PITTMAN, MALLERY KNEE. Flavor Acceptance of Selected Sweet Potato Cultivars. (1976) Directed by: Dr. Joan Cassilly. Pp. 43.

The purposes of this study were to investigate the acceptance of 20 sweet potato cultivars and to investigate the detection of bitterness in these same cultivars under four stages of treatment: freshly harvested, cured, stored, and processed. The cultivars were treated and prepared by standard methods and were presented to a sensory panel for evaluation of flavor and acceptability. Panelists' scores for bitterness and acceptability were converted into percentages. These percentages among cultivars and among the four treatments were compared in order to determine results.

Results of the data collected show definite differences in acceptability among sweet potato cultivars and in acceptability of any one cultivar after undergoing the four treatments. Bitterness ratings of the different sweet potato cultivars changed during curing, storing, and processing. There appears to be a slight increase of bitterness during storage, while most cultivars tended to become less bitter when processed. Half of the sample population could detect the sweet potato bitterness. Each cultivar was scored as bitter to some degree by the panelists.

FLAVOR ACCEPTANCE OF SELECTED SWEET POTATO CULTIVARS

by

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A Thesis Submitted to
the Faculty of the Graduate School at
The University of North Carolina at Greensboro
in Partial Fulfillment
of the Requirements for the Degree
Master of Science in Home Economics

Greensboro
1976

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APPROVAL SHEET

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ACKNOWLEDGMENTS

The author wishes to express sincere gratitude to Dr. Joan Cassilly, Chairman of her Advisory Committee, for her advice, guidance and constant encouragement throughout this study. The author is especially grateful to Dr. Albert E. Purcell, Professor of Food Science at North Carolina State University for technical assistance. Dr. Dan Pope, Professor of Horticulture, emeritus, North Carolina State University, is recognized for determining the selection of sweet potato cultivars for this study. Appreciation also goes to Dr. Aden Magee and Mrs. Nancy Holmes for their service on the Advisory Committee.

The Department of Food Science at North Carolina State University is recognized for contributing sweet potatoes used in this study and for allowing the use of research facilities. Students, faculty, and staff at the University of North Carolina at Greensboro who willingly participated in the sensory evaluation are also recognized.

Special thanks go to family and friends who, through their support and encouragement, have made the completion of this work possible.

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CHAPTER I

INTRODUCTION

The sweet potato (Ipomoea batatas) is an important vegetable crop in the United States, and North Carolina is one of the largest sweet potato producing states. Although the North Carolina crop in 1967 was valued at $10 million per annum (Kushman, 1967), the sweet potato has not been as high a profit product as it could be due to low consumer demand. Factors which may influence consumer acceptance of sweet potatoes are flavor and individual taste acuity.

Bitterness may be a factor in consumer acceptance of sweet potatoes. A number of people have stated that they occasionally detect bitterness in sweet potatoes but bitterness of sweet potatoes has not been studied (Purcell, unpublished personal communication). This research is to study bitterness and other flavors.

The sweet potato is a root tuber of a creeping vine native to tropical America which requires long summers to permit sufficient root growth (Ward, 1923). Sweet potatoes are low in sugar content and high in starch content during the growing season. Varieties or cultivars differ in starch/sugar changes during various treatments after being dug. Increased sugar content is desirable as it improves flavor. After storage at high temperatures (the curing process) following harvest, the conversion of starch to sugar is rapid at first but slows

down to an equilibrium state (Sistrunk, et. al., 1954). Curing is also valuable to the quality of the sweet potato because it provides ideal conditions for wounds incurred during harvest to heal thus sealing pathways for decay (Kushman, 1967).

When cooked, maltose was produced from the conversion of starch in the sweet potatoes in the canning process. Baking seems to be the most important factor influencing the final quality of sweet potatoes because there appears to be an increased sugar content in the baked product (Sistrunk, et al., 1954).

Bitter is one of the basic tastes which is best detected at the back of the tongue and may not be tasted until the substance is swallowed (Amerine, et al., 1965). Several studies have indicated that a large portion of the population is blind to bitter taste. But while one individual may be taste-blind to one bitter substance, he may be able to detect bitterness in a different substance. Experiments by Blakeslee and Fox (1932) on bitterness using phenyl-thiocarbamide gave evidence that in a sample population 28% of the individuals were taste-blind to bitterness of this compound. Flavor-thresholds vary for individuals; one person may find a low concentration of a bitter substance objectable whereas another individual who can detect bitterness of the substance may not detect it at the low level. This is because the concentration of the substance is below his threshold for bitterness (King, 1937).

Since only individual people can determine the ultimate desirableness of food (Knowels and Johnson, 1941), any subjective testing for taste must

utilize the human subject as a measuring instrument. Sensory evaluations of the sweet potato will indicate if bitterness can be detected by panel members and if the various cultivars are liked or disliked by panel members.

The purposes of this study were to determine whether a panel could detect bitterness in the selected sweet potato cultivars, how many cultivars the panelists found to be bitter, and whether the treatment of the sweet potato cultivars influenced bitterness and acceptability.

CHAPTER II

REVIEW OF LITERATURE

Two-thirds of the annual sweet potato yield is sent to the market for sale as fresh produce; one-third is either processed as canned, flaked, frozen or used as seed for the next crop (Kushman, 1967). Therefore, it is important that research determine the cultivars best suited for the various treatments to insure consumers a desirable product. Increased emphasis is being placed upon suitable methods of preparing sweet potatoes for the fresh market because of the large number of products available to consumers and the importance of attractiveness and convenience.

Sweet potato dry matter is composed mostly of carbohydrate. Changes of this carbohydrate as sweet potatoes are cured, stored, and canned have been studied extensively in order to improve consumer acceptance. The sudden transformation of starch to sugar immediately after the sweet potato is dug is in the form of cane sugar (Hasselbring and Hawkins, 1915a). Hasselbring and Hawkins (1915b) later referred to the cause of the transformation as an enzymatic process.

Hopkins and Phillips (1937) determined that 2.5% sucrose in freshly harvested roots changed to 3.3% during the curing period at 10 to 15 C. The change in the amount of sucrose was dependent on temperature and time. Sistrunk, et al. (1954) agreed with the results of Hopkins and Miller. They

also found that the three principal sugars in sweet potatoes were glucose, fructose, and sucrose. These researchers suggested the key to the origin of better sweet potato varieties was high total solids content and good cooking ability because total solids directly influence the total sugar content after cooking. Lambou (1958) found sucrose to be the principal sugar in the raw root with beta-amylase responsible for most starch breakdown.

Jenkins and Geiger (1956) tested for carbohydrates in freshly harvested and cured sweet potatoes. Half the starch in the freshly dug root was converted to sugar when baked while more than half the starch was converted when the root was cured and stored for seven weeks and then baked. With curing and storing, the responsible enzyme increased its effectiveness. The study suggests enzymatic activeness during both curing and baking.

Ikemiya and Deobald (1966) tested freshly harvested sweet potatoes and found relatively small amounts of alpha-amylase. After storage for nine months, the enzyme increased six times. The enzyme was evenly distributed throughout the inner tissues of the root. Alpha-amylase gives dextrinizing activity which increases with the length of storage. Its optimum temperature is below 50 C. Later work by Deobald, et al. (1971) confirmed that alpha-amylase increased in cured and stored sweet potatoes.

Bitterness is a possible factor influencing consumer acceptance of sweet potatoes. Some bitter stimuli are: alkaloids (quinine, caffeine, strychnine), electrolytes (magnesium, ammonium salts), amids, glucosides, benzamide, nitro compounds, and tannins. Bitter is one of the four basic

tastes and is exclusively the sensation perceived by the receptors on the back of the tongue (Amerine, et al., 1965). The salivary glands dissolve or dilute tasteful substances and carry them to receptors. The mechanism for human sensitivity to bitter taste is not well understood. Tasters often find difficulty in identifying dilute bitter solutions confusing them with other tastes, particularly sour solutions (Amerine, et al., 1965). Jellinek (1973) emphasized that taste is also affected by texture and appearance. He composed a list of fifteen adjectives to describe flavor.

Sensory tests for the primary tastes are obvious necessities in obtaining data concerning consumer preference for food and for adding validity to food preference research. Fox (1931) tested a group of people for their ability to taste the bitter compound para-ethoxy-phenyl-thio-urea. He found that there was a great variation in individual reactions to the compound. Forty percent were taste-blind to the bitter compound while sixty percent found it to be intensely bitter.

Blakeslee and Fox (1932) repeated the test with a related compound, phenyl-thio-carbamide (PTC), and found similar results. Twenty-eight percent were taste-blind; sixty-five percent found the compound to be bitter; seven percent indicated other results. The results indicated the ability to taste bitter was in no way related to sex, race, or age.

Levene and Anderson (1932) investigated three groups of people in regard to taste-blindness. The groups were: American Indians (183), Indians with some white blood (110), and Caucasians (150). They found 6% American

Indians, 10.4% Indians with some white blood, and 42% Caucasians to be non-tasters. This study indicated that the incidence of taste-blindness is more prevalent among the white population than among Indians.

King (1937) tested for the lowest concentration of substances at which each individual could identify the substance. This threshold was tested for each of the basic four tastes. Caffeine was the bitter substance tested. No taste-blindness was indicated by her 64 panelists. The threshold for caffeine was 0.0002 M to 0.0128 M.

Knowles and Johnson (1941) repeated King's threshold tests. Of the 35 panelists, one could not detect bitter. Several could not discriminate sour-bitter tastes in low concentrations. Thresholds determined were much lower than King's, who evidently used solutions of higher molar concentrations. Caffeine thresholds obtained by Knowles and Johnson were 0.0002 M to 0.005 M.

Cohen and Ogdon (1949a) reported that age and sex are unrelated to taste but found that smoking may dull taste acuity. They compiled PTC (phenyl-thio-carbamide) studies from many nationalities, but concluded the data was internally inconsistent and indicates weak experimental procedures. These results indicated that some standard method of administration of PTC should be agreed upon.

Cohen and Ogdon (1949b) also researched taste blindness to PTC as a function of saliva. Results from PTC tests suggested that an individu's saliva may be the factor determining bitterness rather than PTC itself. PTC

may be insoluble in some peoples' saliva.

There is still doubt about how taste receptors work. Stone, et al. (1974), Weisberg (1974), and Gregson (1962) state that taste is a chemical, physiological, and psychological process. Threshold determination is difficult. Dallenbach and Dallenbach (1943) found that all taste qualities undergo adaptation. Bekesy (1964) states that the tongue is sensitive to the four primary tastes (bitter, sweet, sour, salty) and to heat and cold. Often times two tastes can be combined to give one sensation. Temperature can influence the reception of a taste.

A bitterness test for orange juice was administered by Coote (1956) with 8 panelists rating bitterness on a scale 0 to 4. Resulting statistics showed that tasters differ widely in their consistency of scoring and tasters do not maintain their individual levels of scoring.

Sensory evaluation is the most important factor in food analysis since consumer acceptance is the ultimate judge of food quality. The human being is the measuring instrument. Since individuals vary in likes and dislikes as well as in sensitivity, consistent results are difficult to obtain even under the most ideal conditions (Knowles and Johnson, 1941). Consumer preference tests are used when the ideal standard for the product is unknown. In a consumer preference test, expert judges are not used; thus, simple and few instructions are requires (Knowles and Johnson, 1941). Chemicals such as PTC can be used to see if judges have the ability to recognize basic tastes (Martin, 1973).

Peryam and Swartz (1950) consider consumer acceptance as the crucial test of quality of a food product and as paramount to every food processor and to all engaged in food research and development. An ideal panel evaluation is a situation precise enough to allow human responses to be treated as statistical units while at the same time controlled enough to reduce the impact of human factors.

Henderson and Vaisey (1970) consider sensory testing as an ability test because it requires a certain amount of memory, concentration and innate acuity in order for an individual to operate at peak performance. When students selected to serve on a taste panel were given a Personality Research Form in order to ascertain which personality traits correlated with superior food judging ability, the best discriminators of flavors were those with personality traits indicating a high need to achieve.

Motivation was discussed as the most important criteria for selection of panel members by Foster (1954). Martin (1973) and Krum (1955) add other important factors to consider when selecting a sensory panel. The individuals must be reasonably accessible and available. Twenty to 50 is the ideal age since sensory ability diminishes after 50 and members younger than 20 lack experience. Sex will not influence results since taste discriminations are not sex-linked or sex-influenced. Health should be good and the individual should not be allergic to the material being tested. Smoking has not been proven to dull the sense of taste. A panel size of 10 to 30 is ideal; the larger the panel, the more reliable the results.

Environmental factors in panel evaluations have been researched. Larmond (1973) and Krum (1955) found a quiet room with neutral colored booths, good lighting, and good ventilation to be ideal. Samples should be served on identical, colorless plates in portions of 2 or 3 bites. Two to 8 samples may be tasted in one session. Coding is a necessity in order to conceal the actual identity of the sample. Written directions for judges should be simple, complete, and specific.

Larmond (1973) suggests a preliminary test to determine the best method of preparation of a product. Certain factors such as time and temperature of cooking, amount of water, size of cooking pot, and time and speed of blending should be constant. If judges want to rinse their palate between samples, neutral water at room temperature may be used. But they must rinse between each sample to keep their testing conditions constant.

Griswold (1962) points out that samples should always be served at same temperature. In the case of applesauce or potatoes, a well-mixed and homogeneous sample is desirable. Judges should not be distracted while scoring samples in order to give most valid results. Written comments by judges often furnish valuable added information as to why a sample is undesirable. Griswold points out that if make-up tests are needed, it is possible to keep samples in satisfactory condition by freezing.

CHAPTER III

EXPERIMENTAL PROCEDURES

Raw and Canned Sweet Potatoes

Sweet potatoes for this study were obtained from the North Carolina State University Experiment Station at Clayton, North Carolina. Twenty cultivars were selected for testing in four stages: fresh, cured, canned, and cured and stored. Eight standard cultivars were harvested October 3, 1975: Porto Rico, Red Jewel, Georgia Jet, Gem, Copper Skin Jewel, Jewel, Redmar, and Centennial. Six cultivars rated fair to good by the Horticulture Department at North Carolina State University were selected and harvested October 6, 1975. These cultivars were designated as samples 196x228-11, 228x241-13, 228-0-25, 241-0-3, 184x241-4, and 196-0-50. Also six poor quality sweet potatoes were selected by the standards mentioned above and were harvested October 6, 1975. These were designated 228-0-26, 198-234-1, 226x198-1, 228-0-1, 258, 256-3, 273x234-1.

Each cultivar was stored for three days after harvest at 55 F and 50% humidity, and samples of each cultivar were canned by the following procedure. The sweet potatoes were washed, placed in a 13% NaOH solution, held at 101 C for 4 1/2 minutes, and sprayed with cold water to remove the peel. Potatoes were hand trimmed, cut into approximately two inch sections and packed in Number 2 1/2 cans (1000 ml.) with a 25% sucrose solution. The

filled cans were placed in a steam exhaust box for six minutes to bring the temperature of the potato to 190 F. Each can was mechanically sealed and retorted immediately at 240 F for 30 minutes and 10 pounds pressure. These cans were stored until February 15, 1976.

The canned potatoes were presented to the panel without a baking procedure due to the heating and cooking involved in the canning process. These sweet potato samples were taken directly from the individual cans, drained, mashed, mixed thoroughly, and served at room temperature.

The sensory evaluation of canned cultivars was performed on six of the original 20 potatoes. Three well liked cultivars (Porto Rico, 196x228-11, 228-0-1) and three poorly rated cultivars (Georgia Jet, 228-0-26, 198-234-1) were selected based on the results of taste panel evaluations on tests of freshly dug and cured sweet potatoes.

Cured Sweet Potatoes

Samples of each cultivar were cured immediately after harvest. The sweet potatoes were held at 85% to 90% relative humidity at 80 F for eight days. They were then stored at 55 F and 50% relative humidity. Half of each sample was taken to Greensboro, North Carolina, for testing on November 5, 1975. The remaining half were stored until February 24, 1976 for testing at that time.

Baking Procedure

Number One grade sweet potatoes of each cultivar were selected for use in each taste panel test. The raw roots were washed in tap water to

remove surface dirt, allowed to air dry, and punctured with a fork to prevent explosions during baking. Samples were placed on cookie sheets and baked in preheated electric ovens at 375 F for 70 minutes. Due to the large size of some samples, some potatoes were baked an additional 10 minutes.

After baking and removal from the oven, each potato was split lengthwise. The flesh was scraped out leaving the fibrous portion attached to the skin. The flesh of each cultivar was placed in clear pyrex bowls and mixed to minimize differences in individual roots of the cultivar.

Panel Evaluations

All sensory evaluations were conducted in a food preparation laboratory in the School of Home Economics at the University of North Carolina at Greensboro. Panel members rated the twenty cultivars in four different stages: fresh, cured, canned, and cured and stored.

Panel members were students, staff, and faculty of the School of Home Economics at the University of North Carolina at Greensboro who volunteered to participate in the testing. Each panel member was given identical written instructions prior to the first taste evaluation (see Appendix A). Panelists were instructed to determine their acceptance or rejection of each sweet potato sample and to identify off-flavors, particularly bitterness. The score sheet provided space for additional comments.

Samples were randomly coded with three-digit numbers. One tablespoon of each cultivar was served at room temperature on a white paper

plate. Five samples were presented to each panel member on each test day except the one day on which the six canned samples were evaluated. Panelists were provided with a fork, glass of water, score sheets, and samples to be evaluated. The score sheet used is included in Appendix B.

Due to changes in availability of people, panel composition varied somewhat throughout the testing; the daily number of participants varied from 35 to 31. Panel evaluations were conducted: immediately after harvest while fresh, after curing, after canning, and after curing and storing. Dates of panel testing are given in Appendix C.

Bitter Compounds

On November 20, 1975, and March 4, 1976, bitter compounds, ammonium citrate and ammonium citrate dibasic respectively, were administered to the panel members to determine if each could detect bitterness in these compounds. The compounds were prepared in concentrations of 1 gram per 100 milliliters of distilled water and 2 grams per 100 milliliters of distilled water.

Make-up Evaluations

One-fourth cup of each prepared cultivar was sealed in aluminum foil, coded with the random sample number, and frozen. On the final day of each stage of testing, a make-up test was given for panel members who had missed evaluation periods. The frozen samples were removed from the freezer and allowed to thaw undisturbed until they reached room temperature. Evaluations were then carried out as in all previous test situations.

CHAPTER IV

RESULTS

The results of the panel evaluations showed a significant difference in the acceptance of the twenty sweet potato cultivars tested in each state. The acceptance of cultivars varied greatly with a change of treatment.

Fifty-seven percent of the panelists detected sweet potato bitterness. Results indicated a slight increase of bitterness occurred during storage but a decrease of bitterness resulted from the canning process when compared to the fresh state. When given a bitter solution to taste, ninety-four percent of the panelists detected bitterness.

Other off-flavors, either desirable or undesirable, were detected by fifty-four percent of the panel members. The descriptions of the off-flavors were inconsistent in most cases. General conclusions are listed in Table 1.

Fresh State

Acceptance of the twenty cultivars as judged by the panelists varied greatly. The most acceptable variety in the fresh state was Porto Rico; 88% of the panelists indicated "like." The least acceptable was cultivar 198-234-1 with only 3% of the panelists indicating "like." Bitterness was detected least in Porto Rico and Gem, 3% each. The greatest percent of bitterness, 38%, was found in cultivar 198-234-1.

Table 1. OFF-FLAVOR EVALUATIONS FOR ALL STAGES

Cultivar	Comments
Porto Rico	Sweet (except when canned)
Red Jewel	Bland
Georgia Jet	Bland, poor flavor
Gem	No general conclusion
Copper Skin Jewel	No general conclusion
Jewel	Good to bland
Redmar	No general conclusion
Centennial	No general conclusion
196x228-11	Chemical flavor
228x241-13	No general conclusion
228-0-25	No general conclusion
241-0-3	Too moist
184x241-4	Poor flavor
196-0-50	Sweet
228-0-26	Very dry, chalky, bland
198-234-1	Very dry, bland
226x198-1	Poor flavor
228-0-1	Sweet
258x256-3	Musty
273x234-1	Bad flavor, chemical

An average percentage of the panelists' scores indicating "like," showed sweet potatoes in the fresh state were the most desirable of the four stages tested. However, these same cultivars were second to the cured plus stored stage for being most bitter. Table 2 gives the actual percentage of acceptance and taste perception of the 20 sweet potatoes in the fresh state. Appendix D gives the panel scores in total numbers.

Cured Stage

Acceptance and bitterness scores of the cultivars varied greatly. Again, in the cured stage, the panelists' score cards revealed Porto Rico was the most liked cultivar, 97%, while cultivar 198-234-1 was the least liked variety, 0%. The least bitter cultivar was 228-0-1 at 0%; the most bitter cultivar was 228-0-26 at 49%. The percentages for each sweet potato in the cured state are listed in Table 3. The actual scores are listed in Appendix D. Next to the fresh state, sweet potatoes in the cured state were most acceptable. The cured cultivars were also second least bitter, following the canned cultivars.

Canned State

Six cultivars were selected from the original twenty to indicate any changes in acceptability caused by the canning process. Three "good" (highly rated) cultivars; Porto Rico, 196x228-11, 228-0-1, and three "poor" (rated low) cultivars; Georgia Jet, 228-0-26, 198-234-1, were selected. An average percent of scores for each stage of all cultivars indicated that canned sweet

Table 2. ACCEPTANCE AND TASTE PERCEPTION OF VARIOUS SWEET POTATOES PREPARED FROM FRESH STATE

Variety	Percent Like	Percent Detecting Bitterness	Percent Detecting Off-flavors
Porto Rico	88	3	21
Red Jewel	79	12	6
Georgia Jet	38	35	26
Gem	76	3	24
Copper Skin Jewel	59	32	26
Jewel	77	23	17
Redmar	49	37	23
Centennial	74	23	9
198x228-11	86	11	14
228x241-13	54	37	17
228-0-25	65	23	13
241-0-3	58	10	13
184x241-4	71	16	16
196-0-50	84	13	16
228-0-26	6	26	26
198-234-1	3	38	31
226-198-1	66	25	25
228-0-1	84	6	9
258x256-3	59	19	16
273x234-1	63	19	31

Table 3. ACCEPTANCE AND TASTE PERCEPTION OF VARIOUS SWEET POTATOES PREPARED FROM THE CURED STATE

Variety	Percent Like	Percent Detecting Bitterness	Percent Detecting Off-flavors
Porto Rico	97	9	6
Red Jewel	60	20	11
Georgia Jet	40	46	29
Gem	71	14	17
Copper Skin Jewel	74	17	11
Jewel	60	27	9
Redmar	70	27	9
Centennial	73	15	24
196x228-11	94	3	6
228x241-13	70	18	18
228-0-25	74	9	14
241-0-3	57	17	11
184x241-4	63	17	14
196-0-50	71	11	11
228-0-26	9	49	29
198-234-1	0	24	18
226x198-1	53	9	9
228-0-1	88	0	18
258x256-3	56	29	15
273-234-1	29	47	26

potatoes were less well liked than cultivars in the three other stages. Cultivar 196x228-11 was most liked (76%) in the canned stage while the least liked of the six cultivars tested was 228-0-26 at 21%. A lower average incidence of bitterness was detected by panelists in the canned stage than in the other stages. It is noted, though, that bitterness increased greatly in the Porto Rico variety and browning was observed. The percentage scores are listed in Table 4; the actual scores are listed in Appendix D.

Cured and Stored Stage

Panelists found cured and stored cultivars to be more bitter than cultivars at the other three stages. The sweet potatoes were liked more than in the canned stage but less than the fresh stage and the cured stage. The Jewel variety received the highest rating, 85%, while Georgia Jet was liked least by the panel, 9%. Table 5 shows the percent figures scored by the twenty cultivars in the cured and stored state. Appendix D lists the actual taste panel scores of acceptance and taste perception.

Bitter Compounds

Of the thirty-four panel members tasting ammonium citrate, twenty-eight (82%) detected bitterness in a solution of one gram per 100 milliliters. Four panelists (12%) could not detect bitterness in the one gram solution but could detect it in a two grams per 100 milliliter solution. Two (6%) panel members could not detect bitterness in either solution. Therefore, 94% of the panel members were able to detect bitterness of this compound.

Table 4. ACCEPTANCE AND TASTE PERCEPTION OF VARIOUS SWEET POTATOES PREPARED FROM CANNED STATE

Variety	Percent Like	Percent Detecting Bitterness	Percent Detecting Off-flavors
Porto Rico	55	30	33
Georgia Jet	55	21	33
196x228-11	76	3	15
228-0-26	21	18	30
198-234-1	24	21	21
228-0-1	70	3	9

Table 5. ACCEPTANCE AND TASTE PERCEPTION OF VARIOUS SWEET POTATOES PREPARED FROM THE CURED PLUS STORED STATE

Variety	Percent Like	Percent Detecting Bitterness	Percent Detecting Off-flavors
Porto Rico	83	14	9
Red Jewel	74	23	9
Georgia Jet	9	57	46
Gem	29	37	54
Copper Skin Jewel	83	11	9
Jewel	85	12	6
Redmar	74	18	12
Centennial	76	12	15
196x228-11	79	21	9
228x241-13	59	26	18
228-0-25	71	6	14
241-0-3	71	20	11
184x241-4	66	11	17
196x0-50	66	20	29
228-0-26	20	43	26
198-234-1	19	29	16
226x198-1	68	13	6
228-0-1	81	16	6
258x256-3	29	32	26
273x234-1	45	23	35

Several months later, ammonium citrate dibase was administered to the panel of thirty-five members. Twenty-six (74%) of them detected bitterness in the one gram per 100 milliliter solution; while seven panelists (20%) who could not detect bitterness in the one gram solution detected bitterness in the two gram per 100 milliliter solution. Two of the panelists (6%) could not detect bitterness in either solution.

Of the twenty sweet potato cultivars tested, each was scored to be bitter in varying degrees indicating there was not a non-bitter cultivar. Acceptance of a sweet potato, however, depended on the cultivar and its treatment. Based on the results, it would appear that each cultivar responded independently to treatment.

CHAPTER V

DISCUSSION

Results of the sensory evaluations by panel members revealed varying degrees of taste acuity. While 94% of the panel members could detect bitterness in the ammonium citrate solutions, only 54% could detect bitterness in any one cultivar. Two panel members said they found mild bitterness to be a pleasant taste. Several others who could detect bitterness in a particular cultivar said they would not necessarily refrain from eating the sweet potato simply due to the bitterness. Bitterness, however, was generally an undesirable characteristic found in the twenty cultivars.

Off-flavor evaluation could not be measured as desirable or undesirable in most cultivars due to the great inconsistency of descriptions. For example, although most off-flavor descriptions for cultivar 228-0-1 were "sweet," some panelists indicated this sample was "too sweet." In the case of the cultivar Gem, equal numbers of panelists indicated "sweet," "bland," and "rotten" as the off-flavors in each of the four states.

Numerical scores for each cultivar were converted into percentages of the categories "like," "bitter," and "off-flavor." Comparisons were made to determine if differences existed in each category. Results of these comparisons could be helpful in determining trends of change in each cultivar with the four treatment states or in determining differences of the twenty cultivars in

the same treatment state.

It was noted that Porto Rico markedly increased in bitterness after the canning process. Each of the other five cultivars undergoing the canning process decreased in bitterness from the fresh state. Browning was observed in the Porto Rico cultivar during the canning process before the 25% sucrose solution was poured into the can of potatoes. Porto Rico was exposed to the air longer than the other cultivars. Possibly the browning was due to polyphenols and the oxidase system which resulted in increased bitterness.

Cultivar 228-0-1 was well liked by panelists throughout the four states: 84%, 88%, 70%, 80%. In the cured state, none of the panel members indicated bitterness present. This was the only point of the sensory evaluations in which a cultivar showed no bitterness. Cultivars 196x228-11 and 228-0-1 were the least bitter canned cultivars, 3%. The off-flavor attributed to 228-0-1 was "sweet." These findings should be significant to sweet potato researchers because 228-0-1 was previously suggested as being one of the six poor quality sweet potatoes.

Subjective testing by a sensory panel was an appropriate means to collect data. In order to determine if individuals like sweet potatoes and if they are able to detect bitterness or other off-flavors in a variety of cultivars, a large enough panel must taste the sweet potatoes and score the flavor. Each treatment stage of each cultivar was rated under standard conditions by a sample population of 31 to 34 individuals. To determine if the panel members could detect bitterness and to add validity to the results, ammonium citrate

solutions were administered.

The sensory panel, as a sample of the whole population, indicated a much greater acceptance of some cultivars than of others. If the highly liked and less bitter cultivars were marketed, consumer demand for sweet potatoes could increase. Also, the consumer could be aided in the grocery store if sweet potatoes were labeled by the cultivar name rather than by the general "Sweet potato" label as is now required by the USDA for all varieties.

CHAPTER VI

SUMMARY AND CONCLUSIONS

North Carolina is one of the two largest sweet potato producing states in the United States but the sweet potato is not a high profit product. The apparent low consumer demand for sweet potatoes may be caused by several factors, one of which could be flavor and individual taste acuity. Some people report a bitter after taste in sweet potatoes, and it may be this bitterness which strongly influences consumer acceptance. The purpose of this study was to determine if bitterness is detected in sweet potatoes and if acceptability of sweet potatoes varies according to the state of the potato: fresh, cured, canned, or cured and stored.

Taste panel testing of twenty cultivars in the four states was performed. Results of acceptability and bitterness scores were compared.

Several conclusions can be drawn from the research completed:

1. There was a difference in the acceptability of individual cultivars in the fresh, cured, canned, and cured plus stored states.
2. There was a difference of acceptability in each state of treatment of the twenty cultivars.
3. There was a difference in the detection of bitterness in each of the twenty cultivars when compared within the same state and when an individual cultivar was scored in all four states.

4. The four treatments influence the acceptability and the incidence of bitterness.
5. All twenty cultivars tested were bitter in varying degrees.
6. Half of the test population can detect some bitterness in sweet potatoes.
7. Bitterness tends to increase with curing and storing processes.
8. Bitterness tends to decrease with the canning process.

Sweet potatoes have not been systematically or objectively studied for a bitterness factor. Information gathered from this study could form a basis for future objective research, such as running flavor profiles on sweet potatoes to identify the bitter compound. Since bitterness has now been identified in sweet potatoes, this study could be repeated with bitterness ranked on a scale in order to apply the statistical treatment, analysis of variance.

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APPENDIX A

INSTRUCTIONS FOR TASTE PANEL MEMBERS

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Taste is exclusively the sensation perceived by the receptors on the tongue. For the purpose of this test you are asked to determine your acceptance (like) or rejection (dislike) of each sweet potato sample. You are also asked to identify any off-flavors you detect, particularly bitterness. You may drink water between samples to clear your palate. If this is desirable to you, please be consistent by doing so after each sample. Please do not discuss your participation in the panel evaluation with anyone else.

APPENDIX B

SWEET POTATO EVALUATION SCORE SHEET

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SWEET POTATO EVALUATION SCORE SHEET

Name_____ Date_____

Sample #_____

Directions: Please check the following as applicable.

Like:_____

Dislike:_____

Bitterness present? Yes_____ Other off-flavors present? Yes_____

No_____ No_____

If other off-flavors are detectable, please describe:_____

_____

Other comments:_____

_____

APPENDIX C

DATES OF TASTE PANELS

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DATES OF TASTE PANELS

Cultivar	Fresh Dug 1975	Cured 1975	Canned 1976	Cured and Stored 1976
Porto Rico	October 15	November 12	February 18	February 25
Red Jewel	October 15	November 12		February 25
Georgia Jet	October 15	November 12	February 18	February 25
Gem	October 15	November 12		February 25
Copper Skin Jewel	October 15	November 12		February 25
Jewel	October 16	November 13		February 26
Redmar	October 16	November 13		February 26
Centennial	October 16	November 13		February 26
196x228-11	October 16	November 13	February 18	February 26
228x241-13	October 16	November 13		February 26
228-0-25	October 21	November 19		March 3
241-0-3	October 21	November 19		March 3
184x241-4	October 21	November 19		March 3
196-0-50	October 21	November 19		March 3
228-0-26	October 21	November 19	February 18	March 3
198-234-1	October 22	November 20	February 18	March 4
226x198-1	October 22	November 20		March 4
228-0-1	October 22	November 20	February 18	March 4
258x256-3	October 22	November 20		March 4
273x234-1	October 22	November 20		March 4

APPENDIX D

TASTE PANEL SCORES OF ACCEPTANCE AND TASTE PERCENTION

APPENDIX D

TASTE PANEL SCORES OF ACCEPTANCE AND TASTE PERCEPTION

Table 1. 20 CULTIVARS IN THE FRESH STATE

Cultivar	Like/Dislike	Bitter/Not Bitter	Off-flavors/No off-flavors
Porto Rico	30/4	1/33	7/27
Red Jewel	27/7	4/30	2/32
Georgia Jet	13/21	12/22	9/25
Gem	26/8	1/33	8/26
Copper Skin Jewel	20/14	11/23	9/25
Jewel	27/8	8/27	6/29
Redmar	17/18	13/22	8/27
Centennial	26/9	8/27	3/32
196x227-11	30/5	4/31	5/30
228x241-13	19/16	13/22	6/29
228-0-25	20/11	7/24	4/27
241-0-3	18/13	3/28	4/27
184x241-4	22/9	5/26	5/26
198-0-50	26/5	4/27	5/26
228-0-26	2/29	8/23	8/23
198-234-1	1/31	12/20	10/22
226x198-1	21/11	8/24	8/24
228-0-1	27/5	2/30	3/29
258x256-3	19/13	6/26	5/27
273x234-1	20/12	6/26	10/22

Table 2. 20 CULTIVARS IN THE CURED STATE

Cultivar	Like/Dislike	Bitter/Not Bitter	Off-flavors/No off-flavors
Porto Rico	34/1	3/32	2/33
Red Jewel	21/14	7/28	4/31
Georgia Jet	14/21	16/19	10/25
Gem	25/10	5/30	6/29
Copper Skin Jewel	26/9	6/29	4/31
Jewel	20/13	9/24	3/30
Redmar	23/10	9/24	3/30
Centennial	24/9	5/28	8/25
196x228-11	31/2	1/32	2/31
228x241-13	23/10	6/27	6/27
228-0-25	26/9	3/32	5/30
241-0-3	20/15	6/29	4/31
184x241-4	22/13	6/29	5/30
196-0-50	25/10	4/31	4/31
228-0-26	3/32	17/18	10/25
198-234-1	0/34	8/26	6/28
226x198-1	18/16	3/31	3/31
228-0-1	30/4	0/34	6/28
258x256-3	19/15	10/24	5/29
273x234-1	10/24	16/18	9/24

Table 3. 6 CULTIVARS IN THE CANNED STATE

Cultivar	Like/Dislike	Bitter/Not Bitter	Off-flavors/No off-flavors
Porto Rico	18/15	10/23	11/22
Georgia Jet	18/15	7/26	11/22
196x228-11	25/8	1/32	5/28
228-0-26	7/26	6/27	10/23
198-234-1	8/25	7/26	7/26
228-0-1	23/10	1/32	3/30

Table 4. 20 CULTIVARS IN THE CURED AND STORED STATE

Cultivar	Like/Dislike	Bitter/Not Bitter	Off-flavors/No off-flavors
Porto Rico	29/6	5/30	3/32
Red Jewel	26/9	8/27	3/32
Georgia Jet	3/32	20/15	16/19
Gem	10/25	13/22	19/16
Copper Skin Jewel	29/6	4/31	3/32
Jewel	29/5	4/30	2/32
Redmar	25/9	6/28	4/30
Centennial	26/8	4/30	5/29
196x228-11	27/7	7/27	3/31
228x241-13	20/14	9/25	6/28
228-0-25	25/10	2/33	5/30
241-0-3	25/10	7/28	4/31
184x241-4	23/12	4/31	6/29
196-0-50	23/12	7/28	10/25
228-0-26	7/28	15/20	9/26
198-234-1	6/25	9/22	5/26
226x198-1	21/10	4/27	2/29
228-0-1	25/6	5/26	2/29
258x256-3	9/22	10/21	8/23
273x234-1	14/17	7/24	11/20