made to this store several times in September and October to allow for a thorough analysis of the size of the market for this squash at this store. The owner of this market estimated that they could sell a minimum of 150 pounds/week of this squash.

Abóbora híbrida was also sold at three stores of a traditional supermarket chain, located in Somerville, Ashland and Chelsea, MA. These stores were chosen due to their large Brazilian clientele, as indicated by management. A major difference in working with these stores compared to the Brazilian-owned store described above is that store and produce managers, who were not Brazilian, were unaware of the popularity of these crops. They needed to be educated on the popularity of the abóbora híbrida and how it should be displayed on the shelves (cut in half so the consumer can see the orange flesh). Another key component of the marketing at these stores was to place point-of-sales materials next to the squash. This material was in Portuguese and English and let the consumer know that the squash was authentic. Since this crop had never been sold in
markets in Massachusetts before, it was important that the Brazilian consumer was assured that it was the popular variety of hard squash from Brazil.

At one of these stores an event was held on September 20 and advertised with an article in a Brazilian newspaper and flyers in Portuguese distributed throughout the Brazilian community in the area of the store. This event featured another crop popular among Brazilians, t'aioba, in addition to abóbora híbrida. Some Brazilians came from over 100 miles away to buy the abóbora híbrida and t'aioba. The store sold over 500 pounds of abóbora híbrida in 4 days.

In stores located in Somerville and Chelsea, 100 pounds of abóbora híbrida were given to the produce managers with point-of-sales materials. These stores had no promotional event, publicity or other type promotion other than point-of-sales materials that were put out next to the squash. Both stores sold the 100 pounds in less than 24 hours. This supermarket chain has 59 stores in MA and NH, many of which have large Brazilian customer bases. It is estimated that this chain store could sell over 3,000 pounds of abóbora híbrida/week.

Two Wholesale-Retail fruit and vegetable produce markets were also targeted to sell this crop, one in Hyannis, MA and another in Watertown, MA. Both of these stores serve large ethnic populations, including Brazilians, in addition to American consumers. A Brazilian employee at the store in Hyannis, MA estimated that Brazilian make up at least 25% of the customers.

At the store in Watertown the only promotion used was point-of-sales materials, in English and Portuguese, which were placed next to the squash. However, both of these stores have Brazilian staff that work in the produce section and were able to promote the
products to Brazilian and non-Brazilian customers. Brazilian staff who at the store in Watertown estimated that there were more non-Brazilians buying this squash than Brazilians. One non-Brazilian customer was interviewed by UMass personnel while purchasing the abóbora híbrida. He stated “Every time I come to this store I always try and buy at least one fruit or vegetable that is different”. The store owner estimates that he could sell at least 175 pounds/week, based on sales from this pilot study.

At the Wholesale-Retail store in Hyannis, an event was implemented to promote the abóbora híbrida and taioba. This event was held on December 30th, 2006 and was promoted with flyers in Portuguese disseminated among the Brazilian community on Cape Cod, estimated to be over 20,000. The 2000 census for Barnstable County (which covers all of Cape Cod) showed about 12,000 Brazilians living there (Shorr 2004). In addition, an article promoting the event in the largest English-language newspaper in the area was published two days before the event. Two Brazilians interviewed at the store said they learned of the event in an article in an English-language newspaper. This store sold over 150 pounds of abóbora híbrida on the day of the event and all 360 pounds given to them in one week. The retail price of the abóbora híbrida at the store was $1.49/pound. The retail price of butternut squash, a common substitute used by Brazilians at the store, was $0.39/pound. The owner said that they would sell a minimum of 150 pounds/week of the abóbora híbrida on a regular basis.

Two Massachusetts stores of the ethnic supermarket chain based in Newark New Jersey were also targeted in this pilot study, one in New Bedford and one in Fall River. Both stores were given abóbora híbrida for two weeks in September. The promotion at these stores consisted of point-of-sales materials in English and Portuguese and a second
article published in a Brazilian newspaper. The article in this popular Portuguese-language newspaper came out a few weeks before the abóbora híbrida was in the market. The article let consumers know that they could find the abóbora híbrida in stores soon and that the seed for the variety came from Brazil, emphasizing its authenticity. In addition, when surveys were conducted at these two stores the week before the abóbora híbrida was on sale, and respondents were told that the abóbora híbrida would be available the next week. Each store sold 70 pounds/week of the abóbora híbrida for the two weeks of the study. The fact that the Brazilian population in these two cities is smaller than the Brazilian populations in the cities and vicinities of the other targeted stores certainly is thought to have been a significant factor in the lower sales.

1.5.2 Maxixe

This vegetable was sold at seven markets in order to estimate the market demand. Four of the stores were the same stores used in the pilot study for abóbora híbrida assessment: one store of a traditional supermarket, two independent Wholesale-Retail stores, and one Brazilian small market. Three markets were not part of the abóbora híbrida assessment: two stores of a different “ethnic” supermarket chain and one farmers’ market. Except for a one-time event at a farmers’ market, the only promotion used with this crop at all stores was point-of-sales materials put with the maxixe on the shelves. The wholesale price for maxixe was set at $2.00/pound. Stores set their own retail price.

At the traditional chain store with a large Brazilian customer base, maxixe was sold for about three weeks, and based on sales, the manager estimated he could sell 100 pounds/week. This crop was also sold at a small Brazilian market on a more limited
basis; the owner estimated that he could sell 60 pounds/week based on experimental sales at the store.

Maxixe was sold at two stores of a Brazilian supermarket chain in Massachusetts for two weeks. One store had positive sales, according to the store manager, and estimated that they could sell at least 60 pounds/week. The second store, which has a larger Brazilian clientele, had much lower sales. In visits to the stores during sales, the store with lower sales had the maxixe in a poor location without point-of-sales materials (they did not use the ones given to them). The store with higher sales had the maxixe in a very prominent place in the store, with point-of-sales materials not only next to the produce but also on the front door of the store, so that consumers would know about this new product upon entering the store.

Maxixe was also sold at the two Wholesale-Retail fruit and vegetable produce markets used in the trial with abóbora híbrida. Sales were modest, and each store estimated they could sell approximately 75 pounds/week. However, both store owners were very interested in the “cross-over” potential of this crop. They both felt that the unusual appearance and the unique taste would be attractive to non-Brazilians.

Maxixe was sold for one day at a farmers’ market in New Bedford, MA on August 2006. This was part of an event to promote several crops popular among Brazilians and Hispanics at the market. To promote the Brazilian crops, flyers were produced in Portuguese and English and distributed among Brazilian businesses in New Bedford. In addition, flyers were also made available at USDA WIC and Food Stamp Offices in the city. Sales of the maxixe at the market were very low, with less than 15 pounds sold. Surveys conducted with consumers at the market documented that only 5
Brazilians came to the event to buy the Brazilian crops promoted. As mentioned above, the Brazilian population in New Bedford is much smaller than other areas where target markets were located; however, it was expected that a larger number of Brazilians would have come to the event given the publicity and the popularity of the crops. One farmer at the market has bought seed to produce and sell at the market in 2007. She feels that there is a good market for this crop among non-Brazilians due to its unique qualities mentioned above. She could not estimate the amount she could sell.

Based on sales data from this study, and considering use of promotional strategies and ethnic media discussed in this research sales estimative for abóbora híbrida and maxixe are summarized on Table 1.1 by businesses categories, which were described earlier in this research.

1.6 Conclusions

The large and growing Brazilian population in Massachusetts has a strong preference for their traditional cuisine, and this represents a market with strong potential for local producers. In order for local farmers to fully take advantage of these opportunities, it is critical that they understand the market demand for the specific products and the distribution system used by the markets that sell these products. The Terminal Wholesale Market in Chelsea, MA is a dominant distribution point for most of the retail markets that cater to Brazilians (Figure 1.2). This is especially true for small Brazilian stores and restaurants, which represent over 400 markets in the state. Most of these 400 businesses sell relatively small amounts of fresh produce per week, and therefore, it is not practical for local farmers to deliver to individual stores. Instead, it
would be more efficient to sell the produce to vendors at the terminal market where these smaller stores buy their produce.

It is important that local farmers understand the difference between Brazilian-owned and non-Brazilian owned businesses. The owners of Brazilian-owned businesses are very knowledgeable about the fresh fruits and vegetables desired by their clientele and are in a position to promote them to their customers. The use of point-of-sales materials and other types of promotion are not as critical with these smaller Brazilian-owned stores, since the employees of the stores can promote the products themselves. A focus of the promotion, including the point-of-sales materials, was to let the community know that these products are authentic (i.e. the specific varieties used in Brazil are being grown by local farmers). However, for businesses not owned by Brazilians that sell fresh fruits and vegetables popular among this ethnic group, the store owners and managers need to be educated about the popularity of specific products and how to promote them. In the case of the abóbora híbrida, for example, it was important to put this hard squash on the shelf cut and wrapped in plastic so that the consumer can see that it was mature and be assured that it was authentic.

Managers of supermarket chain stores understand the changes in their marketplace due to the growth of immigrant populations and are eager to offer fresh produce that is desired by these groups; however, they need to be educated about the specific crops desired by these groups and what the market potential for them is before they will buy them. It is critical to have staff that understands the language and the culture of the target ethnic group in order to implement a market analysis of the specific products to be assessed. In the case of the market analysis of the abóbora híbrida and
maxixe in this study, Portuguese-speaking survey takers were essential, since the majority of consumers interviewed were Portuguese-dominant. In addition to linguistic reasons, there were cultural considerations. A large percentage of the Brazilian population in Massachusetts is undocumented and the fact that project personnel implementing the surveys were Brazilian and spoke Portuguese made interviewees more comfortable to take the survey.

An understanding of the importance and power of ethnic media outlets is critical to maximize the sales of target products. Brazilian newspapers and cable TV are important sources of information for the consumers in this study, and articles and programming on Brazilian TV promoting locally-grown vegetables had a tremendous impact on sales. These newspapers and locally-produced TV programs are hungry for stories that highlight products desired by their audience, in particular ones that they did not know could be produce locally. It was very easy to get Brazilian-owned newspapers to produce articles about the availability of the locally-grown vegetables that were used in this research.

The importance of promoting these crops in the marketplace with personnel who speak the language (Portuguese) and understand the culture and cuisine of Brazil cannot be underestimated in the promotion of these products. Brazilian and Portuguese-speaking project personnel were able to draft articles in Portuguese for the newspapers targeted in this work and also able to produce point-of-sales materials in Portuguese that resonated with Brazilians store owners and customers. In addition, some store owners and managers were Portuguese-dominant, or in some cases spoke little or no English, so having personnel who spoke Portuguese was essential.
Farmers rightfully see the introduction of new crops as a challenge, beginning with the availability of seeds in the U.S. to the different production practices that they must learn in order to grow them successfully. There can also be considerable risk in growing new crops without a thorough understanding of their market potential. It is essential that the farmers understand the market demand for a specific crop, and the distribution system used to deliver the crops to the consumer, before planting the seed.

1.7 References


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1.8 Appendices

1.8.1 Figures

Figure 1.1 Total imports of cassava to the United States *Source: Data adopted from Yucca (cassava) reports* (Fruit and Vegetable Market News 2007)
Figure 1.2 Supply chain for fresh produce used by Brazilians in Massachusetts (Line thickness of arrows varies according to estimates of product flows) Source: based on interviews with wholesale and retail managers of traditional and ethnic chains, small markets and restaurant owners, jobbers, farmers and consumers.
Figure 1.3 Amount of maxixe purchased weekly by Brazilian consumers when living in Brazil. Survey conducted with 105 Brazilians at two stores in Massachusetts (Fall River and New Bedford) and two stores in New Jersey (Newark and Kearny) in 2006.

Figure 1.4 Amount of maxixe purchased weekly by Brazilian consumers when living in Brazil. Survey conducted with 105 Brazilians at two stores in Massachusetts (Fall River and New Bedford) and two stores in New Jersey (Newark and Kearny) in 2006.
Figure 1.5 Amount of different types of squash purchased by Brazilian consumers when living in the U.S. Survey conducted with 105 Brazilians at two stores in Massachusetts (Fall River and New Bedford) and two stores in New Jersey (Newark and Kearny) in 2006.

Figure 1.6 Types of squash purchased by Brazilian consumers when living in the U.S. Survey conducted with 105 Brazilians at two stores in Massachusetts (Fall River and New Bedford) and two stores in New Jersey (Newark and Kearny) in 2006.
Figure 1.7 Price range that Brazilian consumers are willing to pay for abóbora híbrida if available in the U.S. markets. Survey conducted with 105 Brazilians at two stores in Massachusetts (Fall River and New Bedford) and two stores in New Jersey (Newark and Kearny) in 2006.

1.8.2 Tables

Table 1.1 Potential sales of abóbora híbrida and maxixe by category of businesses involved in the Brazilian fresh produce supply chain in Massachusetts

<table>
<thead>
<tr>
<th>Business Category</th>
<th># of stores</th>
<th>Sources</th>
<th>Potential sales (lb/week)</th>
<th>Potential sales (lb/week)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>abóbora</td>
<td>maxixe</td>
</tr>
<tr>
<td>Restaurants</td>
<td>100</td>
<td>jobbers / terminal market</td>
<td>3,000</td>
<td>3,000</td>
</tr>
<tr>
<td>Small markets</td>
<td>300</td>
<td>jobbers / terminal market</td>
<td>21,000</td>
<td>9,000</td>
</tr>
<tr>
<td>Ethnic chains</td>
<td>8</td>
<td>local farms / terminal markets</td>
<td>1,000</td>
<td>500</td>
</tr>
<tr>
<td>Traditional chains</td>
<td>10(^y)</td>
<td>local, outside farms / brokers</td>
<td>3,000</td>
<td>2,000</td>
</tr>
<tr>
<td>Wholesale-Retail(^z)</td>
<td>---</td>
<td>local farms / terminal markets</td>
<td>200</td>
<td>100</td>
</tr>
</tbody>
</table>

\(^y\) Number of stores estimated by reference or personal communication, references cited in the text under each category.

\(^w\) Major sources of fresh produce by category.

\(^x\) Sales estimated according to test marketing in addition to the input from store owners and produce managers. A major variable in this estimate will be the marketing plan and implementation.

\(^y\) Number of supermarket chain stores located in Massachusetts. The most important chain store for ethnic produce was the one targeted in this study, and the bulk of the sales estimate comes from this chain store.

\(^z\) Amounts estimated for individual wholesale retail stores based on trials and interviews at two stores.
CHAPTER 2

MARKET ANALYSIS OF ABÓBORA HÍBRIDA (CUCURBITA SPP.) PRODUCED IN MASSACHUSETTS

2.1 Introduction

Many farmers in the United States are interested in producing agricultural products desired by the large and growing ethnic communities. Farmers devote valuable land and resources to the production of new crops and it is critical that they understand the size of the market, the prices they can expect to get for the products and the cost to produce the crop. Several researchers have emphasized the importance of understanding the market for crops before producing them, including the supply and demand dynamics for each specific crop (Ballenger and Blaylock 2003, Mangan 2002, and Tubene 2002). Batres-Marquez et al. (2000) found that Salvadorans living in the United States had a strong desire for specific agricultural products that were popular in Salvadoran cuisine and were willing to buy them if they were available in U.S. markets. Similar results were found with Mexicans living in California, where they described food as an expression of their culture of origin (Penaloza 1994).

The Brazilian population in the U.S. represents a growing immigrant market. The exact population has been difficult to quantify due to immigration issues, but in 2000, the U.S. Census estimated that there were 212,636 Brazilians living in the United States (Lima et al. 2006); however, the Brazilian government estimates that there are 1.5 million Brazilians living in the U.S., both legal and illegal (The New York Times 2005). Similar discrepancies exist for the estimate of the Brazilian population in Massachusetts, the state considered to have one of the largest Brazilian populations in the U.S. In 2000, the US
Census estimated that there were 36,669 Brazilian living in Massachusetts, and in 2005, the US Census updated this number to 84,836 (Levenson and Zeng 2006). The Brazilian Immigrant Center in Allston, MA estimated that there are at least 250,000 Brazilians living in the State (The Boston Globe 2006).

In recent years, supermarkets have become more aware of growing ethnic markets and are devoting more inventories to products desired by these groups. Additionally, they are putting resources into advertising and marketing campaigns with the intention of attracting these groups to their stores (Grow with America 2002; Mc Taggart 2005). The manager of the supermarket chain where this research took place states that stores targeting the Brazilian population are continually looking for innovative and culturally appropriate marketing strategies in order to build a better relationship with Brazilian consumers living in the United States (Cadima 2006).

Marketer acculturation is used to refer to intercultural contact and the resulting change for marketers in contact with a new culture. Penaloza and Gilly (1999) studying the adaptation of Mexicans in California found that employment practices, pricing, and promotions that appeal to Mexicans are important avenues of cultural market adaptation. Marketers’ adaptation to the cultural characteristics and needs of their clientele results in changes to themselves, their firms, and the marketplace. Marketers serving the Mexican community studied by Penaloza and Gilly (1999) in Southern California accommodated consumers through: product and service assortments; displays; sales support services; holiday celebrations; and community support.

Abóbora, the generic name for “pumpkin” or “hard squash” in Portuguese, is a staple vegetable throughout Brazil. In the state of Minas Gerais, the most popular type of
abóbora is a variety known by several names, including “abóbora moranga”, “abóbora japonesa”, “abóbora híbrida”, and “moranga híbrida” (Almeida 2007). People use it to make salads, soups, and as a side dish.

Abóbora híbrida has never been grown commercially or evaluated by researchers in the Northeastern United States before the present project was implemented in 2006. Therefore, markets in the U.S. that cater to Brazilian consumers have been selling other varieties of hard squash as substitutes for the abóbora varieties, such as abóbora híbrida that are popular in Brazil. Some of these stores label these substitute varieties as “abóbora” in deference to their Portuguese-speaking customers. There are no studies that document the popularity of squash substitutes within the Brazilian community living in the United States or the demand for abóbora híbrida if it were available in U.S. markets.

The objective of this study was to evaluate the potential market for abóbora híbrida grown by farmers in Massachusetts. This includes the amount of abóbora híbrida that would be purchased by Brazilians and the price that they would be willing to pay.

2.2 Exploratory Research

Acculturation is a process of cultural substitution or change, in which people adopt the behaviors, values, and beliefs of a new culture (Penaloza 1994). The language spoken in the home is a strong indicator of the degree of acculturation in Hispanic communities. People who are more comfortable speaking Spanish usually are less likely to be acculturated (Hispanic Meals at Home 2006). According to studies conducted by Coca Cola, ethnic consumers residing in the U.S. for less than ten years tended to prefer fresh ingredients, traditional homemade meals, use of ethnic brands, and the native
language is dominant (Grow with America 2002). Exploratory studies were conducted in advance of the market analysis described in this study in order to learn more about the Brazilian population in the U.S.

Personal interviews were used to generate primary descriptive data about the characteristics and food habits of the Brazilian population living in the U.S. Two markets were selected in Somerville, MA in 2003: a farmers’ market (39 respondents) and a Brazilian market (15 respondents). In September 2005, two more surveys were conducted with Brazilians: one in Boston MA at the Brazilian Independence Day Festival (65 respondents) and another at a supermarket based in Newark NJ (50 respondents). To encourage people to take the surveys in Somerville, consumers were offered Brazilian cheese (“queijo fresco”) and pamonha, a traditional corn dish popular throughout Brazil. At the Brazilian Independence Day Festival, a coupon for $5-off a meal at a well-known Brazilian restaurant was given to people who took the survey. In Newark NJ, consumers received small amounts of Brazilian vegetables produced at the UMass Research Farm when they took the survey.

Based on the results of these four surveys, it became clear that a large percentage of the Brazilian population in these areas was from the state of Minas Gerais (Figure 2.1). These data were confirmed by owners of Brazilian markets and restaurants and community leaders who work with the Brazilian population in Massachusetts and other states in the Northeastern U.S. When given the choice of taking the MA and NJ survey in Portuguese or English, 98% preferred to take the survey in Portuguese (data not shown). Similarly, Penazola (1994) found that only 9% of Mexicans interviewed in California
preferred English and that 87% were monolingual Spanish speakers who had been in the U.S. for less than 10 years.

Penaloza (1994) also found that Mexicans living in the United States who come from rural areas of Mexico stated that they used shop for food on a daily basis at small corner stores when living in Mexico. Mexicans that come from urban areas in Mexico reported shopping for food once per week at large supermarkets and/or central markets and looked for the best deals. Despite these differences between rural and urban residents, all respondents stated they preferred to buy fresh produce and freshly cut meat. When living in the United States, they shop at large supermarkets for prices and at small stores for convenience and especially to purchase products from Mexico and special cuts of meat. Patterson and Martinez (2004) also found that most of the Hispanic consumers living in Arizona shop for produce once per week.

It is estimated that a large percentage of the Brazilian population living in the Northeastern U.S. come from small villages in Brazil (Guimarães 2007). From results of surveys conducted in this research more than 50% of the Brazilians interviewed stated that they would buy traditional Brazilian vegetables that can be grown in the Northeastern U.S. at least once per week.

In order to learn more about crops popular in Minas Gerais, Brazil, researchers from UMass visited this state in Southeastern Brazil in January 2006. Visits included farms, supermarkets, the main terminal market in the capital of Minas Gerais (Belo Horizonte), and meetings with agricultural professionals of Minas state and federal agencies that work in agricultural production and marketing.
Terminal markets located throughout Brazil are important components of the distribution system for fresh fruits and vegetables. These markets are called CEASA (Centrais de Abastecimento in Portuguese, translated as “Centers of Supplies”). The state of Minas Gerais has six terminal markets located in the following areas: Contagem, Barbacena, Uberlândia, Caratinga, Governador Valadares, and Juiz de Fora. The terminal market in Contagem, a neighborhood of Belo Horizonte (BH), is by far the largest and most important one in the state of Minas Gerais and the second largest terminal market in the country (CeasaMinas 2007a). It is called CEASA Grande BH.

Table 2.1 shows the amount and value of products available at CEASA Grande BH. Abóbora híbrida is by far the most important type of squash sold at CEASA Grande BH (Figure 2.2). These data show the prominence of abóbora híbrida compared to other varieties of hard squash. Researchers and agricultural professionals in Brazil state that growers in Minas Gerais prefer abóbora híbrida over other varieties due to the higher yields, greater uniformity, superior quality, and the longer postharvest life compared to other types of hard squash. In addition, abóbora híbrida is the most preferred squash by consumers in Minas Gerais, where it has become an important part of the cuisine in the State (Almeida 2007).

As a result of the information gathered during these visits and the strong desire to purchase traditional vegetables by the Brazilian community living in Massachusetts and New Jersey, abóbora híbrida was chosen as a candidate to evaluate for production and marketing.
2.3 Methodology

Surveys of Brazilians were used to ascertain the characteristics of the population and their food habits while living in the United States and in Brazil. Personal interviews conducted at supermarkets were considered to be the most effective technique for gathering specific information from Brazilian consumers for two reasons. First, this allowed the interviewer to clarify any confusion that respondents had about certain questions. For example, respondents were asked about specific types of squash used as substitutes, and a personal survey allowed the interviewer to show the different types of squashes, either real ones or pictures, to ensure an understanding of the specific varieties used in the survey. The second reason for choosing personal surveys was due to cultural and linguistic reasons. Bilingual (Portuguese and English) interviewers were chosen so that the respondents would feel comfortable with an interviewer who spoke their first language, thus facilitating the social interaction. The presence of an interviewer generally increases the percentage of people willing to complete the interview (Zikmund 2002).

Convenience sampling, a non-probability method was used in this study in conducting surveys with consumers. It was convenient and economical to set up an interviewing station to intercept consumers at the selected supermarket stores. The survey instrument used in this study consisted of 9 structured questions on languages spoken, time spent in the United States, specific vegetable purchasing habits, and willingness to buy locally grown Brazilian vegetables (survey questions are provided in the appendix).

Test marketing was used to evaluate the effectiveness of the surveys in estimating the sales of abóbora híbrida. Test marketing is defined as an experimental procedure to test a new product or a new marketing plan under realistic market conditions in order to
measure sales or profit potential (Zikmund 2002). For this study, test marketing was established using abóbora híbrida was produced at the UMass Research Farm in South Deerfield, MA and being sold at selected stores at different prices.

2.3.1 Selection of supermarket stores

This study was conducted at stores that are part of an “ethnic” supermarket chain, Seabras, a Portuguese-owned chain based in New Jersey with 17 stores in four states: New Jersey, Rhode Island, Massachusetts, and Florida. Traditionally these stores were located in areas with large Portuguese communities, but they now are expanding into areas with other immigrant and traditional customers. They currently have four stores in Massachusetts, in New Bedford, Fall River, Swansea, and Attleboro.

Seabresas supermarket is considered to have the largest sales of Brazilian products, both fresh and processed, of any chain store in the United States. Brazilians are a significant market share of this supermarket chain and an important growth area for its business. This chain store started buying jiló from a farm in Massachusetts in 2004. The store managers were interested in buying more locally-grown crops popular among Brazilians, and were, therefore, willing to assist in the implementation of this research. The percentage of Brazilian clientele at the 17 stores varies widely, ranging from as low as 5% to as high as 90% (Cadima 2006)

Several of Seabresas stores in New Jersey, Massachusetts and Florida were visited by UMass project personnel to evaluate them for inclusion in this study and four stores (located in Newark, NJ, Kearny, NJ, Fall River, MA and New Bedford, MA) were selected. The criteria used to choose the four stores were: size of the produce section,
ease of working with store managers, and ease of access to the store for collecting data. In addition to visits to the stores, the general managers of stores in New Jersey and Massachusetts gave project personnel estimates of the size of the Brazilian marketshare of all the stores under consideration (Table 2.2).

### 2.3.2 Consumer survey

Personal interviews were conducted at the four selected stores in this study. Previous experiences with preliminary surveys at Brazilian markets demonstrated the importance of having a product for consumers to see or take with them as part of the interview process. In this study, a gift was used as a tool to attract people’s attention and make them more willing to participate.

At each store, a table was set up near the store entrance with information on the project and with examples of Brazilian vegetables grown at the UMass Research Farm, such as jiló, maxixe, and different types of abóbora. The survey methodology used at each store was as follows:

1. There were three bilingual (English and Portuguese) interviewers used over the course of the project: two were Brazilians and the third was Portuguese. The two Brazilians wore either UMass shirts or shirts with the Brazilian colors (green and yellow) with the word “Brazil” embroidered on them.

2. UMass Extension table cloth and two medium-size Brazilian flags were put on the table to draw attention of the Brazilians in the stores.

3. Signs were placed on the table indicating that a survey was being conducted and that a gift would be given to those who participated. Gifts used at these stores were
transplants of tiaoba and a package with three fruits of maxixe. Both crops were being studied for local production at the UMass Research Farm and were available to be used as part of the survey.

4. Also on the table were fruits of different abóboras popular in Brazil: abóbora híbrida, abóbora moranga comum (*Cucurbita maxima*), and abóbora menina brasileira (*Cucurbita mixta*). These also were produced at the UMass Research Farm and were available to allow interviewers to clarify the names of the different types of squashes popular in Brazil.

Surveys were conducted on one weekend in August at the stores in New Jersey and in September for the two stores in Massachusetts. Store managers told UMass personnel that they had the highest number of Brazilian customers on weekends. A total of 105 people were surveyed in the four stores: 36 in Newark, NJ, 32 in Kearny, NJ, 21 in Fall River, MA, and 16 in New Bedford, MA.

2.3.3 Sales experiment

The four stores used in this study were exposed to different prices during the experimental period (Table 2.3). The selection of prices at each store was randomly chosen. The reason for using this method was to evaluate the price sensitivity of the abóbora híbrida by measuring sales at the different prices.

The abóbora híbrida used in the experiment was produced at the UMass Research Farm in Deerfield, MA and stored at the Pioneer Valley Growers Association Cooling facility in Whatley, MA. Deliveries of the abóbora híbrida to the four target stores were made by UMass personnel. The amount of abóbora híbrida delivered to the four stores
was based on the sales of other hard squashes and on the opinions of the store managers. All stores were supplied with abóbora híbrida in excess of their sales to ensure that they would not run out.

On 17 August, an article was published in one of the most popular Brazilian newspapers in the Eastern US, The National Brazilian Newspaper. This free newspaper is found in most Brazilian stores located in New Jersey and Massachusetts. Project personnel contacted the newspaper to let them know about the project and the availability of this popular Brazilian squash that had never been sold in stores in the United States. This newspaper published an article about the research being conducted by UMass on Brazilian vegetables and emphasized the availability of abóbora híbrida at target stores. The article, which was based on interviews with Brazilian staff working on the project, emphasized the authenticity of the abóbora híbrida (i.e. that the seed came from Brazil).

Point-of-sales materials in Portuguese and English, including signs with price and information on the abóbora híbrida, were made available to the stores. The squash was put on the stores shelves by project personnel to ensure that the prices were set according to the experiment and also that the squash was available as both whole fruit and cut in halves and wrapped in plastic. Brazilians prefer the squash cut in half in order see that the flesh is deep orange, indicating it is mature.

The amount of abóbora híbrida given to each store was documented and the stores were visited in person, or the produce managers were called by phone, to document the amount sold at least twice per week during the two weeks of the study at each store. Amount of the abóbora híbrida sold was calculated by subtracting the amount given to the store at a given time and the amount available at the store. Data at stores in New
Jersey were collected from 9 to 24 September, and from stores in Massachusetts from 15 September to 1 October.

2.4 Results and discussion

2.4.1 Characterization of the Brazilian population living in the Northeastern U.S

With the exception of New Bedford, more than 50% of those surveyed in the four locations of this study had been living in the U.S. for less than 10 years (Figure 2.3). Over 40% of the respondents in New Bedford stated that they speak English in addition to Portuguese, which was also higher than any other store (Figure 2.4). It is expected that there would be a correlation between the length of time living in the U.S. and the ability to speak English.

More than 50% of the respondents at the four locations speak Portuguese only (Figure 2.4). Kaiser et al. (2003) also found similar results with Latino families in California residing in the country for an average of 11.8 years, and 83.6% of respondents prefer to speak Spanish. In Newark and Kearny, some Brazilians stated that they also speak some Spanish, most likely due to the large and growing Latino population in these cities. The combination of Spanish and Portuguese accounted for less than 10% total (data not shown).

In order to better understand the potential size of the market for abóbora híbrida, Brazilian consumers were asked about the amount of this squash they used to buy in Brazil (Figure 2.5) and the amount of other types of squash they purchase in the U.S. (Figure 2.6). Only one person surveyed, in Newark, NJ, was not familiar with abóbora
hibrida, emphasizing its popularity in Brazil (at least in the states of origin of those interviewed).

More than 30% of the respondents in Newark used to buy more than 2 kg/week of this squash while living in Brazil. The percentage of these consumers that bought more than 2 kg of squash/week since moving to the U.S. was only 6% (Figure 2.6). Among the four stores, most of the consumers were purchasing less than 1 kg or between 1 and 2 kg/week. Based on answers from consumers one of reason to the lower purchases is because these consumers were part of bigger families while living in Brazil and would by larger quantities of all foods.

In Fall River, 23% of the respondents stated they are not buying any squash. Respondents stated they are not currently purchasing any squash because they do not like the types of squash available at the store. Respondents were also asked about the types of squash they purchase in the United States as substitutes for hard squashes they bought in Brazil (Figure 2.7). The store in Fall River did not carry any calabaza, which was the most common substitute bought by Brazilians in both stores in New Jersey (Figure 2.7). The store in New Bedford carried calabaza; however, it was only available whole. Calabaza is almost exclusively sold in pieces wrapped in plastic, similar to abóbora híbrida, so that the consumer can see the deep orange flesh indicating that it is mature. These facts might have affected sales in Fall River and New Bedford, respectively (Table 2.4).

Understanding the consumers’ needs and behavior are essential to provide adequate products to ethnic communities. For example, among Latinos and Dominicans living in Massachusetts, the preference is to purchase cilantro with roots intact (over than
60% of the respondents) rather than with no roots (20% of the respondents), because of the increased freshness when the roots are not removed (Mangan et al. 1999).

Consumers were asked about how much they would be willing to pay for abóbora híbrida if available where they shop (Figure 2.8). The majority of those surveyed said that they would pay “any price”. The answer “any price” shows the respondents’ enthusiasm and desire to purchase abóbora híbrida, and willingness to pay higher prices for this product if available at stores where they shop in the U.S. The highest percentage was Fall River with 67% and the lowest was Newark with 30%. The high number of people in Fall River stating they would pay “any price” is probably due to the fact that Fall River did not have calabaza available, one of the most popular substitutes in other stores. The fact that a much lower percentage of consumers in Newark stated that they would pay “any price” might be related the cost of the most popular substitute in that store, calabaza. Calabaza was being sold at $0.79/pound. More than 40% of the customers in Newark stated that they would pay between $1.00 and $2.00/pound, which is still much higher than calabaza.

The Brazilian respondents’ state of origin for those surveyed showed similar results (Figure 2.9) to preliminary data collected in 2003 and 2005 (Figure 2.1). Minas Gerais was the most common state of origin, ranging from 44% New Bedford, MA to 47.6% in Fall River, MA. Two other states of origin with large percentages were Espírito Santos and Rio de Janeiro, states that border Minas Gerais and have similar cuisines. Brazil has 26 states with strong regional differences. Many consumers from São Paulo, for example, do not use crops such as jiló or taioba, vegetables mentioned above that are very popular in Minas Gerais, Espírito Santos, and to a lesser extent in Rio de Janeiro. It
is critical that market managers understand the state of origin of their Brazilian customers so that they will offer the products that are part of their cuisine.

2.4.2 Types of squash available and abóbora híbrida sales experiment

There was a large variation in the types and amounts of each type of squash sold in the four target stores (Table 2.4). The prices of the substitute squashes varied from $0.59/pound for calabaza in Kearney, NJ to $1.19 for butternut squash in Newark, Kearney, and New Bedford.

The store in Newark had the highest sales of all squashes (almost 2,000 pounds/week) and of abóbora híbrida, higher than the other three stores put together. This difference would be expected because of the larger number of weekly customers compared to the other stores, both total and Brazilian (Table 2.2). It is likely that the majority of people buying the abóbora híbrida were Brazilian; however, a few consumers from other ethnicities were found purchasing it while UMass personnel were present. For example, a Bolivian couple interviewed said: “I know this squash from Bolivia, we call it zapallo”, the Spanish word for squash in South America. Brazil exports many products to Bolivia, including abóbora híbrida (Almeida 2007).

The store based in Kearny showed a much greater percentage of calabaza being sold compared to the only other substitute, butternut squash (350 lbs/week compared to 70 lbs/week, respectively). This difference is thought to be due to the larger Latino customer base at this store compared to the store in Newark. The store in Newark sold 450 and 625 pounds/week of calabaza and butternut, respectively. In addition, shelf space given to butternut squash in Kearny is only 50% of the shelf space given to calabaza. As
stated earlier, the store management estimated that the store in Kearny had a smaller Brazilian customer base than the store in Newark (Table 2.2). The amount of abóbora híbrida sold was much lower in Kearney than in Newark when prices at both stores were $1.79/lb (175 vs. 420lb/week, respectively).

The store in New Bedford sold small amounts of calabaza per week (25lb); whereas the store in Fall River did not carry calabaza during the trial period. Buttercup squash, not sold in either of the stores in New Jersey, was sold at a greater rate in Fall River than in New Bedford with 70 and 18 pounds/week, respectively. Buttercup and kabocha squashes are being used by some Latino stores as substitutes for calabaza, and the fact that Fall River did not carry calabaza might account for their higher sales of buttercup squash compared to New Bedford.

Abóbora híbrida sales at the two stores in Massachusetts were the same for both weeks of the trial, 70 pounds/week, despite the fact that the shelf space given to abóbora híbrida in Fall River was 1/5 of the space given in New Bedford. However, another important difference between these two stores was the location chosen by store management. In New Bedford, the store manager wanted to highlight this new product and placed the abóbora híbrida in front of the entrance, so customers would see it upon entering the store. In Fall River, the abóbora híbrida was placed next to other squashes, which were located in the middle of the of the produce section. It would have been expected that the sales of abóbora híbrida would have been greater in Fall River compared to New Bedford due to the larger Brazilian clientele estimated by store managers (1,875 vs. 1,000 weekly consumers). It is postulated that the more prominent
placement of the abóbora híbrida at the store in New Bedford led to higher sales than would have been expected due to the Brazilian customer base.

Sales of substitutes did not vary during the two weeks among the four stores according the produce managers. It is suggested that the reason for the lack of change is due to poor data from the produce managers. This underscores the importance of “data collectors” to be at the stores to take all data necessary for a given study (McFetridge et al. 2004). As part of this study, personnel took specific data of abóbora híbrida in-person or by calling produce managers during the trial. Project personnel depended on store managers for the data on sales of substitutes. It is thought that store managers were given quantities based on orders that were made rather than actual sales, which they do not measure. Even though the sales of substitutes most likely decreased due to sales of abóbora híbrida, the store managers did not decrease the orders of the substitutes accordingly.

2.4.3 Price sensitivity of sales of abóbora híbrida

For those respondents that set a price range rather than “any price”, a follow-up question was asked in order to measure price sensitivity among the respondents. When they stated the price they would be willing to pay, they were then asked if they would pay 20 cents more than the price they stated. Ranging from 72 to 92% among the four stores, respondents said ‘YES’ they would pay 20 cents more than the original price they stated (data not shown).

Changing the price (higher at two stores and lower at two stores) between the two weeks of the study (Table 2.3) did not affect sales of abóbora híbrida at three of the four
stores and suggests that consumers were not price sensitive (Figure 2.10). During the first experimental week, abóbora híbrida was sold at the Newark store at $2.09 (75% more than the highest substitute) and sales were 280 pounds. When the price was lowered during the second week at the Newark location, abóbora híbrida sales rose to 420 pounds. In addition to the lower price, other factors could have affected sales. The product was relocated to a more visible location for the second week, which could have had a similar effect to the one noted for New Bedford. In addition, word of month publicity could have played a role in increased sales. This increase was not noted in the other store that went from a higher price in week 1 to a lower price in week 2 (Fall River) might have been because of a lower proportion of Brazilian clientele and the poor location of the squash. There was no loss of sales in the other two stores where prices rose.

2.5 Conclusions

The large and growing Brazilian population in the Northeastern U.S. has a strong preference for their traditional cuisine, and this represents opportunities for local producers in the Northeastern states, in particular Massachusetts. In order for local farmers to take full advantage of these opportunities, it is critical that they understand the market demand for specific products. This study provides a preliminary analysis of the demand and the potential pricing levels for abóbora híbrida in the Brazilian communities in the Northeastern United States.

The findings show that these consumers maintain a strong preference for the Brazilian varieties of squash and that they are willing to pay higher prices for them. Their familiarity and preference for these crops provide opportunities for farmers and
businesses to focus on this niche market and demand a price premium over the domestic varieties at both the wholesale and retail levels.

Abóbora híbrida has good sales potential in the Brazilian community living in the U.S., and survey results showed that most of the respondents would prefer the Brazilian squash to other types available. Calabaza was found to be the most common type of substitute squash used by Brazilians living in New Jersey.

Most of the Brazilian population in the Northeastern U.S. has been in the country for less than ten years and still prefers to speak their native language, Portuguese, a sign of low acculturation level. Most of the Brazilians, now living in smaller households, would like to purchase less than 1 kg (2.2 lbs) of abóbora per week when some of them have been accustomed to buying more than 2 kg (4.4 lbs) of abóbora per week in Brazil, highlighting the role of marketing research to adequately understand consumer behavior and evaluate the potential of traditional products for Brazilian consumers in the United States. It is also critical that markets understand the states of origin of their Brazilian customers so that they will offer the products that are part of their unique cuisines.

Sales results proved that consumers purchased the product at higher prices as they stated in the surveys.

2.5.1 Limitations and Future Research

Project personnel depended on store managers for the data on sales of squash substitutes. It is thought that store managers were giving sales data based on orders that they make on a weekly basis rather than on assessment of sales. The approach to collecting retail data in a real-time market-research project needs to be analyzed carefully.
in advance. Interviews with store managers about the process, flexibility, and the use of tools that facilitate the data collection are key elements are necessary to ensure efficiently collected and accurate data. It is recommend that tools such as an inventory list, maps of the produce department, a weekly log, and pictures of the product be used.

Convenience sampling might be limiting when used to compare or generalize findings to other populations. The illegal status of much of the target population impeded sampling and affected survey characteristics. Future research should investigate the demographic and socio-economic characteristics of the Brazilian population, food patterns and expenditures, levels of acculturation, and desire to purchase traditional vegetables that are part of their cuisine.

More than 50% of the Brazilians interviewed in this study intend to purchase traditional Brazilian vegetables at least once per week. It is estimated that a large percentage of the Brazilian population living in the Northeastern U.S. comes from small villages in Brazil. These consumers might be price conscious for various reasons, and future research is necessary to investigate the effects on consumer behavior, price sensitivity and the introduction of Brazilian crops in the United States.

Despite the limitations of this study, survey and sales results have shown that Brazilian consumers living in the U.S. have a preference for the abóbora híbrida compared to substitute varieties available in the market, and they are willing to pay higher prices for this Brazilian squash. Studies of other ethnic communities living in the U.S. have revealed similar results, demonstrating the opportunity for local growers to invest on niche crops with a focus on the marketing component in order to successfully provide ethnic communities with desired products.
2.6 References

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2.7 Appendices

2.7.1 Figures

Figure 2.1 States of origin of based on 2003 (Somerville MA) and 2005 (Boston MA and Newark NJ) Surveys conducted with 169 Brazilians.

Figure 2.2 Amount of different types of squash sold at CEASA Minas in 2006 Source: Acompanhamento mensal de Produtos do ano de 2006 (Ceasa Minas 2007(c))
Figure 2.3 Period of time that Brazilians have been living in the U.S. Survey conducted with 105 Brazilians at two stores in Massachusetts (Fall River and New Bedford) and two stores in New Jersey (Newark and Kearny) in 2006.

Figure 2.4 Languages Brazilians speak in the U.S. Survey conducted with 105 Brazilians at two stores in Massachusetts (Fall River and New Bedford) and two stores in New Jersey (Newark and Kearny) in 2006.
Figure 2.5 Amount of abóbora híbrida purchased by Brazilian consumers when living in Brazil. Survey conducted with 105 Brazilians at two stores in Massachusetts (Fall River and New Bedford) and two stores in New Jersey (Newark and Kearny) in 2006.

Figure 2.6 Amount of different types of squash purchased by Brazilian consumers when living in the U.S. Survey conducted with 105 Brazilians at two stores in Massachusetts (Fall River and New Bedford) and two stores in New Jersey (Newark and Kearny) in 2006.
Figure 2.7 Types of squash purchased by Brazilian consumers when living in the U.S. Survey conducted with 105 Brazilians at two stores in Massachusetts (Fall River and New Bedford) and two stores in New Jersey (Newark and Kearny) in 2006.

Figure 2.8 Price range that Brazilian consumers are willing to pay for abóbora híbrida if available in the U.S. markets Survey conducted with 105 Brazilians at two stores in Massachusetts (Fall River and New Bedford) and two stores in New Jersey (Newark and Kearny) in 2006.
Figure 2.9 States of origin  Survey conducted with 105 Brazilians at two stores in Massachusetts (Fall River and New Bedford) and two stores in New Jersey (Newark and Kearny) in 2006.

Figure 2.10 Sales of Abóbora híbrida at four selected stores in Newark and Kearny, NJ and in New Bedford and Fall River, MA  Experiment lasted two weeks. Prices and
sales tracking were coordinate by UMASS personnel, produce staff, and store managers. September, 2006.

### 2.7.2 Tables

**Table 2.1 Amount and values of products marketed at CEASA-Minas Grande BH**  
Largest terminal wholesale market in the state of Minas Gerais, Brazil.

<table>
<thead>
<tr>
<th>Products</th>
<th>Amount (kg)</th>
<th>Percentage (%)</th>
<th>Value (US$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vegetables</td>
<td>56,189,456</td>
<td>30</td>
<td>20,584,287</td>
</tr>
<tr>
<td>Fruits</td>
<td>43,391,817</td>
<td>23</td>
<td>21,992,737</td>
</tr>
<tr>
<td>Poultry and dairy products</td>
<td>5,361,501</td>
<td>3</td>
<td>3,124,649</td>
</tr>
<tr>
<td>Processed and non-food products</td>
<td>82,252,772</td>
<td>44</td>
<td>68,304,585</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>187,195,546</td>
<td>100</td>
<td>114,006,258</td>
</tr>
</tbody>
</table>

*Source: Data adopted from Analise Conjuntural 2006 (CeasaMinas 2007b).*

**Table 2.2 Estimates of the numbers of Brazilian consumers at selected store locations**

<table>
<thead>
<tr>
<th>Store location</th>
<th>Weekly customers</th>
<th>% Brazilians</th>
<th>Weekly Brazilian customers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Newark, NJ</td>
<td>25,000</td>
<td>30</td>
<td>7,500</td>
</tr>
<tr>
<td>Kearny, NJ</td>
<td>11,000</td>
<td>25</td>
<td>2,750</td>
</tr>
<tr>
<td>Fall River, MA</td>
<td>12,500</td>
<td>15</td>
<td>1,875</td>
</tr>
<tr>
<td>New Bedford, MA</td>
<td>10,000</td>
<td>10</td>
<td>1,000</td>
</tr>
</tbody>
</table>

*Estimates given by management of supermarket chain.*

**Table 2.3 Established at target stores during the period of the experiment**

<table>
<thead>
<tr>
<th>Prices by period</th>
<th>Newark NJ</th>
<th>Kearny NJ</th>
<th>Fall River MA</th>
<th>New Bedford MA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Week 1</td>
<td>75% higher</td>
<td>50% higher</td>
<td>50% higher</td>
<td>25% higher</td>
</tr>
<tr>
<td>Week 2</td>
<td>50% higher</td>
<td>75% higher</td>
<td>25% higher</td>
<td>50% higher</td>
</tr>
</tbody>
</table>

*Percent increases proportional to the highest price of squash substitute in the store*
Table 2.4 Types of squash available at the selected stores, shelf space, price, and amount sold per week

<table>
<thead>
<tr>
<th>Squash substitutes x</th>
<th>Shelf space (in)</th>
<th>Amount sold (lb)z</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Length</td>
<td>Width</td>
</tr>
<tr>
<td>Newark NJ</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Calabaza</td>
<td>31</td>
<td>10</td>
</tr>
<tr>
<td>Butternut squash</td>
<td>47</td>
<td>16</td>
</tr>
<tr>
<td>Acorn squash</td>
<td>47</td>
<td>10</td>
</tr>
<tr>
<td>Abóbora híbrida</td>
<td>47</td>
<td>12</td>
</tr>
<tr>
<td><strong>TOTAL SALES</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kearny NJ</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Calabaza</td>
<td>33</td>
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<tr>
<td>Butternut squash</td>
<td>16</td>
<td>12</td>
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<tr>
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<td>24</td>
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<tr>
<td><strong>TOTAL SALES</strong></td>
<td></td>
<td></td>
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<tr>
<td>Fall River MA</td>
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<td></td>
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<tr>
<td>Butternut squash</td>
<td>40</td>
<td>40</td>
</tr>
<tr>
<td>Buttercup</td>
<td>40</td>
<td>24</td>
</tr>
<tr>
<td>Acorn squash</td>
<td>40</td>
<td>4</td>
</tr>
<tr>
<td>Spaghetti squash</td>
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<td>New Bedford MA</td>
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<tr>
<td>Butternut squash</td>
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<tr>
<td>Buttercup</td>
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</tr>
<tr>
<td>Acorn squash</td>
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</tr>
<tr>
<td>Abóbora híbrida</td>
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<td>40</td>
</tr>
<tr>
<td><strong>TOTAL SALES</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

x Types of squash available in the store while conducting research. Types, space, price, and amount sold may vary with seasonal availability. Sales of types were not affected during the experiment period.
y Prices for abóbora híbrida were established according to the research criteria. Two prices were used in each store in successive weeks. Price for the first week followed by the price for the second week, similarly for the quantities reported.
z Amount of abóbora híbrida sold at each store in each experimental week under specific marketing plan. Amount may vary under different strategies. Sales of substitutes did not vary according to store managers during the two experimental weeks.
1. Where are you from?
2. How long have you been in the US?
3. What languages do you speak at home/work?
4. How much “Abóbora moranga” did you buy in Brazil weekly (Kg)?
   - A) less than 1 Kg
   - B) between 1 and 2 Kg
   - C) more than 2 Kg
5. How much of other types of hard squash do you buy in the U.S. weekly? Which types? (Kg)
   - butternut squash A B C
   - calabaza A B C
   - other (state if known) A B C
   - other (don’t know type) A B C
6. Would you buy the Brazilian type if it were available?
7. If so, how much of the Brazilian type would you buy weekly (Kg)?
   - A) less than 1 Kg
   - B) between 1 and 2 Kg
   - C) more than 2 Kg
8. Today we have _________ squash (name a common hard squash that members of this group might purchase) selling for ______ cents a pound. We expect that Brazilian type squash will be more expensive to grow and to market. How much more per pound would you be willing to pay to purchase the quantity of Brazilian squash you mentioned earlier?
9. If the price of Brazilian squash was (20 cents more/pound then the amount the respondent stated in question 8), would you still be willing to purchase abóbora híbrida?
CHAPTER 3

ADAPTATION OF TROPICAL PUMPKIN CULTIVARS (CUCURBITA SPP.) FOR PRODUCTION IN THE NORTHEASTERN UNITED STATES

3.1 Introduction

The demographics of the United States are changing rapidly as immigrant populations have increased at rates not seen since the early 20th century. In 2005, 7.9 million immigrants came to the United States, the largest number in a single year in U.S. history. In this same year, it was estimated that there were more than 35 million immigrants (both legal and illegal) living in the U.S., also the largest number in U.S. history (Center for Immigration Studies 2005).

Massachusetts also has experienced significant increases in the number of immigrants in recent years. According 2005 Census estimates, Hispanics are the largest ethnic minority in the state with 8% of the population, outnumbering African-Americans (7%). Asians represent 5% of the total population and the proportion is increasing (Abraham 2006). Forty percent of the southeastern Massachusetts population is of Portuguese and Cape Verdean descent. About 150,000 Brazilians live in greater Boston and Cape Cod, making Portuguese the second most spoken language in Massachusetts according to the U.S. Census (Rapoza 2000).

This dramatic increase in numbers of immigrants has had a significant effect on the U.S. marketplace, including those dealing in fresh fruits and vegetables. These immigrant groups desire products that are part of their culture, items that are readily
available in their countries of origin but sometimes of limited availability or unavailable in the U.S.

These changes in the U.S. population and the resulting increased market demand for specific agricultural products bring opportunities for local farmers to produce the specific fresh fruits and vegetables desired by these expanding markets. Cultivars in the *Cucurbita* genus, which originated in the tropical Americas, are staples in many of the countries of origin of immigrants in the U.S., especially those from the Americas. Vegetable cultivars in the *Cucurbita* genus (e.g., butternut squash and pumpkin cultivars) are important crops in Massachusetts with over 3,000 acres cultivated in 2002 (USDA National Agricultural Statistics Service 2002).

It is important that species and cultivars of crops are evaluated for their adaptation to local growing conditions before growing them commercially (Pierce 1987). Several studies in recent years conducted by researchers at the University of Massachusetts have evaluated ethnic crops for potential Northeastern U.S. production. These include: calabaza, a popular type of squash in Latin America (Rulevich et al 2003); ethnic herbs (Casey et al. 2004; Mangan et al. 1999); and Asian Brassica crops (Porth et al. 2003). Researchers have found that the adaptation of specific pumpkin and squash cultivars vary dramatically from region to region in the U.S. Some cultivars that are adapted to the Northeastern U.S., for example, did not yield well in the much warmer and humid Southeastern U.S. (Stanghelli et al. 2003; Wien et al. 1998).

*Abóbora*, the name for “pumpkin” or “hard squash” in Portuguese, is a staple vegetable throughout Brazil. In the Brazilian state of Minas Gerais, the most popular type of abóbora is a cultivar known by several names, including *abóbora moranga,*
*abóbora japonesa, abóbora híbrida,* and *moranga híbrida* (Almeida 2007). People use it to make salads, soups, and as a side dish. This hybrid cultivar is an intra-species cross of *Cucurbita maxima* and *Cucurbita moschata* and was introduced to Brazil from Japan in 1960. Since the male flowers of this intra-species cultivar are sterile, it must be grown with another cucurbit species to provide pollen for pollination. It is recommended to plant 10-20% of the field with the “pollinator” cultivar (Filgueira 2003). The most common cultivar used in Brazil for pollination is called *Abóbora Moranga,* an open-pollinated cultivar that was the most popular type of hard squash in states such as Minas Gerais before the introduction of *abóbora híbrida.* This cultivar is still sold in the markets where it is used in a similar way to *abóbora híbrida* and also to make a popular desert called *doce de abóbora* (Almeida 2007).

There are several cultivars of *Cucurbita moschata* that are important hard squashes in many parts of the Americas where they are known by many different names, including *calabaza* (Puerto Rico), *auyama* (Dominican Republic and Venezuela), *ayote* (parts of Central America), *zapallo* (parts of South America), and West Indian pumpkin in parts of the English-speaking Caribbean. The fruit of *C. moschata* vary in size, shape, and color due to outcrossing and strain selection. Tropical lines of *C. moschata* can vine extensively, up to 50 feet long, and also produce fruit in excess of 50 pounds. These tropical lines are not well suited to production in the Northeast due to their vining nature and long time between planting and maturity. The majority of growers in Latin America save seed from harvest of these open-pollinated lines for the next planting (Maynard et al. 2002; Rulevich et al. 2003).
The rind color of commercial cultivars of *C. moschata* range from green to light-orange. A mature fruit will lose the shine of an immature fruit and develop a yellow under-coloring as the fruit matures. The most important factor affecting consumer selection is the color of the flesh. It should be dark yellow to deep orange in color. The dark orange color is a sign of full maturity and consumers prefer it to the lighter colored pulp of young fruit. Because the color of the flesh is of primary importance, the fruits are often halved at the market, enabling the consumer to see the color of the flesh clearly (Maynard et al. 2002; Rulevich et al. 2003).

Kabocha squash cultivars (*C. maxima*) have a very hard, dark-green rind and yellow to bright-orange flesh. The flavor is very sweet, tasting like a cross between sweet potato and pumpkin. Kabocha is a popular vegetable in Japan being used in soups, sushi, and tempura dishes. Kabocha was originally introduced to Japan by Portuguese traders in the mid 16th century. The word *kabocha* is thought to have originated from a Portuguese word for pumpkin, *calabasa*. Kabocha is a generic term for squash in Japan, whereas in North America, Kabocha is a specific type of winter squash. Japan has the highest consumption of Kabocha in the world.

Pipián (*C. mixta*) is originally from the Southern U.S. and Mexico and is very popular in El Salvador and other parts of Central America and Southern Mexico. There are two cultivars found in the main terminal market in San Salvador (La Tiendona), ‘Criollo’ and ‘Zimbrillo.’ The cultivar ‘Criollo’ is the most popular and was the variety used in this study. The fruit is harvested and used when immature. The mature, larger fruit is used for seed, both for propagation and for consumption. The seed is open-pollinated, and thus, there is tremendous variation in phenotypes. In 1998, the
government of El Salvador estimated that there were about 1,000 acres gown in El Salvador (CAMAGRO 2001).

3.2 Material and Methods

Twelve tropical pumpkin cultivars in the *Cucurbita* genus were grown from seeds in transplant cells at the Harvest Farm greenhouse facilities based in Whatley, MA. Table 3.1 lists the cultivar names and seed sources. Each transplant cell was thinned to two plants. The ‘Abóbora Moranga’ was seeded on 27 April, the ‘Tetsukabuto’ and ‘Triunfo’ on 8 May, and the remaining 9 cultivars were seeded on 5 May. ‘Abóbora Moranga’ was seeded two weeks earlier than ‘Tetsukabuto’ and ‘Triunfo’ in order to synchronize flowering of the three cultivars and ensure cross pollination (Filgueira 2003).

The experiment was implemented at the UMass Research Farm in South Deerfield, Massachusetts, on an Occum fine sandy loam (coarse-loamy, mixed, mesic Fluventic Dystrochrept) with a pH of 6.5 and a soil organic matter content of 2.4 %. Lime and preplant fertilizer were applied according to soil test results (New England Vegetable Management Guide 2006-2007). One thousand pounds/acre of calcitic lime were applied on 4 May. Muriate of potash (60% K) was applied on 4 May at a rate of 100 pounds/acre. Available phosphorus in the soil was high, so no pre-plant application was made. The soil was covered with a black polyethylene mulch to control weeds and conserve moisture.

The experimental design consisted of four replicate blocks. Plots were 28’ long by 19.5’ wide and transplants were set 4’ apart in the row, and three rows were 6.5’ apart for a total of 42 plants/plot, equivalent to a plant population of 3,350 plants/acre. Seedlings were transplanted to the UMass field in South Deerfield on 30 May. This arrangement of
plants allowed for a border of plants to surround 10 central experimental (sample plants) plants for each plot. For the plots with the ‘Tetsukabuto’ and ‘Triunfo,’ the border rows were planted with the pollinator, ‘Abóbora Moranga.’

Fertilizer was applied through the drip irrigation in the form of a complete fertilizer (20%N–20%P₂O₅–20%K₂O) and calcium nitrate (16%N-0%P₂O₅-20%K₂O-19%Ca). The spring nitrate test was used to determine if the soil N levels were sufficient (Riggs et al. 2003). The total amount of fertilizer applied through the drip system during the experiment was (lbs/acre): 57 N, 13 P₂O₅, 13 K₂O, and 45 Ca.

Plants were irrigated using drip irrigation with tensiometers (Irrometer Co. Riverside CA) used to time irrigation. Weeds in-between plastic were removed by hand, and striped cucumber beetle (*Acalymma vittatum* (Fabricius)) and spotted cucumber beetle (*Diabrotica undecimpunctata howardi* Barber) were controlled by one application of Admire 2F (8 ounces/acre; a.i. imidacloprid) applied through the drip system on 1 June. *Phytophthora capsici* was identified in the field and two applications were made with Prophyte (active ingredient: phosphoric acid) at a rate of one gallon/acre on 7 and 14 August.

Harvest for Pipián began on 20 July when the fruit reached 5” in length, and took place once per week until 28 August. For each harvest, fruit between approximately 5” and 8” in length were harvested, since this size was considered the most desirable in the markets (Mancia 2006). On 22 August all other cultivars were considered to be mature and were harvested. For each harvest date, the fruit from the 10 middle plants were weighed and the length and width of each fruit was recorded. ‘Ayote’ was not harvested, since very few fruit produced, the largest of which was less than 2” long. Data were
analyzed by analysis of variance using standard software (SAS Institute, Cary NC) with the means separated using Duncan’s test.

3.3 Results and Discussion

Figure 3.1 lists the yield of 11 of the 12 cultivars evaluated in this trial. The cultivar ‘Ayote’ was not included since the plants did not produce mature fruit. “Pipián” yielded higher than other cultivars; however, this is mostly due to the fact that some fruit were allowed to grow larger than the desired size. As described above, the market prefers ‘Pipián’ fruit that is approximately 5” to 8” in length. Even though harvest occurred weekly, there were fruit harvested that was much larger than 8” in length. The average fruit length of ‘Pipián’ for the trial was 10.7” (Table 3.1). Part of this problem occurred because fruit grew rapidly between harvests; however, it is clear that some fruit that were the desired size at harvest were missed, perhaps due to the thick plant foliage early in the season. Test marketing of the ‘Pipián’ in selected Hispanic markets in Massachusetts demonstrated that consumers would buy fruit larger than 8” long; however, the sales were slower, and the markets sold them at lower prices/pound compared to the smaller fruit (data not shown).

Tetsukabuto and Triunfo, the two hybrid cultivars popular in Brazil, yielded 24,932 and 20,277 pounds/acre, respectively. The pollinator cultivar from Brazil evaluated in this experiment, ‘Abóbora Moranga,’ had good size fruit (Table 3.1) and also yielded well with 24,245 pounds/acre. ‘La Estrella,’ the hybrid calabaza cultivar, had the second highest yield, after ‘Pipián,’ with 31,815 pounds/acre and had the largest fruit of the 12 cultivars evaluated (9.2 pounds). This large size of the fruit, typical of
calabaza (Maynard et al. 2002; Rulevich et al. 2003), requires that it is sold in wholesale markets in 50-pound bags and stored in bins instead of cases. Among the six kabocha cultivars, ‘Sweet Mama’ yielded the highest with 21,054 pounds/acre, followed by ‘Thunder,’ ‘Eclipse,’ ‘Hokkori,’ ‘Delica,’ and ‘T-133.’ ‘Sweet Mama’ also had the largest fruit of the six kabocha cultivars evaluated with an average fruit size of 4.2 pounds and ‘Hokkori’ had the smallest fruit weight with 2.3 pounds (Table 3.1).

Due to the smaller size of the kabocha types compared to the calabaza, these cultivars are sold in wholesale markets in the United States in 1.1-bushel boxes, which are much more convenient to store than the 50 pound sacks in which calabaza is stored. Interviews with Hispanic store owners and Hispanic consumers in these stores in Massachusetts and New York City, found a strong demand for the kabocha cultivars where it is being used as substitute for calabaza. Ten Hispanic stores in the Washington Heights section of Manhattan in New York City, which has one of the largest concentrations of Dominicans in the United States, were canvassed in researching cultivars for this trial. All 10 stores had kabocha cultivars on their shelves, and all were labeled as either calabaza or auyama, the most common name for C. moschata in the Dominican Republic. Only one of the ten stores visited in Washington Heights had calabaza (C. moschata). Kabocha was also tested in the Boston Terminal Wholesale Market and buyers of Hispanic produce prefer counts of 6-8 fruit/1.1-bushel compared to counts of 10 per box (Obergoso 2006). The larger cultivars, ‘Sweet Mama,’ ‘Delica,’ and ‘Thunder,’ would fit the desired size of 6-8 fruit/1.1-bushel box.

These observations underscore the popularity of the kabocha cultivars in Hispanic stores that traditionally would carry calabaza. In addition, buyers of kabocha at the
Boston Terminal Wholesale Market pay a premium for cultivars with larger fruit. Yield results suggest that these cultivars are commercially viable for production in Massachusetts. However, a thorough understanding of the preferences of the marketplace for characteristics such as size and shape of the different cultivars is critical for farmers to know before planting a specific cultivar. This knowledge is part of a comprehensive marketing plan needed to sell tropical pumpkin cultivars to ethnic consumers in the Northeastern U.S.

3.4 References


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3.5 Appendices

3.5.1 Figures

Figure 3.1 Yield of 11 hard squashes varieties grown at the UMass Research Farm in 2006 Mean separation within columns by Duncan’s multiple range test at $P = 0.05$
### Table 3.1: Species, seed sources, fruit length, width, weight, and number/acre for 12 *Cucurbita* varieties

<table>
<thead>
<tr>
<th>Cultivar</th>
<th>Latin name</th>
<th>Seed source&lt;sup&gt;x&lt;/sup&gt;</th>
<th>Fruit length (in.)</th>
<th>Fruit width (in.)</th>
<th>Fruit wt (lbs)</th>
<th>Num. fruit/A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tetsukabuto</td>
<td><em>C. maxima</em> x <em>C. moschata</em></td>
<td>SE</td>
<td>5.2&lt;sup&gt;bc&lt;/sup&gt;</td>
<td>7.2&lt;sup&gt;bc&lt;/sup&gt;</td>
<td>5.0&lt;sup&gt;c&lt;/sup&gt;</td>
<td>4,606&lt;sup&gt;ab&lt;/sup&gt;</td>
</tr>
<tr>
<td>Triunfo F1</td>
<td><em>C. maxima</em> x <em>C. moschata</em></td>
<td>AG</td>
<td>4.0&lt;sup&gt;c&lt;/sup&gt;</td>
<td>4.5&lt;sup&gt;d&lt;/sup&gt;</td>
<td>4.5&lt;sup&gt;cd&lt;/sup&gt;</td>
<td>4,355&lt;sup&gt;abc&lt;/sup&gt;</td>
</tr>
<tr>
<td>Abóbora moranga</td>
<td><em>C. moschata</em></td>
<td>AG</td>
<td>4.3&lt;sup&gt;c&lt;/sup&gt;</td>
<td>9.3&lt;sup&gt;a&lt;/sup&gt;</td>
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<td>4,020&lt;sup&gt;abc&lt;/sup&gt;</td>
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<tr>
<td>Delica</td>
<td><em>C. máxima</em></td>
<td>AT</td>
<td>4.0&lt;sup&gt;c&lt;/sup&gt;</td>
<td>7.3&lt;sup&gt;bc&lt;/sup&gt;</td>
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<td>2,931&lt;sup&gt;bc&lt;/sup&gt;</td>
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<tr>
<td>Hokkori</td>
<td><em>C. máxima</em></td>
<td>JS</td>
<td>3.8&lt;sup&gt;c&lt;/sup&gt;</td>
<td>6.2&lt;sup&gt;c&lt;/sup&gt;</td>
<td>2.3&lt;sup&gt;g&lt;/sup&gt;</td>
<td>4,606&lt;sup&gt;abc&lt;/sup&gt;</td>
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<tr>
<td>Sweet Mama</td>
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<td>AT</td>
<td>3.8&lt;sup&gt;c&lt;/sup&gt;</td>
<td>7.5&lt;sup&gt;bc&lt;/sup&gt;</td>
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<td>4,690&lt;sup&gt;abc&lt;/sup&gt;</td>
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<tr>
<td>Thunder</td>
<td><em>C. máxima</em></td>
<td>RP</td>
<td>3.9&lt;sup&gt;c&lt;/sup&gt;</td>
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<td>La Estrella</td>
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<td>Ayote</td>
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<td><em>C. mixta</em></td>
<td>MA</td>
<td>10.7&lt;sup&gt;a&lt;/sup&gt;</td>
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<td>3.2&lt;sup&gt;efg&lt;/sup&gt;</td>
<td>5,527&lt;sup&gt;a&lt;/sup&gt;</td>
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</table>

<sup>x</sup> Seed source: SE = Seminis (Brasilia Brazil) AG = Agristar (Petrópolis Brazil), AT = American Takaii Seed (Salinas CA), JS = Johnny’s Selected Seeds (Winslow ME), MA = Salvadoran Ministry of Agriculture, RP = Rupp Seed (Wauseon, OH).

<sup>y</sup> Mean separation within columns by Duncan’s multiple range test at $P = 0.05$. 

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CONCLUSIONS

The large and growing Brazilian population in Massachusetts has a strong preference for their traditional cuisine, and this situation represents a market with strong potential for local producers. In order for local farmers to take full advantage of these opportunities, it is critical that they understand the market demand for the specific products and the distribution system used by the markets that sell these products.

The Terminal Wholesale Market in Chelsea, MA is a dominant distribution point for most of the retail markets that cater to Brazilians. This is especially true for small Brazilian stores and restaurants, which represent over 400 markets in the State. Most of these 400 businesses sell relatively small amounts of fresh produce per week, and therefore it is not practical for local farmers to deliver to individual stores. Instead, it would be more efficient to sell the produce to vendors at the Terminal Wholesale Market where these smaller stores buy their produce.

Survey results demonstrate that Brazilians living in the United States have a strong preference for the varieties of squash popular in Brazil and that they are willing to pay higher prices compared to other squash varieties available in U.S. stores. This preference provides opportunities for farmers and businesses to focus on this niche market and allows them to demand higher prices over the domestic varieties at both the wholesale and retail levels.

Portuguese-speaking survey takers were essential to implement the market analysis for abóbora híbrida and maxixe in this study, since the majority of consumers interviewed was Portuguese-dominant. In addition to linguistic reasons, there were
cultural considerations. A large percentage of the Brazilian population in Massachusetts is undocumented, and the fact that project personnel implementing the surveys were Brazilian and spoke Portuguese made interviewees more comfortable about taking the survey.

Brazilians surveyed in this work have been in the U.S. for less than ten years and therefore still prefer to speak their native language, Portuguese. This is a strong indication of low acculturation to U.S. culture and customs. Most of the Brazilians surveyed, who live in the U.S. in smaller households compared to Brazil, prefer to purchase less than 1 kg (2.2 lbs) of abóbora per week compared to 2 kg (4.4 lbs) of abóbora per week when living in Brazil. This highlights the role of marketing research to understand consumer behavior adequately and to evaluate the potential of traditional products for Brazilian consumers in the United States. Because Brazil is a large and diverse country, it is also essential that markets understand the states of origin of their Brazilian customers so that they will offer the unique products particular to the customers state of origin.

An understanding of the importance and power of ethnic media outlets allows for maximization of sales of target products. Brazilian newspapers and cable TV are important sources of information for the consumers in this study, and articles and programming on Brazilian TV promoting locally-grown vegetables had a tremendous impact on sales. These newspapers and locally-produced TV programs are hungry for stories that highlight products desired by their readers and viewers, in particular ones that they did not know could be produced locally.
Research on production practices showed the two hybrid squash varieties popular in Brazil, “Tetsukabuto” and “Triunfo”, yielded well, more than 20,000 pounds per acre. The pollinator variety from Brazil evaluated in this experiment, “Abóbora Moranga,” had good size fruit and also yielded well with more than 24,000 pounds/acre.

Farmers rightfully see the introduction of new crops as a challenge, beginning with the availability of seeds in the U.S. to the different production practices that they have to learn in order to grow them successfully. There can also be tremendous risk in growing new crops without a thorough understanding of the market potential for specific corps. It is essential that the farmers understand the market demand for a crop, the distribution system used to deliver produce to the consumer, and have a focus on the marketing component before devoting land and resources to grow new cultivars in commercial scale.
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