SILANCE, MARY FRANCES. The Acceptability of Reconstituted Sweet Potato Flakes. (1974) Directed by: Dr. Joan P. Cassilly. Pp. 36.

The purpose of the study was to determine if sweet potato flakes with added fiber (Sample B) and/or flakes with an enzyme added (Sample C) were more acceptable than flakes which meet government specifications for military and school lunch programs (Sample A). It was thought that the addition of fiber or enzyme would improve the texture of reconstituted sweet potato flakes and make them more acceptable to the consumer.

A thirteen-member untrained taste panel and cafeteria patrons who purchased the sweet potato products being tested were judges. The three different samples were reconstituted and served at the same time on each of six days to the panel while each product was served three times each on different days in the cafeteria.

A scoring card, employing the hedonic rating scale for scoring appearance, flavor, texture, and overall acceptability of the reconstituted sweet potato flakes, was used. Standard analysis of variance procedures were used to determine whether there were differences between the samples. Data for the taste panel and patrons of the cafeteria were analyzed separately.

Results of the study revealed a significant difference at the .01 level between Sample C and Samples A and B for the taste panel. Sample C received the highest scores on all aspects of the test. Even though the differences were not significant, Sample B was rated slightly higher than Sample A in all characteristics rated. The cafeteria patrons rated Sample C highest followed by B and A respectively, but the difference was significant at the .05 level only for the flavor.

In this study, Sample C sweet potato flakes were more acceptable than Samples A and B; and Sample B was slightly more acceptable than Sample A. Sample B yielded more servings per cup of flakes than either of the others and maintained its consistency when held over steam better than Sample A or C.

THE ACCEPTABILITY OF RECONSTITUTED SWEET POTATO FLAKES

by

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APPROVAL PAGE

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CHAPTER I

INTRODUCTION

The need for an easily shipped, stored, prepared foodstuff which was tasty and palatable led to the production of white potato granules during World War II. The process for making these granules was modified to produce white potato flakes; and later, this process was further modified to produce sweet potato flakes.

Sweet potato flakes have been produced commercially since 1962, but this product has not been enthusiastically accepted by the consumer. The major objection to the flakes was thought to be "off flavor" which developed during storage. Recent studies have shown that texture may contribute more to the lack of acceptance of sweet potato flakes than "off flavor." Although less than half the sweet potatoes produced are suitable for marketing fresh or canned, the yield of marketable sweet potatoes per acre could be increased if flakes were produced from those rejected by size or shape for marketing fresh or canned.

Present government specifications for sweet potato flakes for use by military and in school lunch programs require that no fiber be added, but there are no government specifications for other sweet potato flakes. Manufacturers desire to add fiber from cut ends of canning sweet potatoes to determine if this will improve texture and make the flakes more acceptable.

This study was conducted in an attempt to verify whether flakes with higher fiber content or added enzyme are more acceptable than flakes made to government specifications. Information obtained from this study may be helpful in determining whether or not a change in the government specifications for sweet potato flakes should be considered.

CHAPTER II

REVIEW OF LITERATURE

Sweet Potato Flakes

The commercial production of white potato granules was begun during World War II to meet the armed forces' need for a product with low shipping volume and weight, easy storage in tropical and arctic conditions, easy and quick kitchen preparation, and a tasty and palatable foodstuff (1,2). The process was modified slightly to produce white potato flakes. Later, a further modification of the same process was used to develop sweet potato flakes.

Although all sweet potatoes are equally palatable and nutritious, a large percentage of those harvested cannot be marketed due to their size and shape. Sweet potato flakes increase the yield per acre because those rejected for fresh and canned marketing can be used for flake production (3,4). Since sweet potatoes do not store well, flakes will increase the quality of sweet potatoes on the market and extend the area and time in which they are available (4,5). The reconstituted flakes are also more nutritious than the fresh product because the flakes contain less water than fresh mashed sweet potatoes (6). Fresh sweet potatoes are good sources of vitamins A and C, and retention of both nutrients in the production of flakes is quite good (3).

There are many varieties of sweet potatoes, all of which can be categorized into either a dry type or a moist-fleshed type. The dry

type is dry and mealy when cooked, but the moist-fleshed type becomes soft and watery when cooked. The dry-type sweet potato has a yellowish skin and light yellow flesh, whereas the moist-fleshed sweet potato has a reddish skin and a flesh color which varies from light greenish-yellow to reddish-orange. The latter also has more sugar than the former (7,8,9).

The Goldrush variety, a moist-fleshed type, has been the one primarily used for flakes, even though the process is successful with various mixtures which contain at least 50 per cent of the Goldrush variety (10). Other varieties used for sweet potato flake production are Centennial, another moist variety, and Nugget, a dry-type (11).

Research to develop sweet potato flakes was initiated at the United States Department of Agriculture (USDA) Southern Regional Research Laboratory in New Orleans, Louisiana (3,4). At about the same time, research was also begun at North Carolina State University in Raleigh. Sweet potato flakes were first produced commercially in 1962 (3).

In the production of flakes, the sweet potatoes are first washed and preheated. The skins are removed by either lye or steam, and the potatoes hand trimmed, mechanically sliced, steam cooked, machine puréed, screened to remove the fiber, dried, and finally broken into flakes by mechanical means (3,10,11).

The first sweet potato flakes were made from cured sweet potatoes (10,11). Curing involves keeping the sweet potatoes for about 10 days in a well ventilated area with 90 per cent humidity and a temperature around 30° C (12,13,14). This process causes a rapid starch to sugar conversion and a concentration of the sugar in the flake product (15,16,

17). The sweet potatoes are stored in a dry place for 2 to 5 months at temperatures between 10° and 24° C (18). Most researchers, however, think that 16° C is the most acceptable storage temperature for sweet potatoes. The length of time the sweet potatoes are held determines the amount of pectin which is changed to amylopectin, thereby increasing the total sugar content (10,11).

Research with uncured sweet potato roots used for flakes showed that they would not stick to the drying drum properly. This resulted in slower production and flakes which were porous and of low bulk density. Better flakes would be produced and the processing season lengthened with control of the soluble to insoluble solids ratio. Amylase present in the fresh sweet potatoes acted upon the insoluble solids changing them to soluble solids during curing and storage. However, the variability of amylase activity among the varieties of sweet potatoes, among storage conditions, and among harvest dates made control difficult. A method for controlling amylase activity by the addition of an amylolytic enzyme to the sweet potato purée was developed by Hoover in 1966 (10). This enzyme converted starch to sugar, and after the desired degree of conversion of starch to sugar had occurred, the purée was heated to inactivate the amylolytic enzyme. The production process was completed by drying the puree and breaking it into flakes. An increase in the proportion of enzyme to purée yielded sweet potato flakes with a deeper orange color and increased flavor probably because of the higher sugar content and smaller amount of water necessary to reconstitute the flakes.

In 1967, Hoover (11) developed another method for controlling the amylase activity of sweet potatoes in the production of flakes. The

sweet potatoes were peeled, trimmed, and ground, then immediately heated by steam injection to activate the natural saccharifying enzyme system. The mixture was held at this temperature to allow starch conversion to occur and then heated to above 93° C by steam injection to inactivate the enzyme system and to cook the product. The purée was then dried on a drum dryer and broken into flakes.

Fulton et al. (6) used a small trained panel and a large consumer panel to determine the most acceptable proportion of water to sweet potato flakes for small and large quantities of the reconstituted product. Salt and butter were added to make the product comparable to mashed fresh sweet potatoes. The sweet potato flakes for small, and large quantities, were mixed with the boiling water, butter, and salt in a four-quart mixing bowl. This mixing consisted of one minute at low speed and one minute at medium speed before heating in the top of a double boiler 30 minutes previous to serving the panel members. For the small quantity of reconstituted sweet potato flakes, 2, 2½, and 3 parts water to 1 part flakes by weight were used; whereas, only 2 and 2½ parts water to 1 part flakes by weight were used for the large quantity. The most desirable reconstituted product in all characteristics was obtained with 2 parts water to 1 part flakes by weight. A significant difference was found in one or more characteristics among different cans of sweet potato flakes from all processors.

Reseachers believe that the consumer judges any food product on general appearance, color, taste, and texture (19). Matz (20) states that appearance is most important, followed by texture, and then flavor. An institutional test of sweet potato flakes showed favorable reactions

associated with flavor and texture. The major objection was to "off flavor," and other objections were to texture, appearance, and form of the reconstituted product (4). Another study of sweet potato flakes used by homemakers showed favorable and unfavorable comments about flavor and texture. Whenever the flakes were used in an orange-flavored casserole, there were fewer negative comments on texture than when the sweet potato flakes were served as plain mashed sweet potatoes. The homemakers liked the flakes because they could be used in many different dishes and added color to meals (13,21). Trained and consumer panels in a study by Fulton et al. (6) preferred gold colored sweet potato flakes to orange ones. The "off flavors" found by these panels included bitterness, sourness, and burnt taste. Untrained judges in a study by Cassilly (22) were unable to pair the two "off-flavored" samples of reconstituted sweet potato flakes in a triangle test with good sweet potato flakes. The texture was sticky or paste like, but the flavor was even more objectionable. "Off-flavored" flakes however, might have been as acceptable as others, without a comparison. Other researchers found texture of reconstituted sweet potato flakes to be the most important variable in the organoleptic and visual acceptance of the reconstituted product (23).

Taste Panels

Food researchers need to know the consumers' reactions to any new product before it is put on the market (24). The ideal way to obtain this information is to ask all, or at least a randomly selected sample of, potential consumers to try the product and complete a questionnaire

designed to obtain the desired information. Since this method would be time consuming and costly, a more economical and convenient method to obtain an evaluation of a product is to use a taste panel.

The panel used for taste testing may be trained for more accuracy or untrained. If the researcher wants to simulate consumer reaction, an untrained panel should be used (25,26). Krum (27) reported small panels indicate consumer preferences well, but numerical scoring, ranking, or paired comparison of the samples should be used in evaluation of the product. Prentice and Sheppard (28) found that judgments of small untrained panels correlated well with consumer group judgments, except for texture.

Wiley et al. (29) advised researchers to use as many judges as were available for taste testing if they were untrained. Boggs and Hanson (25) found that 5 to 10 people could generally estimate differences in color, odor, flavor, texture, and other qualities of food. Wiley et al. (29) also suggested using 8 to 12 judges and 4 replications for a trained taste testing panel. The panel should be large enough to counteract factors such as illness which might influence day to day comparisons (24,25).

Characteristics of the judges can influence the results of taste testing panels. Some investigators have shown age to be a factor affecting food evaluations (20,27,30); Krum (27) stated that judges should be between 20 and 50 years of age, but Pangborn and Leonard (31) found no significant difference among scores because of age. Amerine (24) declared that results of age discrimination in tasting may have been influenced by other factors. Matz (20) stated that sex may affect

the results of taste tests significantly, but this factor has less influence than age. Even though Valdés and Roessler (30) found women agreed more as a group than men, they concurred with Pangborn and Leonard (31) that there was no significant difference in the results because of sex. Results of taste testing are affected by economic and educational status of the judges. Race, religion, and national origin also influence the results of taste tests, but the differences have been decreasing (20).

Pettit (32), using tomato juice, found that if the product were swallowed the results of the taste test were more accurate. However, tasting order, time of day, and rinsing of the mouth have no apparent effect on the results of taste tests (30,31,32).

Researchers modified the process of producing white potato granules to produce white potato flakes and later further modified the process to produce sweet potato flakes. Those interested in producting sweet potato flakes are continually searching for ways to make the product more acceptable to the consumer. Taste panels are used to help determine acceptance of the product by consumers. The panel may be large and have one session or it may be small and have several replications. Characteristics, such as age and sex, of the judges may influence results of taste panel tests, but not all researchers are in agreement about these characteristics.

CHAPTER III

PROCEDURE

Introduction

An untrained taste panel and patrons in the University of North Carolina at Greensboro (UNC-G) School of Home Economics Cafeteria judged acceptability of reconstituted sweet potato flakes in this study. Three samples of sweet potato flakes were provided by the USDA and these were designated as Samples A, B, and C. Sample A was manufactured to meet current government specifications for the military and school lunch programs. Sample B was the sample to which whole sweet potatoes were added to increase fiber content. Both samples were made from moist-fleshed Jewel and Centennial sweet potatoes. The sweet potatoes used for Samples A and B were grown in North Carolina and were processed in a plant in Wilson, North Carolina. The Sample C was made from Centennial variety sweet potatoes and included an enzyme for texture improvement. These potatoes were grown and processed in Louisiana. The enzyme was different from the one Hoover (11) used in experimentation in 1967, in that this one acted on the starch before it was gelatinized. The enzyme that Hoover used acted upon the gelatinized starch of the puréed sweet potatoes. Sample C was bright orange in color, whereas Samples A and B were brownish gold. The color differences may have been influenced by climatic conditions and variety as well as treatment. The color of Samples A and B is believed to be due to caramelization of sugar.

Preliminary tests were conducted to determine the amount of boiling water necessary to produce reconstituted samples with a consistency similar to that of fresh mashed sweet potatoes. Samples A and C when mixed with equal volumes of water formed products that were smooth and of a consistency which would not spread when a tablespoon of the product was put onto a plate. Sample B required one and a half parts of water to one part flakes to form a product which would not be too stiff after sitting for awhile. After three sessions with the taste panel, the volume of water was reduced to one and a third parts water to one part flakes for Sample B because comments from the panel members suggested this product had a "runny" consistency. The water was reduced to one and a sixth parts for one part flakes for the fifth session. Sample B product became pasty after standing a few minutes, so the water was increased to one and a third parts for one part flakes for the final tasting session. When Sample B was prepared for serving in the School of Home Economics Cafeteria, the proportion of water to flakes was further reduced. Initially $7\frac{1}{2}$ cups water were added to 6 cups sweet potato flakes, but the product was too "runny" so 7 cups of water were used to reconstitute 6 cups of flakes for the last two servings.

Samples A and C were reconstituted about ten minutes before serving for tasting by the panel and for serving on the cafeteria line. Sample B was allowed to stand about thirty minutes before serving because it absorbed water more slowly than did Samples A and C. To reconstitute the sweet potato flakes, the measured volume of boiling water was added to the measured volume of sweet potato flakes in a stainless steel saucepan. The mixture was stirred with a spoon until

the product looked smooth and free of lumps. The reconstitution procedure for the cafeteria was similar although an institution type electric mixer was used at low speed for the mixing. All samples were held over steam during the serving period, about an hour for both the taste panel and cafeteria.

Evaluation forms (see Appendix A) were developed for use with the taste panel and the patrons in the UNC-G School of Home Economics Cafeteria. A hedonic rating scale with values of one to five was employed for scoring the samples for appearance, flavor, texture, and overall acceptability. The evaluation form for the cafeteria was condensed to fit on a card which would be easy to handle by an individual selecting sweet potatoes for a meal.

The data from the taste panel and the cafeteria patrons were analyzed separately by standard analysis of variance procedures to determine whether there were differences between the samples.

Small Taste Panel

There were fourteen members of the taste panel, eight of whom attended all six tasting sessions. One individual missed two sessions and was subsequently eliminated as a panel member. The final panel consisted of one professor, one teacher, one secretary, one assistant projector director, one housekeeping assistant, one lab technician, four graduate students, and three undergraduate students. All test panel members were associated with the foods and nutrition area in the School of Home Economics at UNC-G. Two graduate students and all the undergraduate students missed one session each. The missing data for the

taste panel was estimated by averaging ratings for the sessions they rated the product.

The taste testing sessions were conducted in a foods laboratory in the School of Home Economics at UNC-G. Because the space was small, three or four taste panel members were assigned to come at a time convenient to them every day during the hour the tasting session was to last. The time between 10:30 a.m. and 11:30 a.m. seemed the best time for the least interference during the sessions. The time was divided into four fifteen-minute periods so that panel members would have ample time to do the evaluation.

When the panel member arrived for the tasting session, he or she was seated at a table alone. Each panel member was provided a glass of water, an evaluation form, napkin, pencil, a spoon for tasting, and a tablespoon of each sample of the reconstituted sweet potato flakes on a white plate with code numbers, randomly selected for each day, to correspond with the sample numbers on the evaluation sheet. The only instructions given were to taste the products and complete the evaluation form provided.

The taste testing sessions for evaluating the sweet potato flakes were held twice weekly for three consecutive weeks during February and March, 1974. The sessions were conducted at least once on each of the days Monday through Friday. All three samples of reconstituted sweet potato flakes were presented at the same time each day.

School of Home Economics Cafeteria Patrons

The sweet potato flakes were reconstituted and served in the School of Home Economics Cafeteria as plain mashed sweet potatoes. Persons who purchased the sweet potato product were given an evaluation form with a different randomly selected three-digit code for each day and were asked to complete the form. To help prevent the patrons from knowing the sweet potato product was being tested and thus not selecting the sweet potato product, another vegetable was chosen for evaluation each day the sweet potato product was sold. The evaluation forms for the other vegetables were given to the cafeteria manager.

Samples A, B, and C were served three times each in the cafeteria beginning February 15, 1974, and ending April 1, 1974. The reconstituted sweet potato flakes were served at least once on each of the days Monday through Friday, but only one sample was served on a particular day.

CHAPTER IV

RESULTS AND DISCUSSION

Analysis of the data (see Appendix C) revealed a highly significant difference ($p \leq 0.01$) between the samples of reconstituted sweet potato flakes when they were presented together to an untrained taste panel. The statistical analysis also indicated that the mean evaluations for Sample C were significantly higher than Samples A and B. The judges could find no difference between the mean evaluations of Samples A and B. The least difference was found in flavor and the greatest difference was in appearance between Sample C and Samples A and B. The greatest differences, though not significant, between Samples A and B were in texture and overall acceptability with Sample B receiving the higher scores. The least difference between Samples A and B was in flavor with Sample B receiving the higher scores.

The taste panel scored Sample C reconstituted sweet potato flakes higher than they scored either Sample A or B. There were highly significant differences ($p \leq 0.01$) between Sample C and Samples A and B; therefore, the taste panel judged Sample C to be a more acceptable product than Sample A or B.

There was a significant difference ($p \leq 0.05$) found only in flavor among samples of reconstituted sweet potato flakes served to patrons in the School of Home Economics Cafeteria. Since the means for Samples A and B were the same, the difference in flavor was between Sample C and Samples A and B. There were no significant differences in appearance,

texture, or overall acceptability among the three samples when judged by the cafeteria patrons where only one sample was presented at a time.

The means for Samples A and B reconstituted sweet potato flakes when judged by an untrained taste panel were identical for flavor and overall acceptability (see Table 1 and Appendix B). The mean of

TABLE 1

RANKED MEANS FOR TASTE PANEL

Sample	Appearance	Flavor	Texture	Overall Acceptability
A	3.3	3.1	3.2	3.1
B	3.4	3.1	3.3	3.1
C	4.2	3.8	4.1	3.9

Number of servings per sample=78.

Rating scale: 5=very good, 4=good, 3=fair, 2=poor, 1=very poor.

Sample B was slightly higher for appearance and texture than the mean of Sample A. The means for Sample C were significantly higher for appearance, flavor, texture, and overall acceptability than the means for either Sample A or B.

Means of Samples A and B reconstituted sweet potato flakes were the same for appearance and flavor when judged separately by the School of Home Economics Cafeteria patrons (see Table 2). The texture mean was higher for Sample B than for Sample A. The mean of overall acceptability for Sample A was higher than for Sample B. The mean for appearance, flavor, texture, and overall acceptability of Sample C was higher than for Sample A or B.

TABLE 2

RANKED MEANS FOR CAFETERIA PATRONS

Sample	N*	Appearance	Flavor	Texture	Overall Acceptability
A	15	3.5	3.2	3.1	3.4
B	17	3.5	3.2	3.4	3.1
C	31	4.0	3.9	3.7	3.6

*N=number of servings.

Rating scale: 5=very good, 4=good, 3=fair, 2=poor, 1=very poor.

Sample C reconstituted sweet potato flakes were scored higher in all aspects than were Sample A or B. The color of Sample C was much brighter than the color of the other samples and may have influenced the rating of flavor, texture, and overall acceptability as well as appearance. The differences were not as noticeable when the samples were served in the cafeteria. Taste panel members commented that Samples A and B were scored lower because their brownish-gold color was not as appealing as the orange color associated with sweet potatoes.

Some taste panel members reported Samples A and B were tasteless, flat, or had something missing and had less "sweet potato taste" than Sample C. These samples were too sweet for some, while others detected a bitter taste. The comments about excess sweetness were greater in number for Sample A than for Sample B even though more sugar was suggested by one panelist for Sample A to reduce the bitter taste. "Lemoney" was used to describe both samples, but "sharp" referred only to Sample B. "Gummy" and "sticking to the palate" were panelists' comments for Sample A while Sample B was described as "runny." However,

gumminess was reported for Sample B when the researcher reduced the amount of water from 2 to 1 3/4 cups for 1 1/2 cups flakes because taste panel members had described the product as "runny." The total rating for texture was lower for this replication than for others, but one panelist indicated the texture of Sample B was improved. This product with 1 3/4 cups water to 1 1/2 cups flakes became pastey, gummy, and lumpy upon sitting over steam more quickly than Sample A or C. Therefore, the water was increased to the previous 2 cups of water for 1 1/2 cups flakes for the final session, as this produced the most acceptable product. Throughout the tasting sessions both Samples A and B were described as like "baby food."

The color of Sample C reconstituted sweet potato flakes was "too harsh" according to one taste panel member, and the texture was "pastey" and like "baby food." This product was described as tasting flat and needing more flavor and salt. Negative comments about the flavor increased after the first four tasting sessions. This may have been due to a deterioration in quality because of storage of the sweet potato flakes.

Almost 99 per cent of the taste panel members would improve the sweet potato flake products either in flavor, appearance, texture, or a combination of these. The percentage of panel members who affirmed they would buy the sweet potato flakes if they were available in the grocery store was 61.6 (see Table 3). Of those panelists who indicated the sample they would buy, 4.1 per cent would buy Sample A, 6.8 per cent would buy Sample B, and 28.8 per cent would buy Sample C.

The School of Home Economics Cafeteria patrons described the Sample A sweet potato flake product as too sweet, too smooth, sticky,

and having an unidentifiable spice which was too prevalent. They indicated that the product "might be slightly thicker," needed "to be chunky," and needed more sweetness and spice or other flavoring and food added. Two patrons preferred sweet potatoes baked or candied.

TABLE 3

RESPONSE OF PANEL MEMBERS REGARDING IMPROVEMENT AND BUYING OF FLAKES TESTED

Type of flakes	Would improve per cent	Would buy per cent
All samples	98.6	61.6
Sample A	68.5	4.1
Sample B	54.8	6.8
Sample C	37.0	28.8

Number of servings per sample=78.

According to the cafeteria patrons, the Sample B reconstituted sweet potato flake product needed to be thicker, have marshmallows, spices, pineapple, nuts, or raisins added, be less sweet, be sweeter, and be a lighter color. Even though this sample had fiber added, one comment for improving the product was "add fiber." Some described Sample B as "pastey" and "gummy."

The patrons in the UNC-G School of Home Economics Cafeteria commented that the Sample C reconstituted sweet potato flake was too sweet, too thin, gummy, too smooth, left an after taste, needed spices, and had too bright a color. One patron remarked that this product needed "more sweet potato content."

The percentage of cafeteria patrons indicating a need for improvement in the sweet potato flake products increased from Sample C to

Sample A to Sample B. Two-thirds of the patrons who tried the sweet potato flake product would buy the Sample A product if it were available in a grocery store. Less than 1/5 of those who tried Sample B would buy it and less than 1/3 would buy the Sample C sweet potato flake product (see Table 4).

TABLE 4

RESPONSE OF CAFETERIA PATRONS REGARDING IMPROVEMENT AND BUYING OF FLAKES TESTED

Type of flakes	N*	Would Improve per cent	Would Buy per cent
All samples	63	84.1[a]	36.0[a]
Sample A	15	93.7	66.7
Sample B	17	94.1	17.6[b]
Sample C	31	74.2	32.3[b]

*N=number of servings per sample.

[a]The cafeteria patrons did not evaluate the products together. This value was determined by finding the percentage of the total who tried the product during the testing period and responded positively to improving and buying.

[b]There was a large percentage of "no response" for these.

Samples A and C reconstituted sweet potato flake products thickened after they were held over steam for some length of time. The porducts also became gummy. Sample B reconstituted sweet potato flakes maintained the same consistency throughout the time they were held except when the water was reduced to 1 3/4 cups for 1 1/2 cups flakes and the quantity was small. Sample B sweet potato flakes, when reconstituted, yielded more servings than either Sample A or C.

Results of the study were not affected by sex or occupation of the panelists or by the sex, occupation or age of the cafeteria patrons.

Entree or other vegetables selected by the cafeteria patrons who tried the reconstituted sweet potato flake products had no apparent effect on their evaluations.

There was no significant difference between Samples A and B, but Sample C was rated significantly higher ($p \leq 0.01$) in all characteristics than either Sample A or B when all samples were presented together. The only significant difference ($p \leq 0.05$) between Sample C and Samples A and B was in flavor when the reconstituted sweet potato flakes were served separately.

Sample B may be a better choice than the other samples of sweet potato flakes when it has to be held for serving to a large group because it does not change consistency as readily as Samples A and C when reconstituted. Sample B sweet potato flakes may be more economical than the other samples because the whole sweet potato can be used and the yield of reconstituted product is greater. Even though more water is needed to reconstitute Sample B sweet potato flakes than is needed for Samples A and C, the Sample B product is more nutritious than fresh mashed sweet potatoes because the moisture content of the reconstituted product is lower than that of fresh mashed potatoes (6).

The taste panel rated Sample C reconstituted sweet potato flakes significantly higher ($p \leq 0.01$) than Sample A or B, while the UNC-G School of Home Economics Cafeteria patrons who tried the sweet potato products rated Sample C significantly higher ($p \leq 0.05$) than the others only for flavor. The means of the scores were slightly higher for Sample B than for Sample A, but the difference was not significant for any of the characteristics.

CHAPTER V

SUMMARY AND CONCLUSIONS

Summary

Sweet potato flakes, produced commercially since 1962, have not been zealousy accepted by the consumer. It was thought at first that the major objection was to "off flavor" developed during storage, but recent studies indicate that texture may be the major reason for lack of acceptance of the flakes.

Using three different samples of sweet potato flakes, a study was conducted with an untrained taste panel and patrons of the School of Home Economics Cafeteria who tried the sweet potato products during the lunch period. The purpose of the study was to determine if those flakes with added fiber (Sample B) or added enzyme (Sample C) were more acceptable than those which meet government specifications for military and school lunch programs (Sample A). The government specifications require that the ends of the sweet potatoes be removed during the processing of the flakes and that no fiber or other product be added.

A scoring card, employing the hedonic rating scale for scoring appearance, flavor, texture, and overall acceptability, was developed and used with the taste panel and patrons of the cafeteria. After the data were collected on these cards, analysis of variance was used to determine whether there was a significant difference between samples. Data for the taste panel and patrons of the cafeteria were treated independently.

Results of the study revealed a highly significant difference ($p \leq 0.01$) between Sample C and Samples A and B for the taste panel. Sample C received the highest scores on all aspects of the test. Even though the differences were not significant, Sample B was rated slightly higher than Sample A in all characteristics evaluated. The cafeteria patrons rated Sample C highest followed by B and A respectively, but the difference was significant ($p \leq 0.05$) only for the flavor between Sample C and Samples A and B.

Conclusions

The researcher reached the following conclusions from this study:

1. Sample C sweet potato flakes were more acceptable than Sample A or B.

2. Sample B sweet potato flakes were more acceptable than Sample A.

3. Sample B sweet potato flakes yielded more servings per cup than either Sample A or C.

4. Sample B sweet potato flakes maintained their consistency when held over steam better than the other samples.

Recommendations for Further Study

Since the color of Sample C sweet potato flakes differed greatly from that of Samples A and B, there is the possiblity that color could have had an influence on the judgments made by panel members and cafeteria patrons. One way to eliminate this possible influencing factor when testing sweet potato flake products in the future would be to use an amber or red light so that all samples would appear to look the same.

Further research is needed to determine the acceptability of Samples B and C sweet potato flakes when seasonings and foods are added to the reconstituted product.

Acceptability of various food products, such as sweet potato pie or souffle, using Samples B and C sweet potato flakes needs to be determined. It would also be interesting to determine whether one product was more acceptable than the other.

Studies need to be conducted using sweet potato flakes which have been processed in the same plant from the same variety of sweet potatoes grown in the same locality for the three samples.

Another study using only Samples A and B needs to be conducted to determine whether one is significantly more acceptable than the other, when there is no third sample for comparison.

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APPENDIX A

SCORE CARDS

SCORE CARD USED BY THE TASTE PANEL

NAME____DATE____________________

SWEET POTATO PRODUCTS

Please circle the number which best describes the factor being scored.

Sample No.	Factor	Very Good	Good	Fair	Poor	Very Poor
______	Appearance	5	4	3	2	1
	Flavor	5	4	3	2	1
	Texture	5	4	3	2	1
	Overall Acceptability	5	4	3	2	1

Sample No.	Factor	Very Good	Good	Fair	Poor	Very Poor
______	Appearance	5	4	3	2	1
	Flavor	5	4	3	2	1
	Texture	5	4	3	2	1
	Overall Acceptability	5	4	3	2	1

Sample No.	Factor	Very Good	Good	Fair	Poor	Very Poor
______	Appearance	5	4	3	2	1
	Flavor	5	4	3	2	1
	Texture	5	4	3	2	1
	Overall Acceptability	5	4	3	2	1

Would you improve any of the products? ___ Yes ___ No
If "Yes," which one(s) and how would you improve it?

Would you be willing to buy this product if available in a grocery store? ___Yes ___No

Occupation______________________________ Sex: ___M ___F

SCORE CARD USED BY THE CAFETERIA PATRONS

Sample No. _____ Kind _____ Date _____

VEGETABLE PRODUCT

Please rate the texture, flavor, appearance, and overall acceptability of the product according to the following scale.

5 very good (you would suggest no improvement)

4 good (enjoyed it; minor improvement desirable)

3 fair (could eat it without enthusiasm; improvement needed)

2 poor (somewhat acceptable)

1 very poor (unacceptable)

(___Appearance) (___Flavor) (___Texture) (___Overall Acceptability)

Do you think this product should be improved? ___ Yes ___ No
If "Yes," how would you improve it?

Would you be willing to buy this product if it were available in a grocery store? ___ Yes ___ No

Age Range: (___16 - 30) (___31 - 45) (___46 - 60) (___61 - 75)
(___Over 75)

Occupation _____ Sex: ___M ___F

Please list any entrée and all vegetables selected.

APPENDIX B

COMPILATION OF JUDGES' SCORES

TABLE 1

COMPILATION OF JUDGES' SCORES FOR
TASTE PANEL EVALUATION

Sample	Code no.	Appearance	Flavor	Texture	Overall acceptability
			February 18, 1974		
A	206	40	41	41	41
B	448	41	37	42	38
C	899	59	54	54	53
			February 22, 1974		
A	108	43	42	45	40
B	806	46	43	43	42
C	064	56	49	55	51
			February 27, 1974		
A	298	43	35	37	36
B	428	45	43	45	42
C	249	58	48	53	52
			March 1, 1974		
A	661	44	41	43	42
B	836	41	38	44	40
C	716	53	49	57	53
			March 5, 1974		
A	556	45	44	42	41
B	843	44	43	40	41
C	856	53	48	49	48
			March 7, 1974		
A	553	43	40	43	39
B	585	47	42	44	43
C	571	50	48	52	49

Number of servings each code no.=13.

Rating scale: 5=very good, 4=good, 3=fair, 2=poor, 1=very poor.

TABLE 2

COMPILATION OF SCORES FOR UNC-G SCHOOL OF HOME ECONOMICS CAFETERIA PATRONS

Date	N*	Code no.	Appearance	Flavor	Texture	Overall acceptability
		Sample A				
Friday, March 8	3	772	12	9	10	11
Tuesday, March 26	2	586	5	6	3	6
Friday, March 29	10	157	36	33	34	34
		Sample B				
Monday, March 4	7	313	26	23	22	22
Monday, March 18	2	836	5	8	6	6
Monday, April 1	8	049	29	23	30	25
		Sample C				
Friday, February 15	11	651	52	47	50	47
Wednesday, February 20	11	507	43	39	40	39
Thursday, March 21	9	633	30	34	26	27

*N=number of servings.

APPENDIX C

STATISTICAL ANALYSIS

TABLE 1

ANALYSIS OF VARIANCE OF DATA FOR TASTE PANEL

Source	df	SS	MS
Appearance			
Total	217	182.00	.83
Between samples (A,B,C)	2	40.00	20.00**
A vs B	1	.23	.23
C vs A + B	1	39.52	39.52**
Within samples (A,B,C)	179	121.00	.67
Judges within sample	36	21.00	.58
Flavor			
Total	218	234.00	1.07
Between samples (A,B,C)	2	23.00	11.50**
A vs B	1	.05	.05
C vs A + B	1	22.66	22.66**
Within samples (A,B,C)	180	165.00	.91
Judges within sample	36	33.00	.91
Texture			
Total	216	210.00	.97
Between samples (A,B,C)	2	37.00	18.50**
A vs B	1	.31	.31
C vs A + B	1	36.66	36.66**
Within samples (A,B,C)	178	147.00	.82
Judges within sample	36	26.00	.72
Overall Acceptability			
Total	210	191.00	.90
Between samples (A,B,C)	2	35.00	17.50**
A vs B	1	.31	.31
C vs A + B	1	34.46	34.46**
Within samples (A,B,C)	172	129.00	.75
Judges within sample	36	27.00	.75

**Highly significant ($p \leq 0.01$)

TABLE 2

ANALYSIS OF VARIANCE OF DATA FOR
CAFETERIA PATRONS

Source	df	SS	MS
	Appearance		
Total	62	56.89	.91
Between samples (A,B,C)	2	4.21	2.10
Within samples (A,B,C)	60	52.68	.87
	Flavor		
Total	62	69.72	1.12
Between samples (A,B,C)	2	7.35	3.67*
Within samples (A,B,C)	60	62.37	1.03
	Texture		
Total	62	91.75	1.47
Between samples (A,B,C)	2	3.95	1.97
Within samples (A,B,C)	60	87.80	1.46
	Overall Acceptability		
Total	62	63.56	1.02
Between samples (A,B,C)	2	3.09	1.54
Within samples (A,B,C)	60	60.47	1.00

*Significant ($p \leq 0.05$)