

Preference for Color, Sweetness, and Mouthfeel of Sweet Potato in Puerto Rico¹

F. W. Martin and E. J. Rodríguez-Sosa²

ABSTRACT

The color, softness, mouthfeel, and sweetness of six different sweet potato cultivars were rated by a trained panel. These sweet potatoes were then served to 52 untrained panelists who rated them for flavor and appearance. Panelists also expressed attitudes about their preference regarding color, sweetness, flavor, and mouthfeel. Preference ranking for flavor was closely related to sweetness, and for appearance to orange color. There were differences in preference according to cultural affiliation and sex. Attitudes of panelists were not related to their choice of sweet potatoes except in the case of color. There appear to be two poles of preference, one for the orange, sweet, moist, and the other for the light, less sweet, dry type of sweet potato.

INTRODUCTION

The dietary staple of the tropics is frequently a starchy food such as rice, sago, plantain, cassava, yam, taro, cocoyam (tanier), potato, or sweet potato. The particular crops which are produced and consumed in a region depend not only on the edaphic and climatic characteristics of the region but also on preferences of people. Preferences are based in part on experience. People are likely to prefer the foods they have eaten all their lives. Nevertheless, there is no doubt that some foods are more appealing to the palate than others. The question of preference is of great importance not only to farmers and food-marketing systems, but also to agents who seek to bring about change in food purchase and eating habits. To the plant breeder who seeks to develop better crop plants, the question of preference is vital as he outlines his breeding goals. In this study these questions are addressed with respect to the sweet potato, *Ipomoea batatas* L.

When one eats a sweet potato one receives a variety of sensory stimuli such as appearance, odor, mouthfeel, and taste that lead to an impression such as, "this is good," or "this is not as good as yesterday's." The sum total of the characteristics that help form judgments about "goodness" is quality. One must divide quality into its parts, name them, define them, and find objective ways of measuring them.

A considerable amount of thought as well as experimental study has gone into the task of defining sweet potato quality in the United States.

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² Tropical Agriculture Research Station, Southern Region, Agricultural Research Service, U.S. Department of Agriculture, Mayagüez, Puerto Rico, and Food Technology Laboratory, Agricultural Experiment Station, Río Piedras, P. R.

In the South quality is considered to include an intense orange color, a moist feel in the mouth (mouthfeel), and a very sweet taste (Technical Committee S-101, 1979). Quality is also related to as yet undefined but recognizable flavor attributes. These characteristics are related to consumer preferences within the area where these sweet potatoes are grown and marketed.

There are several reasons why the southern guidelines might not be acceptable everywhere. Many people do not like the flavor of deeply orange sweet potatoes. They state that the flavor is strong, oily, or like that of carrots. Many persons prefer a dryer more palatable mouthfeel. Many persons do not want to eat a sweet farinaceous food every day. The popularity of Cuban "boniatos" (native sweet potatoes, usually white to light yellow before cooking) demonstrates that there are other valid standards for sweet potato quality.³

Factors included in preference for sweet potatoes are color, flavor (including sweetness), and mouthfeel. With respect to color, sweet potatoes can be white to yellow or orange with or without purple. Common color defects are gray, khaki green, mixture of purple and yellow, and blotchy appearance. It is possible to have excellent appearance with white, yellow, and orange colors, but purple color is always irregularly distributed.

Flavor attributes are often difficult to describe. In West Africa the preferred flavor is called yam-like, similar to that of true yams, *Dioscorea*.⁴ In Puerto Rico a good flavor is likely to be described as "rico" (delicious). Good flavor includes blandness, absence of bitterness or "off" flavors, and broad attractiveness. Flavor includes sweetness, but this trait can often be judged separately.

Sweet potatoes differ in the way they feel in the mouth. Some feel moist while others feel dry. A dry but not extremely dry mouthfeel appears to be very satisfying to most palates. When sweet potatoes are extremely dry, they may cause a disagreeable, choking sensation. On the other hand, some persons like a watery mouthfeel. Mouthfeel is not related to the moisture content of the sweet potato but to properties of starchy fractions, especially amounts and lengths of dextrans.

Softness of the cooked sweet potato is a characteristic that is influenced by cooking time as well as density and other factors. It is easy to judge.

The present study was made to evaluate the preference for color, sweetness, mouthfeel, and, to a lesser extent, softness of sweet potato by people of two cultural affiliations in Puerto Rico. This study is expected

³ Gull, D. D. and Conover, R. A., 1977. Quality characteristics and nutritional composition of boniatos (*Ipomoea batatas*). I. Cultivar quality. Proc. Fla. State Hort. Soc. 90:199-201.

⁴ International Institute of Tropical Agriculture, 1981. Annu. Rep. 1980, Ibadan, Nigeria.

to help orient the plant breeding program towards sweet potatoes that people will eat regularly as a staple.

MATERIALS AND METHODS

Six accessions of cultivars known to differ in color, sweetness, softness and mouthfeel were selected for the preference test. These included one recognized cultivar, Gem, and five selections of the senior author. The level of each characteristic was judged by a trained panel before tests were begun, and four characteristics were rated on a scale of from 1 to 6 or 1 to 4 (table 1). The overall quality of the selection was then rated on a scale of 1 to 6, not acceptable to excellent.

The sweet potatoes were cut into cubes of 2.5 cm, boiled for 20 minutes, and allowed to cool. The still warm cubes were placed on paper plates divided by lines into 6 equal pie-shaped sections, each numbered. Un-

TABLE 1.—*Characteristics of sweet potatoes used for preference tests*¹

Variety	Color	Score for orange	Softness ²	Mouthfeel ³	Sweetness ⁴	Panel rating ⁵
Gem	Orange	6	5	1	3	5
Trompo Negro	Deep purple	1	6	5	2	3
SPT 5	Dark yellow	5	4	5	2	5
SPT 32	White	1	1	6	1	3
SPT 38	Very light yellow	2	3	4	3	4
SPT 39	Orange	6	5	3	4	6

¹ As determined by a trained panel.

² 1 = hard, 6 = extremely soft.

³ 1 = moist, 6 = very dry.

⁴ 1 = not sweet, 4 = very sweet.

⁵ 1 = unacceptable, 6 = excellent.

trained panelists were selected at random from visitors and employees of TARS as well as family or friends. They were informed that all of the sweet potatoes were good but that some were better than others. Tests were held at 11:00 a.m. daily, and were completed in 1 week.

Panelists were fitted with red goggles that effectively masked red and yellow colors, but which could not mask the strong purple of one accession, Trompo Negro. They were asked to taste all six sweet potatoes as many times as necessary, and then to rank the sweet potatoes from one (best) to six (poorest) on the basis of preference. Ratings were written directly on the paper plates. The goggles were then removed and panelists were given a pen of another color. They then were asked to disregard previous ratings and to rank the six sweet potatoes again on the basis of appearance only.

After ranking was completed, the panelists were asked seven questions,

and answers were recorded by the examiner. Table 2 summarizes the questions and data.

The data from 52 untrained panelists were analyzed by rank analysis to determine differences among accessions as well as differences in preference due to sex and cultural affiliation. Attitudes as revealed by the test were summarized. The relationship between attitudes and sex and cultural affiliation, and between attitudes and actual choice was tested with chi-square.

The relationship between attitudes towards the six accessions, and preference for taste or appearance were judged from comparisons of weighted attribute scores. These scores were calculated as follows. For each variety a table was prepared showing how many times each variety

TABLE 2.—*Relationship of sex and cultural affiliation to attitudes about sweet potato*

Variable	Variable	Chi-square and probability	Conclusions
Sex	Important factor	4.85 (0.09)	Possible relationship More women say sweetness
Sex	Sweetness	7.72 (0.05)	More women prefer sweetness
Sex	Mouthfeel	8.19 (0.02)	More men prefer dryness
Sex	Color	3.41 (0.64)	No relationship
Sex	Frequency of use	1.64 (0.65)	No relationship
Cultural affiliation	Important factor	0.03 (0.99)	No relationship
Cultural affiliation	Sweetness	6.10 (0.11)	Puerto Ricans prefer low sweet
Cultural affiliation	Mouthfeel	4.27 (0.12)	North Americans moist Puerto Ricans prefer dry and North Americans moist
Cultural affiliation	Color	6.38 (0.27)	No relationship
Cultural affiliation	Frequency of use	2.144 (0.54)	No relationship

had been selected as 1, 2, 3, etc. An average rank was calculated by multiplying the rank value by the number of times rated, and summing. So that high numbers would express high acceptance, the ranks were inverted. Inverted average ranks were multiplied by attribute and rating scores as given in table 1 to obtain weighted attribute scores.

RESULTS

Table 3 gives the ranking of the six sweet potatoes accessions by taste. The accessions were significantly different in rank for taste and for appearance. Males and females as well as Puerto Ricans and North Americans ranked the accessions about the same. Table 3 also gives the average ranking for appearance. Again, there were no differences in

ranking due to sex or cultural affiliation. The highest-ranked cultivar for taste, Gem, was also ranked highest for appearance. The two accessions ranked lowest for taste were also those ranked lowest for appearance.

Table 4 summarizes attitudes expressed towards sweet potatoes by untrained panelists. Panelists believed their choice for sweet potatoes was based on flavor or sweetness. Most prefer low to intermediate sweetness, and not extremes. Only 15% preferred a dry mouthfeel over

TABLE 3.—*Ranking of sweet potatoes by taste and appearance preference of panelists, and by sex and race*

Variety	Preference				
	Total	Females	Males	Puerto Ricans	North Americans
	<i>Taste</i>				
Gem	2.88 a ¹	2.78 a	2.94 a	2.81 a	3.20 a
SPT 38	2.94 a	2.73 a	3.06 a	3.05 ab	2.50 a
SPT 39	3.08 a	2.89 a	3.18 a	3.12 ab	2.90 a
SPT 5	3.56 ab	3.79 a	3.42 a	3.62 b	3.30 a
Trompo Negro	3.84 b	3.74 a	3.91 ab	3.83 bc	3.90 ab
SPT 32	4.69 c	5.05 b	4.48 b	4.57 c	5.20 b
	<i>Appearance</i>				
Gem	2.56 a	2.58 a	2.54 a	2.66 a	2.10 a
SPT 5	2.92 ab	3.31 ab	2.70 ab	2.95 ab	2.80 bc
SPT 39	3.23 bc	2.95 ab	3.39 ab	3.42 ab	2.40 ab
SPT 38	3.25 bc	2.95 ab	3.42 ab	3.19 ab	3.50 bc
SPT 32	3.73 c	3.79 b	3.69 b	3.57 b	4.40 c
Trompo Negro	5.31 d	5.42 c	5.24 c	5.19 c	5.80 d

¹ Means followed by the same letter do not differ significantly ($P = 0.05$).

TABLE 4.—*Attitudes concerning sweet potatoes*

Attitude	Flavor	Sweetness	Mouthfeel		
Most important factor in a good sweet potato	48.1 ¹	42.3	9.6		
	<i>Not sweet</i>	<i>Little sweet</i>	<i>Sweet</i>	<i>Very sweet</i>	
Preference for sweetness	5.7	42.3	42.3	9.6	
	<i>Moist</i>	<i>Intermediate</i>	<i>Dry</i>		
Preference for mouthfeel	42.3	42.3	15.4		
	<i>No preference</i>	<i>White or cream</i>	<i>Yellow</i>	<i>Orange</i>	<i>Purple</i>
Preference for color	15.4	28.8	11.6	40.3	3.8
	<i>Likes</i>	<i>Intermediate</i>	<i>Dislikes</i>		
Attitude toward orange-fleshed sweet potatoes	75.0	3.8	21.2		
	<i>Never</i>	<i>Once in a while</i>	<i>Frequently</i>	<i>Daily</i>	
Preference for frequency of eating	5.8	26.9	53.8	13.5	

¹ Percentage of persons indicating preference.

moist or intermediate. Preference for color appeared to be widely distributed. While many panelists believe that they like or prefer orange sweet potatoes, a definite group prefers white. Only 13% of the panelists believe that they would like to eat sweet potatoes every day, and one third preferred to eat them seldom or never.

Table 2 summarizes the relationship of sex and cultural affiliation to attitudes in terms of *chi*-square tests. Women say that flavor is the most important factor in a good sweet potato and they prefer sweetness; with respect to mouthfeel, men prefer dryness. Puerto Ricans tend to prefer low sweet, dry, whereas North Americans prefer sweet, moist sweet potatoes.

Table 5 summarizes the relationship of attitudes to choice of best tasting variety. The attitudes that panelists expressed about most important factor in choice, sweetness, texture, and preferred frequency in the diet were unrelated to characteristics of accession chosen as best. On the other hand, significant *chi*-squares show that people who say they like orange-fleshed sweet potatoes select them as best, even when they cannot see them. Similarly, there was a strong relationship between color preferred and variety chosen as best.

In order to understand better the reasons for which one variety was ranked higher than another, table 6 shows weighted attribute scores. In this table, accessions are listed by preference rank. If a particular attribute is related to ranking, the weighted attribute scores should be arranged in order similar to the rank, but in either ascending or descending order.

In the first part of the table, related to preference for taste, weighted attribute scores are arranged in the most orderly manner in the case of sweetness, and are almost at random with respect to color, softness, and texture. In the second section of the table, related to preference of appearance, weighted attribute scores for orange color decrease as rank increases. Orange color seems to be the principal factor in appearance preference.

DISCUSSION

The findings of this study do not support the thesis that in the tropics sweet potatoes with light color, dryish in mouthfeel and low sweet are preferred over sweet potatoes that are moist with orange flesh. Within the small sample tested an excellent introduced cultivar, Gem, was selected as best in comparison to other good accessions but not by everyone. Selection for taste could not have been based on color, as color was masked by the use of goggles. Weighted attribute comparisons suggest that the attribute most related to selection for taste is sweetness. However, the author and his trained test panel believed that other, still undefined taste attributes were also of importance. There can be no

TABLE 5.—*Relationship of attitudes expressed to choice of best tasting variety*

Question	Alternative attitudes	Chi-square (probability)	Conclusions
Most important factor in choice	Flavor, sweetness	0.51	No relationship
Preference for sweetness	Little, lot	0.40	No relationship
Preference for mouthfeel	Dry, moist	0.38	No relationship
Preference for frequency in the diet	Frequent, infrequent	0.29	No relationship
Orange-fleshed sweet potatoes	Likes, does not like	0.02	Strong relationship
Color preferred	Orange, purple, other	0.00	Strong relationship

TABLE 6.—*Weighted attribute scores as compared to preference ranking*

Preference ranking	Weighted attributes				Weighted panel ratings
	Orange color	Softness	Mouth-feel on tasting	Sweetness	
<i>For preference</i>					
Gem	25.5	21.2	4.2	12.8	21.2
SPT 38	8.1	12.2	16.2	12.2	16.2
SPT 39	24.0	20.0	12.0	16.0	24.0
SPT 5	18.0	14.4	18.0	7.2	18.0
Trompo Negro	3.3	19.6	16.3	6.5	9.8
SPT 32	2.5	2.5	14.9	2.5	7.4
<i>For appearance</i>					
Gem	32.9	27.4	5.5	16.4	27.4
SPT 5	22.1	17.7	22.1	8.8	22.1
SPT 39	23.9	19.9	11.9	11.9	23.9
SPT 38	8.0	12.0	16.0	12.0	16.0
SPT 32	3.5	3.5	21.1	3.5	10.6
Trompo Negro	1.8	10.5	8.8	3.5	5.2

denying that in sweet potato a combination of orange color, sweetness, moist mouthfeel, and undefined flavor attributes is interpreted by many persons as something good. This is in agreement with the consensus concerning quality in the United States.

The above findings are contrary to findings by Haddock and Mirabel⁵ who questioned consumers about their preferences, but did not make actual preference tests. As seen herein, except with respect to color, opinions regarding sweetness, softness and texture are not related to preferences for either taste or appearance. These results also appear to contradict findings at the International Institute of Tropical Agriculture,

⁵ Haddock, D. and Mirabel, R. A., 1953. Preferencias del Consumidor por la Batata. Bol. 110. Est. Exp. Agríc., Univ. P.R.

Nigeria, that white color, and dry texture are preferred⁴, as well as similar arguments by Gull and Conover.³ Some individuals tested expressed a definite dislike of the flavor associated with orange color.

Yet, it must be recognized that culture affiliation and sex played a part in the choices made. In general, Puerto Ricans preferred drier and less sweet sweet potatoes than North Americans. Furthermore, in these tests, untrained panelists of farm or unsophisticated backgrounds preferred white, dry, low sweet and rejected orange, moist, sweet sweet potatoes.

Thus, in terms of preference for color and taste there appear to be two poles of opinion depending in part on geographical location as well as experience and cultural affiliation.

It is interesting to observe that few people are interested in sweet potato as a daily food. It is possible that the rich, sweet taste of a "preferred" sweet potato might not be the appropriate taste for a daily staple. On the other hand, the combination of characteristics necessary for a daily staple might not have been represented among the six cultivars tested.

RESUMEN

El color, la blandura, la textura en la boca y la dulzura de seis batatas muy distintas fueron evaluados por un grupo de catadores entrenados. Después, las batatas se sirvieron a 52 personas no entrenadas que ordenaron las variedades de su preferencia por sabor y apariencia. Los catadores también expresaron sus opiniones sobre preferencia por color, textura y dulzura. El orden de preferencia para sabor estuvo relacionado principalmente con la dulzura, mientras que la apariencia estuvo relacionada con el color. Hubo diferencias en preferencia debido al sexo y la cultura. Las opiniones de los catadores uvieron poca relación con lo que escogieron como lo más agradable excepto en el caso del color. Parece que hay dos polos de preferencia, uno para el tipo anaranjado, dulce y húmedo, y el otro para el tipo no anaranjado, menos dulce y más seco.