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FOODSERVICE SYSTEMS: NUTRITIONAL AND MICROBIAL EVALUATION OF ON-SITE METHODS FOR GROWING STORING AND SERVING ALFALFA SPROUTS

By

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ABSTRACT

FOODSERVICE SYSTEMS: NUTRITIONAL AND MICROBIAL EVALUATION OF ON-SITE METHODS FOR GROWING STORING AND SERVING ALFALFA SPROUTS

By

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The purpose of the research was to evaluate on-site production of alfalfa sprouts as one method restaurants and institutional foodservice facilities in Lansing, Michigan, could use to meet expectations of the educated consumer. The study consisted of four phases: (1) telephone survey, (2) storage study using commercially produced alfalfa sprouts, (3) product development and (4) consumer study. Thirty percent of the restaurants and institutions contacted in a telephone survey expressed interest in on-site production of alfalfa sprouts. During the storage study, a nine day ascorbic acid analysis showed that the level of this nutrient decreased significantly on Day 4. Also during the storage phase, sensory panelists correctly choose the different samples two out of three times when asked to distinguish one day-old alfalfa sprouts from two and four week-old samples in a triangle test. Four on-site production methods were standardized during the product development phase and the resulting alfalfa sprouts were analyzed for microbial content.

The Glass Container Method was recommended for a variety of reasons. Alfalfa sprouts were promoted in dormitory cafeterias during the final phase of the study. Based on the results of the research, production of alfalfa sprouts on-site in foodservice operations is not recommended.

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CHAPTER I

INTRODUCTION

Over recent years the foodservice industry has been very innovative in attracting patrons to their facilities. Efforts have been successfully; approximately 33% of all meals are being consumed outside the home. Innovative ideas were centered around consumer trends and food preferences. Restaurants and institutional foodservice managers are very aware that their consumers are nutrition-conscious and consuming more fresh foods in their diets (Anon., 1982a). One example of creative menu design was at Sheanigans Restaurant in Austin, Texas (Wintergreen, 1980). Lunch entrees featuring fresh foods were prepared and modeled after popular diets plans such as the Pritikin diet. Another fresh food entree that has experienced increased promotion by the foodservice industry has been the salad bar. Salad bars have expanded from just lettuce, carrots and onions to include fruit, meats, fish, sprouts and various seeds. The salad bar of the 1980's may carry upwards of 30 vegetables fruits and condiments (Buchaneon, 1982).

One of the newer components of salad bars has been alfalfa sprouts. Interest in this product has increased over the past several years as the product is available to the consumer at the retail level or produced at home. Scientific investigations have also been conducted in response to the consumer's interest in the product.

Nutritional content and microbial quality of alfalfa sprouts have been investigated. Kylen and McGready (1975) determined the nutrient

content of alfalfa sprouts and reported that 100 grams of alfalfa sprouts contained 16 mg of ascorbic acid, 5 grams of protein, 2 grams of fiber and 28 mg of calcium. Patterson and Woodburn (1980) determined microbial quality of alfalfa sprouts. Mean Colony Forming Units (CFU) per gram of product was 4.4×10^8. This microbial load was similar to other salad bar items such as lettuce and coleslaw (Fowler, 1976).

In response to the increased interest of the consumer in consumption and household production of alfalfa sprouts, several cookbooks and sprouting system methods have been marketed (Blanchard, 1975; Whtye, 1973). Fordham (1975) developed and published standardized methods of sprout production for household use. Since more people were producing alfalfa sprouts at home by a variety of methods, Hamilton (1979) studied the nutritional analysis of alfalfa sprouts grown and harvested at periods of time, 72 and 120 hours, and grown in light or dark conditions. The research indicated that the nutrient content was not effected by the different harvest periods for such nutrients as protein and carbohydrates. However, the ascorbic acid content increased with increased length of the growing period.

Increased use of alfalfa sprouts by the public has prompted several scientific investigations for household alfalfa sprout use. To date, however, only these household applications have been scientifically explored. The purpose of this study was to explore the feasibility of on-site production of alfalfa sprouts as a quantity food production method.

CHAPTER II

REVIEW OF LITERATURE

Consumer food preferences have changed significantly during the 1970's and the 1980's. The typical American consumer of today desires and enjoys a number of foods which were not popular with consumers of preceding decades. As a result, changing patterns of consumer food consumption are evident and can be traced.

In the 1970's, the emergence of so-called natural food such as whole grain bread and additive-free granola type cereal signaled a change in the dietary habits of the consumers (Kazeniac, 1977). Jim Rose, president of the American Society of Hospital Foodservice Administrators, 1982-1983, has cited the demands of consumers in the 1980's for fresh crisp vegetables (Anon., 1982a).

This trend in consumer preference for fresh rather than processed vegetables was reflected in a recent survey conducted by the editors of Restaurants and Institutions Magazine. Increased consumer acceptance of fresh vegetables in menu entrees such as salads and salad bars might be a result of consumers' awareness of calories and weight reduction objectives. In the survey, the members of 2,000 households were questioned about their eating habits away from the home and their food preferences (DeRoin, 1981). When survey participants were asked if they were ordering salads more, less or the same, 41% indicated that they were consuming more salads. The data compiled revealed that increased salad consumption was

the most predominent trend of 1981. Similarly, fresh vegetables as a category ranked third on the list. When asked in what foodservice market they were consuming more salads, the responses were as follows. In the employee dining and college foodservice markets, 47% of the patrons in both markets were ordering more salads. Forty-four percent of consumers were purchasing salads when frequenting the fast food facility. Finally, 45% more full service restaurant patrons were ordering salads. The survey also revealed that more fresh fruits and vegetables were being ordered in these same market areas. The increases in consumer preferences for salads, fresh fruits and vegetables were greatest of all fifteen food categories studied (DeRoin, 1981).

Food preferences exhibited by the consumer of the 1980's have been toward natural and fresh foods and away from processed foods as indicated by increased consumption of salads and fresh foods outside the home. These preferences have resulted in a direct impact on consumer food ordering patterns when frequenting foodservice establishments.

With the increase in demand for salads, fresh fruits and vegetables, how has the foodservice industry responded to consumers' new preferences? It is economically prudent for the foodservice industry to respond to the desires of the consumer in light of the fact that in an average household 74% of all lunches and 78% of all dinners are consumed outside the home by one or more of the members (Riggs, 1981).

The emergence of salad bars in many segments of the foodservice industry has been one very popular response to the consumer's desire for fresh foods. The popularity of salad bars has been evident in many institutional and commercial foodservice markets. For example, school lunch programs throughout the country provided salad bars first at the

high school level then the junior high level and today some elementary schools have successfully provided salad bars to the students.

Institutions such as hospitals and colleges have incorporated salad bars into their menu offerings. Hospital cafeterias might increase their sales as much as 60% as did Cedars Sinai Hospital in New York with the addition of a salad bar and a hot vegetable bar in the employee cafeteria (Wintergreen, 1981). Two Lansing, Michigan, hospitals, St. Lawerence Hospital and Lansing General Hospital, have incorporated salad bars in their staff and general public cafeterias. Major colleges in Michigan, California, and Indiana have increased the use of fresh vegetables by incorporating salad bars and vegetarian entrees on their menu (Raskin, 1981). The benefits of the salad bar installed at the University of Mississippi has been two-fold. Labor costs have been reduced while student satisfaction increased (Dawson, 1981). Expansion of the existing salad bar at the Wigwum Grill on the campus of William and Mary College was one of the improvements made by the Shamrock Foodservice Company. The improvements made by the company have increased student participation and satisfaction (Anon., 1981). The increasing trend of institutional foodservices featuring more fresh food and salad bars has had benefits for both the consumer and the foodservice facility (Dawson, 1981).

The institutional aspect of the industry has not been alone in salad bar incorporation into their menu. The commercial segment of the industry has also developed salad bars for client consumption. Several fast food chains such as Wendy's, Arbys, Burger Queen and Eat-N-Park offer salad bars to their patrons (Raskin, 1981). Extensive salad bars are commonplace in many full service restaurants also. For example, the Good Earth restaurants' menu focuses on salads, fresh vegetables, fruits

and natural whole-grain products. Restaurants operated by companies such as W.E. Grace and TGY Fridays offer salad bars to their weight-conscious customers (Raskin, 1981).

Institutional and commercial segments of the foodservice industry have begun to use salad bars as a method of meeting consumers' expectations and desires for fresh fruits and vegetables. The salad bar of the 1980's could carry upwards of thirty to forty vegetables (Buchaneon, 1982). Kale, spinach, fresh beets, sunflower seeds, nuts, sprouts, broccolli, salmon and shrimp are a few of the new and unusual components featured on salad bars. Since there are no rigid rules for salad bar components, the foodservice manager has the freedom to add variety and experiment with the design and layout of the salad bar within the physical limitations of the site.

One newer and more popular component on salad bars has been sprouts of various seeds such as alfalfa, mung bean, radish and cabbage seeds. The use of one of these products, alfalfa sprouts, has expanded from the salad bar to sandwiches as the demand for freshness and variety increased (Probber, 1981). As the popularity of alfalfa sprouts increased, scientific researchers began to explore the various qualities of them. Four such investigations have been reported in the literature. A discussion of each of them follows.

Fordham et al (1975) explored the feasibility of sprouting various peas and bean seeds in the home to provide a variety of nutrients especially ascorbic acid at a low cost in terms of time and money for the consumer. Eighteen varieties of peas and beans were sprouted and analyzed for nutrient content. Four seeds were deemed suitable for the sprouting process: Dwarf Gray peas, Early Alaska peas, Wando peas and

Mung beans. Although alfalfa seeds were not considered in this study, it demonstrated the interest in the sprouting process by the scientific community. The nutrient analysis consisted of twelve components: ascorbic acid, thiamin, riboflavin, niacin, tocopherol, carotenes, iron, calcium, magnesium, manganese, potassium and phorsphorus. Nutrient analysis was conducted on seeds and sprouts to assess the effects on the sprouting process on nutrient quality. The results of this study indicated that the proper combination of sprouts could be a significant source of nutrients to the diet in light of the high nutrient/energy ratio in various sprouts (Fordham, 1975).

A similar study was conducted by Kylen and McGready in 1975. The research was three fold to analyse the seeds, raw and cooked sprouts for protein, fat, fiber, ash, calcium, iron, zinc, thiamin, riboflavin, niacin and ascorbic acid. The four types of sprouts: alfalfa, lentil, Mung bean and soybean, used for the analysis were prepared after harvest. The results indicated that the seeds exhibited higher nutrient values than the sprouts for all the nutrients analyzed. When the various sprouts were cooked by stir frying for two minutes, most nutrient contents were not greatly affected. However, niacin and ascorbic acid levels decreased significantly. The niacin level of the raw alfalfa sprouts decreased by one-half when cooked from 1.6 mg to 0.8 mg per 100 grams of product. The ascorbic acid level decreased to 11 mg for cooked from raw values of 16 mg per 100 grams of alfalfa sprouts. Kylen and McGready (1975) concluded that alfalfa, lentil, Mung beans and soybean could contribute to the nutrient intake of the diet.

The research conducted by Hamilton and Vanterstoep (1979) focused on alfalfa sprouts. Alfalfa sprouts were produced in gallon glass jars.

The sprouts were grown for 72 and 120 hour periods in light and dark conditions. Nutrients analyzed were: protein, fat, ash, carbohydrate, ascorbic acid, riboflavin and iron. When proteins, fat, ash and carbohydrate levels were compared, there were differences in content, but no consistent pattern was evident. The researchers concluded that length of growing period or light conditions did not cause the changes in these nutrient levels. Although riboflavin and iron levels were effected somewhat by the manipulation of the growth period and light conditions the findings showed that the nutrient most effected was ascorbic acid. Ascorbic acid levels were higher in alfalfa sprouts grown in lighted condition than those grown in the dark. Both conditions, light and dark, produced increased levels of ascorbic acid when the length of the growth period was increased. The ascorbic acid level ranged from 73 mg/100g for sprouts produced in lighted conditions for 120 hours. Nutrient compositions taken from Watt and Merrill (1963) for cabbage and lettuce was used to compare alfalfa sprouts for nutritional effectiveness. The researchers grant that alfalfa sprouts were a good source of ascorbic acid and better source of protein and some minerals than lettuce or cabbage, but in general, the nutritional value of the alfalfa sprouts has been over-promoted. In their conclusions, the researchers state that the only nutrient effected by the manipulation of length of growth period and light conditions was ascorbic acid (Hamilton and Vandersteop, 1979).

Patterson and Woodburn (1980) evaluated the microbial content of alfalfa sprouts and Mung bean sprouts. A total of 23 alfalfa sprouts and 20 Mung bean sprouts samples were procured from nine retail outlets and were analyzed for microbial content. The microbial analysis consisted of the determination of total aerobic, total coliform, fecal coliform and

Klebsiella plate counts. The microbial load of the products was very similar with the combined range of aerobic counts being 1.2 to 13 x 10^8 cells per gram. Fecal coliforms and Klebsiella microorganisms were present on the sprouts and were considered a normal component of the products' flora. Upon further analysis, it was determined that no pathogenic bacteria was present. One explanation offered by the researchers was that the lactobacilli microbes present lowered the pH of the product which may have inhibited the growth of such pathogenic bacteria. The microbial flora of alfalfa sprouts and bean sprouts was indicative of vegetables and properly produced and packaged sprouts seem to pose no health risks to consumers.

In conclusion, the research studies on alfalfa and other sproutable seed were conducted in response to the general public's increased awareness of this food product. Alfalfa and bean sprouts have been a new component of salad bars at commercial and institutional foodservice establishments. Salad bars in the 1980's are becoming standard fare in foodservice establishments as part of the industry's response to the consumers' needs and desires.

CHAPTER III

METHODS AND MATERIALS

To determine the feasibility of on-site production of alfalfa sprouts in foodservice operations, the study was divided into four phases: (1) telephone survey, (2) storage studies which used commercially produced alfalfa sprouts, (3) development of growing methods and microbial analysis phase and (4) consumer study.

The first phase, telephone survey, was undertaken to determine if there was any interest in alfalfa sprout production by restaurant and institutional foodservice managers in Lansing, Michigan. The second phase of the study was conducted to determine the effects of storage on the ascorbic acid content and consumer acceptance of commercially produced alfalfa sprouts. Alfalfa sprouts growing procedures were standardized and compared in the third phase of the study. Since conditions necessary to successfully sprout alfalfa seeds were conducive to bacterial growth, a microbial analysis was completed to ascertain relative microbial quality of the product. Finally, in phase four, a consumer study analyzed the effects of promotional materials on alfalfa sprout consumption.

Phase 1: Telephone Survey

The objective of the telephone survey was to determine if there was any interest on the part of the local foodservice industry to produce

alfalfa sprouts on-site in foodservice establishments. Restaurants and institutions with foodservice facilities, as listed in the Yellow Pages in the Lansing, Michigan Telephone Directory were considered 100% of the target population (Michigan Bell, 1982). Lansing is the capital of the state of Michigan. Approximately 175,000 people live in the city and surrounding areas (City Clerk, Lansing).

Since two types of establishments, restaurants and institutions, were contacted, two survey instruments were developed, (See Appendix, Figures 1 and 2). After pretesting the survey instruments by calling three restaurants and three institutions at random, any ambiguous questions were modified to reflect client differences between the two groups. The establishments were contacted during the months of July through September of 1982. All telephone calls were placed during the hours 9:00 to 10:30 a.m. and 2:00 to 3:30 p.m. because the foodservice manager was most likely to be available at these times. Whenever possible the foodservice manager was asked to respond to the survey questions. If the manager was not available at the time of the initial call, a call back time was established. Only two attempts were made to contact each facility. All data were recorded on individually coded questionnaires.

Phase 2: Storage Study

The purpose of the second phase of the study was to determine the effects of storage on nutrient quality using ascorbic acid as the nutrient indicator. The effects of storage on consumer acceptance was also studied. Alfalfa sprouts for this phase of the study were secured from a local alfalfa sprout producer after an 84 $\pm$ 1 hour growth period. Information gathered in this phase would be used to make recommendations to foodservice

managers on the optimum storage time from harvest to service.

Ascorbic Acid Analysis

The ascorbic acid analysis was conducted over a nine day time period of time. Counting the day of delivery as Day 1, the alfalfa sprouts were analyzed at 24 $\pm$ 1 hour intervals using the 2,6 dichlorophenolindphenol visual titration method outlined by Freed (1966). The method was modified by using a 1% oxalic acid solution in lieu of a 3% metaphosphoric acid solution. Oxalic acid was used because of ease of procurement and greater stability (Freed, 1966). A random 30 gram sample of alfalfa sprouts was used as the initial slurry for analysis. Throughout the experimental period, alfalfa sprouts were stored in the original plastic package at 4 $\pm$ 1^{o}C. The complete procurement was replicated four times. All data from the four replications were statistically analyzed by analysis of variance, and then by Duncans Multiple Range Test which was used to differentiate among ascorbic acid values for different days of storage (Duncan, 1957).

Sensory Evaluation

Objectives of the sensory evaluation were to ascertain the ability of panelists to distinguish between one day-old alfalfa sprouts from two week-old and four week-old commercially produced samples. The method chosen for the sensory evaluation was a triangle test as described in the ASTM Testing Manual (1974). Eight female college students ranging in age from 20 to 40 served as the untrained panelists for the three replications of the sensory evaluation. Each panelist was presented with two sets of

alfalfa sprout samples. The first set consisted of the appropriate combination of one day-old and two week-old samples. The second set consisted of a similar combination of one day-old and four week-old samples. Two sensory scorecards presented with the sample sets were developed and patterned after other scorecards used in a triangle test. An example of the scorecard is found in the Appendix, Figure 3. Sensory evaluation of the alfalfa sprouts took place in partitioned taste panel booths. The 1.5 gram samples were evaluated under natural lighting conditions. During the two week and four week storage periods, the alfalfa sprouts were stored in the original plastic package at 4 $\pm$ 1^{o}C. For results and discussion purposes, data collected from the sensory evaluation were converted so all data compared one day-old samples to two and four week-old samples.

Phase 3: Product Development

Since methods for growing alfalfa sprouts in foodservice operations were not available in the published literature, the purpose of Phase 3 of the study was to develop alfalfa sprout production methods and determine microbial quality of such products.

Growing Methods

Four alfalfa sprout production methods for foodservice were standardized in a laboratory based on published household methods (Blanchard, 1975; Whyte, 1973). The procedures were: (1) Glass Container Method, (2) Tray Method using Cheese Cloth Covering, (3) Tray Method using Paper Toweling Covering and (4) Tray Method using Paper Toweling on the Bottom. Standardized procedures that could be used in a foodservice

setting were developed and are found in the Appendix (Figures 4, 5 and 6).

The Glass Container Method was based on the glass jar procedure found in Blanchard (1975). The procedure was expanded from a one quart jar to a gallon glass container. Fifty grams of seed were planted in lieu of the 17 grams used in the household version. All other procedures were followed as published. The Tray Methods using Cheese Cloth or Paper Toweling as a covering were also expanded variations of the tray method outlined in Blanchard (1975). The only modification in the procedure was the size of the tray used for sprouting. The Tray Method using Paper Toweling on the Bottom was an expanded version of a sprout production method by Whyte (1973). Again all procedures were followed, except that the size of the sprouting tray and the amount of seeds planted were altered. In all three of the Tray Methods, 50 grams of seeds were planted instead of 17 grams. The size of the tray used was 45 X 25 X 2 cm.

To compare the four methods of alfalfa sprout production two parameters for each method were recorded: yield per equal volume of seed and labor time. Alfalfa sprout yield per equal volume of seed was recorded by starting with 50 grams of alfalfa seed for each method and comparing weights of the resulting alfalfa sprouts. Labor time was computed by recording the minutes required to set up, rinse and clean the alfalfa sprouts during the entire sprouting process. Data on all of the parameters were collected during the four replications of this phase of the study.

Microbial Analysis

The purpose of this part of Phase 3 was to determine relative microbial quality of the alfalfa sprouts produced by four growing methods.

Aerobic Plate Counts (APC) were chosen as the measure of relative microbial quality so that data from this study could be compared with previous research reports. Alfalfa sprouts were produced by the four growing methods and analyzed after the 80 hour growth period. Alfalfa seed used for this phase of the study was obtained from Michigan State University Central Food Stores in one ten pound lot. Procedures for determination of APC's used in the present study were previously described in Speck (1976).

To obtain the initial 1 to 10 dilution, 25 grams of sprouts and 225 ml of sterilized distilled water were blended in a Waring Blender on high speed for one minute. Duplicate plates were plated on standard plate count agar (Difco, Detroit, Michigan) using the pour plate method. The inoculated plates were incubated for 48 hours at 28 $\pm$ 1^{o}C. At the conclusion of the incubation period, plates with 30 to 300 Colony Forming Units (CFU) were counted using a Standard Colony Counter I (Spencer Manufacturing, Buffalo, NY). Data from the four replications were statistically analyzed to ascertain differences in microbial load between the four growing methods.

Phase 4: Consumer Study

The purpose of the consumer study was to determine if the consumer would prefer an on-site produced alfalfa sprout over a commercially produced product. Three Michigan State University dormitory cafeterias were used as test sites. The three sites were labelled: Control Site, Experimental Site One and Experimental Site Two. The Control Site and Experimental Site One served alfalfa sprouts purchased from the Michigan State University Central Food Stores. Experimental Site Two served alfalfa

sprouts produced by the Glass Container Method. Since records of past alfalfa sprout usage were not available from the three cafeterias, one site was used as the Control. Data collected from this site was the basis for comparison Experimental Sites One and Two were used to assess the effects of the promotional material.

Experimental Sites One and Two received promotional materials which consisted of posters placed in areas of high student traffic and Nutritional News Notes placed in weekly dormitory news letters. (Appendix, pages 44 to 55). All promotional materials for Sites One and Two were identical except for the word "HOME-GROWN" which described alfalfa sprouts and appeared in the copy of material used at Site Two. Weights of the alfalfa sprouts were recorded prior to placement on the salad bar in the cafeterias and upon removal from the salad bar to determine the amount of alfalfa sprout served. All records were kept by a foodservice employee. Due to time considerations, the experimental period covered ten days in which the alfalfa sprouts appeared on the salad bar four times.

CHAPTER IV

RESULTS AND DISCUSSION

Phase 1: Telephone Survey

All data collected during the telephone survey can be found in the Appendix (pages 56 to 57). The discussion of the telephone survey will center around the survey questions that reflect the purpose of this phase. These questions were 14 and 15, and questions 13 and 14, respectively, on the restaurant and institutional telephone surveys (Appendix, Figures 1 and 2). The numbers and rate of restaurant and institution participation in the telephone survey are presented in Table 1.

Restaurant Survey

When asked if managers were interested in using alfalfa sprouts in their menu, question 14, 14% of the managers not serving alfalfa sprouts in their current menu expressed interest, while 28% of managers serving alfalfa sprouts expressed interest. Question 15 asked managers if they were interested in on-site production of alfalfa sprouts; 3% of managers not serving alfalfa sprouts and 6% of managers serving alfalfa sprouts said they were interested in the process. Several reasons were listed by the managers for lack of interest in on-site production of alfalfa sprouts. They were: time considerations, labor considerations, space factors and current ease of alfalfa sprout procurement.

Table 1. Phase 1: Number[a] and rate of participation of restaurants and institutions contacted during the telephone survey.

Type of Facility	Number not responding		Number serving alfalfa sprouts		Number not serving alfalfa sprouts	
	(#)	(%)	(#)	(%)	(#)	(%)
Restaurant (n = 180)	59	34	85	47	63	19
Institution (n = 19)	0	0	12	63	7	37

[a]N + 199 (100%)

Institutional Survey

Question 13 of the institutional survey considered the foodservice managers' interest in incorporating alfalfa sprouts into their menu. Forty-three percent of managers serving and 58% of managers not serving alfalfa sprouts were interested. When asked in question 14 about interest in on-site production of alfalfa sprouts, 28% and 8%, respectively, of managers serving and not serving alfalfa sprouts were interested.

One institution was presently producing alfalfa sprouts on-site as well as Mung bean and lentil sprouts for client consumption. The director felt the food was healthier and provided necessary bulk for the residents at the facility.

There was some interest on the part of restaurants and institution managers to grow alfalfa sprouts on-site. Generally, the trend exhibited by the telephone survey data was that a greater percentage of institutional managers were interested in the sprouting process than were restaurant

managers. Specific reasons for this difference could not be found in the literature or determined from conversations. Concerns expressed by restaurant managers relative to space, time and labor considerations might have been unexpressed concerns of institutional managers. Managers of both types of foodservice establishments must be concerned with profit margins or budgetary restrictions and, therefore, might be unwilling to experiment with a new and unproven process.

Phase 2: Storage Study

The effects of storage on nutrient level and consumer acceptance of commercially produced alfalfa sprouts was studied in this phase of the study. Ascorbic acid was used as the indicator of nutrient quality and results of the nine day analysis will be discussed followed by a discussion of the sensory acceptance evaluation.

Ascorbic Acid Analysis

The results of the nine day ascorbic acid analysis are given in Table 2. The mean initial ascorbic acid level was 15 mg per 100 grams of alfalfa sprouts and decreased to 10.7 mg per 100 grams of product on Day 9. This decrease was statistically significant at the $p \leq 0.01$ level. Further statistical analysis was conducted using Duncan Multiple Range Test as indicated in Table 2 (Duncan, 1957). Statistically significant decreases in nutrient levels occurred on Days 2 and 3, and on Days 3 and 4 of storage. The pattern established by the data was representative of the decrease in ascorbic acid levels found in other foods held in storage (Cameron, 1978). During the first few days of storage, the decrease of

Table 2. Phase 2: Reduced ascorbic acid levels of alfalfa sprouts[a] over a nine day period of storage.

Day	1	2	3	4	5	6	7	8	9
Reduced Ascorbic Acid (mg/100 gm)	15.06^{*bc} $\pm$ 1.25	14.47^{*} $\pm$ .10	$12.85^{\#}$ $\pm$ .70	$12.49^{\#@}$ $\pm$ .16	$12.22^{\#@}$ $\pm$ .56	$12.02^{\#@}$ $\pm$ 1.48	$11.03^{@}$ $\pm$ 1.18	$11.03^{@}$ $\pm$ .38	$10.78^{@}$ $\pm$ .63

[a] Alfalfa sprouts were commercially produced and 84 $\pm$ 1 hour old on Day 1 of storage.

[b] Mean values and standard deviations of four replications.

[c] Values with different superscripts (*, # and @) indicate statistical significance at $p \leq 0.01$.

ascorbic acid was rapid, thereafter, the initial decrease rate of ascorbic acid decline began to slow down.

Nutritional analysis of alfalfa sprouts has been explored by other researchers (Hamilton, 1979; Kylen, 1975). The ascorbic acid levels in the studies by these two researchers differed by a slight margin. Hamilton (1979) reported 22 mg of ascorbic acid per 100 grams of alfalfa sprouts, while Kylen (1975) reported an ascorbic acid level of 16 mg per 100 grams of product. Alfalfa sprouts used for both of the studies were produced by a method comparable to the Glass Container Method which was described in the product development section of the study. The initial ascorbic acid level determined in the present study was similar to findings of the other researchers. Although alfalfa sprouts are not comparable to citrus fruits in ascorbic acid content, they do have a higher ascorbic acid content than other salad bar items such as lettuce and carrots (Guthrie, 1976).

The ascorbic acid level of alfalfa sprouts decreased over the nine day storage period. The most significant decreases occurred between Days 2 and 3 and between Days 3 and 4. To obtain the greatest nutritional benefit from the alfalfa sprouts, they should be consumed by the fourth day after harvest.

Sensory Evaluation

The sensory panelists correctly determined the different samples when comparing one day-old alfalfa sprouts to two week of four week-old alfalfa sprouts 66% of the time. The results of the sensory panelists' evaluation of the products are in Table 3. All data of panelists samples

Table 3. Phase 2: Sensory evaluation data comparing one day-old alfalfa sprouts to two or four week-old alfalfa sprouts.

Question[a]	Quality							
	Color		Aroma		Texture		Flavor	
	2 week	4 week	2 week	4 week	2 week	4 week	2 week	4 week
I B. Is the difference?[b]	----------% positive answers----------							
Great	8±11[c]	9±7	0	8±6	3±4	5±4	5±4	13±5
Moderate	22±10	36±11	13±7	24±1	16±11	11±10	28±15	10±9
Slight	20±12	26±5	16±6	32±1	7±6	15±13	15±5	22±16
Very Slight	22±5	13±10	16±1	9±7	24±12	34±15	33±9	39±4
No Difference	27±6	18±16	55±10	27±3	49±7	35±3	19±12	16±4
II. Is the one day-old sample								
More acceptable?	46±26	60±31	18±14	42±13	12±9	36±3	20±10	44±20
Comparable?	57±26	40±31	68±13	52±11	77±8	65±4	42±11	57±19
Less Acceptable?	0	0	14±11	6±15	10±8	0	38±19	0

[a] Answers to question IA, III, IV and V are discussed in text.

[b] When comparing one day-old samples to two or four week-old samples.

[c] Mean percentage and standard deviations of three replications, 24 responses.

When the panelists were asked to rate the differences between the one day-old and the two week or four week-old alfalfa sprouts, (question I B, Table 3), the four week-old samples were consistently rated as more different than the two week-old products. For example, when differences in color were rated 8, 22, 20 and 22 percent of the panelists detected, respectively, a great, moderate, slight or very slight difference between the one day-old and two week-old products. Thus, a total of 72% of the panelists detected some difference. When the percentages of panelists detecting differences between the one day-old and four week-old products were combined 82% of panelists detected some degree of difference.

In question II, panelists were asked to rate the one day-old sample as more or less acceptable than the others. In most cases, the panelists rated the one day-old sample as comparable or more acceptable. The only exception occurred when the panelists compared the flavor of the one day-old to the two week-old alfalfa sprout, (Table 3). Although the majority rated the flavor of the fresher product as comparable, 38% rated the flavor of the fresher product as less acceptable. The sensory panelists' preference for a milder flavored alfalfa sprout could be due to the fact that these are the type the taste panelists were exposed to. Fresh alfalfa sprouts have a distinctive grass-like flavor which might have been unfamiliar to the panelists and mistaken for a spoiled product.

Panelists, when asked to describe the outstanding characteristics of an alfalfa sprout were as follows. Color of the leaves should be bright green, not dark green or light yellow. The stem color should be pearly light, with no rusty areas, especially on the end of the root. Aroma was classified as grass-like. A moldy or musty odor was not desireable. The texture should be crisp and crunchy as opposed to soft and

mushy. The optimum flavor was described as mild but distinctive without a bitter taste. A strong grass-like flavor was not desired.

Sensory panelists did not consistently distinguish the one day-old alfalfa sprouts from the two or four week-old product. Panelists chose the correct sample on an average of two out of three times during the three replications of the sensory panel. The best indicator for the determination of the age differences seemed to be the color parameter. The leaves darken upon exposure to light and the stem begins to have a rusty tinge upon storage. These factors were more valuable to the sensory panelists in determining the age of the product than the other parameters. Many panelists preferred the milder flavor of the two week-old sample to the taste of the one day-old sample. The stronger flavor of the fresher alfalfa sprout was not familiar to the panelists and therefore perhaps less acceptable.

Phase 3: Product Development

Four alfalfa growing methods were developed by expanding the popular home sprouting methods found in Blanchard (1975) and Whyte (1973). Two parameters were used to compare the four methods. The four methods were: (1) Glass Container Method, (2) Tray Method using Cheese Cloth Covering, (3) Tray Method using Paper Toweling and (4) Tray Method with Paper Toweling on Bottom. After the alfalfa sprout production methods were formulated, a microbial analysis was conducted to determine relative microbial quality of the products. A discussion of sprout yield, labor time and microbial quality follow.

Alfalfa Sprout Yield

Mean values of alfalfa sprout yield for the four methods are found in Table 4. The alfalfa sprouts produced by the Glass Container Method exhibited the highest yield per equal volume of seed. The remaining three methods produced yields of alfalfa sprouts that were very similar (Table 4). Although the differences in yields from the four methods was not statistically significant, the Glass Container Method had the most satisfactory yield. Alfalfa sprout producers expect a range of 1 to 5 to 1 to 9 alfalfa sprout yield per weight of seeds (Anon., 1981b). The Glass Container Method proved to be the only method that approached these expected yields.

Labor Time

Labor time in minutes for four alfalfa sprouts is in Table 4. The maximum labor time necessary to product alfalfa sprouts among four methods was 60 minutes. The Tray Methods using Cheese Cloth or Paper Toweling as a Covering required the maximum amount of time. The minimum labor time required by the Glass Container Method and the Tray Method with Paper Toweling on Bottom method was 30 minutes.

A breakdown of required labor time is in Table 4. The Tray Methods with Cheese Cloth or Paper Toweling Covering required 100% more labor time to produce the same quantity of alfalfa sprouts than the other two methods. Rinsing and clean-up time of the Tray Methods using Cheese Cloth or Paper Toweling were 12 times and 6 times greater than the time required for the same procedures in the Glass Container and Tray with Paper Toweling on the Bottom Methods. Reasons for this increase in labor time were as follows.

Table 4. Phase 3: Mean alfalfa sprout yield and labor time for four alfalfa sprout production methods.

Method	Yield	Labor Time			
		Total	Set-Up	Clean-Up	Rinsing
	(g)	min			
Glass Container	242 ± 5	30	2	6	22
Tray using Cheese Cloth	216 ± 3	60	25	13	22
Tray using Paper Toweling	222 ± 3	60	25	13	22
Tray using Paper Towels on Bottom	217 ± 3	30	2	6	22

[a]Mean values for four replications and standard deviations when 50 grams of alfalfa seeds were sprouted

In the Tray Methods using Cheese Cloth or Paper Toweling as a covering, alfalfa sprouts were removed from the trays, placed in a strainer, rinsed and replaced on the tray. The alfalfa sprouts clung to the strainer and made cleaning a difficult and tedious process. In the other two methods, the alfalfa sprouts were not removed from their growing containers. Cleaning procedures were limited to one clean up period. In the Tray Methods using Cheese Cloth or Paper Toweling as a covering, utensils had to be cleaned after each rinsing.

When yield and labor time were considered, the most preferred method for producing alfalfa sprouts on-site in foodservice operations was the Glass Container Method. This method is popular at the retail level as a quart jar method of alfalfa sprout production that is available to the consumer interested in home sprouting.

Microbial Analysis

Values in Table 5 represent the average number of aerobic bacteria per gram of alfalfa sprouts produced by the four growing methods. The Glass Container Method produced alfalfa sprouts with the lowest number of microorganisms. Alfalfa sprouts produced by the Tray Method with Paper Toweling as a covering had the highest microbial load. Patterson and Woodburn (1981) conducted microbial analysis on alfalfa sprouts purchased from retail outlets and reported a mean of 4.4×10^8 Colony Forming Units (CFU) per gram of product with a range of 1.2 to 13×10^8 CFU's per gram. Three of the four growing methods, the Glass Container Method, the Tray Method using Cheese Cloth Covering and the Tray Method with Paper Toweling on the Bottom, produced alfalfa sprouts within the microbial range established by Patterson and Woodburn (1981). The Tray Method with Paper Toweling as a covering did not produce a product within this acceptable range. An explanation for this was that the moist paper toweling covering the seeds/sprouts during the sprouting process was itself covering with plastic film. This additional covering could have created a moisture barrier and thus encouraged bacterial proliferation. It was believed that paper toweling itself could have introduced microorganisms to the system due to the less than sanitary conditions in which they are produced and caused the increased microbial count.

Fowler (1975) in his research performed at Letterman Army Institute attempted to develop microbial safety standards for fresh green salads. Mixed green salads exhibited total plate counts of 3.0×10^3 to 7.3×10^8 microorganisms per gram. Fowler (1975) concluded because of the wide range of microbes found on products and that because product quality or

Table 5. Phase 3: Relative microbial quality of alfalfa sprouts produced by four growing methods.

Growing Method	Total Aerobic Plate Counts[a] (CFU/g of sprouts)[b]
Glass Container	3.4×10^8
Tray Method with Cheese Cloth	5.6×10^8
Tray Method with Paper Toweling	27.3×10^8
Tray Method with Paper Toweling on Bottom	3.5×10^8

[a]Mean values of four replications

[b]CFU/g = Colony Forming Units per gram of product

safety was not altered, microbial guidelines were not feasible at this time. Other fresh salad vegetables, parsley and Mung bean sprouts have been analyzed for microbial content. The total plate counts were very similar to the microbial counts found on the alfalfa sprouts produced for the present study (Kaferstein, 1976; Patterson and Woodburn, 1981). In some foods, 1×10^8 cells per gram were considered a large microbial population. Splitzstoesser (1976) indicated, that for fruits and vegetables such microbial loads were not considered high. He stated that such high counts were indicative of fruits and vegetables because of their contact with the soil and the high counts were in no way a reflection of product safety of quality.

Three of the four alfalfa sprout production methods produced alfalfa sprouts within a microbial range established by other researchers (Patterson and Woodburn, 1981). The conditions necessary to successfully produce

alfalfa sprouts are also conducive to microbial growth. Although the data provided information on the microbial safety of the alfalfa sprouts produced, the importance of maintaining strict sanitation standards cannot be over stressed.

Phase 4: Consumer Study

Three Michigan State University dormitory cafeterias were used as experimental sites for the consumer phase of the current study (Table 6). During the course of the ten day study, all the cafeterias served the standard university cycle menu. Control Site and Experimental Site One served alfalfa sprouts procurred from the University Central Food Stores. Experimental Site Two served alfalfa sprouts produced on-site by the Glass Container Method. These sprouts were termed "HOME-GROWN". Results of the consumer study are in Table 6. Initial alfalfa sprout consumption at the Control Site was 1.1 grams per student per day. This data was used as baseline data to assess the effects of the promotional material used at the Experimental Sites. Experimental Sites One and Two which promoted alfalfa sprouts had consumption rates of 1.3 grams and 0.6 gram per person. Consumption was slightly more at Experimental Site One. Consumption of alfalfa sprouts at Experimental Site Two was not as great as at the Control Site. Possible explanations for the decrease in consumption evident in the "HOME-GROWN" site were as follows. The alfalfa sprouts regularly served at the facility were different than the "HOME-GROWN" product. The fresh "HOME-GROWN" alfalfa sprouts had a stronger flavor than their commercially produced counterpart. This complies with data complied from the sensory evaluation conducted in Phase 2. The one day-old samples were

Table 6. Phase 4: Alfalfa sprout consumption in dormitories participating in the consumer study.

Method	Control	Experimental Sites	
		One	Two
Alfalfa sprouts consumed per site[a] (g)	3810.2	3347.4	1995.8
Total dinner count[b]	3361	2605	3180
Grams consumed per person per site	1.1	1.3	0.6

[a]Over the course of the ten day study, alfalfa sprouts were served four times

[b]Number of residents consuming meals when alfalfa sprouts were served

rated as having a stronger flavor than the older alfalfa sprouts. "HOME-GROWN" alfalfa sprouts were approximately 40% shorter in length and 100% more seed coats were present. Comparing "HOME-GROWN" alfalfa sprouts to commercially produced alfalfa sprouts was like comparing fresh vegetables to processed vegetables. The taste and the appearance were very different between the two items.

People are normally resistant to change especially when it concerns food intake behaviors (Gifft, 1972). A new form of food could cause the consumer to reject it because it was unfamiliar. The "HOME-GROWN" alfalfa sprouts could have been viewed by the university student as unfamiliar. Possibly a more intense form of promotion would have increased consumption (Laine, 1972).

Since the increase in consumption between the Control Site and Experimental Site One was not significant, it was difficult to assess the effects of the promotional material on consumption patterns. The

awareness of the product created by the posters and nutritional news notes could have been the cause of the slight increase in consumption at Experimental Site One. Creating awareness of the target population was the first step in the process of changing consumers' behavior patterns (Gifft, 1972). However, the increase in consumption could very well have been due to chance. Since dormitory residents were asked to participate in numerous University food acceptance and preference surveys, the researchers were not permitted to conduct an alfalfa sprouts acceptance study. Thus, without this information it was impossible to determine the cause of the variations in consumption rates exhibited between the Control Site and Experimental Site One.

The variation in consumption rates between the Control Site and Experimental Site Two could have been due to the differences in the products. The work "HOME-GROWN" used in the promotional materials did not increase consumption. The alfalfa sprouts produced on-site had a different appearance and flavor than the purchased alfalfa sprouts. As the results from the sensory panel indicated, many consumers preferred the milder taste of the older alfalfa sprouts. This factor could have entered into the decrease in consumption at Site Two. The consumer phase of the study was limited by the University's policy and by the length of the study. In future attempts to assess the effects of promotional materials, the authors recommend a longer period of study, follow up tests and additional consumer input.

CHAPTER V

SUMMARY, CONCLUSIONS AND IMPLICATIONS

Summary

The purpose of the study was to determine the feasibility of on-site production of alfalfa sprouts in foodservice establishments. The telephone survey, storage study, product development and consumer study were indicators of alfalfa sprout acceptance by the consumer and the foodservice operator.

For example, the telephone survey of 199 restaurants and institutional foodservice managers indicated some interest in incorporating and producing alfalfa sprouts. Institutional foodservice managers were more interested in the process than restaurant managers.

In the storage phase of the study, the effects of storage on nutrient quality and consumer acceptance were evaluated on commercially produced alfalfa sprouts. The nutrient studied was ascorbic acid. The analysis was conducted over a nine day period of storage. Two significant decreases in nutrient level occurred. The first was between Days 2 and 3; the second occurred between Days 3 and 4. The effects of storage on product acceptance was determined by the triangle test method of sensory evaluation. When comparing one day-old alfalfa sprouts to two or four week-old products, two out of three panelists correctly distinquished the different sample. A surprising finding was that one-third of the panelists

preferred the taste of the two week-old over the fresher one day-old product because of the reported milder flavor of the older sample.

In the product development section, four methods of alfalfa sprout production were adapted from home production procedures and standardized for foodservice establishment use. The methods were: (1) Glass Container Method, (2) Tray Method using Cheese Cloth Covering, (3) Tray Method using Paper Toweling Covering and (4) Tray Method with Paper Toweling on Bottom. The alfalfa sprouts produced by the four methods were then analyzed for microbial quality. Of the four methods, the Glass Container Method was recommended. It produced the highest yield per equal volume of seed, required only 30 minutes of total labor time and produced alfalfa sprouts with an acceptable microbial load.

The promotion of home-grown alfalfa sprouts in the consumer study proved to be unsuccessful. The consumer in the study seemed to prefer the flavor and appearance of the commercially produced alfalfa sprouts.

Conclusions and Implications

The findings of this study do not appear to support on-site production of alfalfa sprouts as a feasible production method for foodservice establishments. Although there was some interest expressed by restaurant and institutional managers in the process, the cost of labor required to produce the product made the endeavor impractable coupled with the fact that the consumer preferred the flavor of the two week-old commercially produced product.

Implications of this research as as follows. If alfalfa sprouts were made more acceptable to the public on-site production of alfalfa

sprouts might be more practicable. Increasing alfalfa sprout desirability could be accomplished in at least two ways. First, the appearance of the home-grown alfalfa sprouts was different than the commercially produced product. This different appearance was not acceptable to the consumer. The on-site production methods need to be refined to minimize the differences in appearance. Such refinement of methods must include more efficient methods of seed coat removal. By improving the growing methods and minimizing the differences between home-grown and commerically produced alfalfa sprouts, it might improve the desirability of the product. If the product is accepted by the consumer, it might be feasible to produce alfalfa sprouts on-site.

Another method of increasing the desirability of alfalfa sprouts would be to create a demand for them by increased exposure on restaurant and institutional menus. Alfalfa sprouts do not have to be limited as a salad bar component. Alfalfa sprouts could receive increased exposure by restaurants and institutions featuring alfalfa sprout salads on their menus. Alfalfa sprouts could be used in place of lettuce as a plate liner or used as a plate garnish. If alfalfa sprouts received more exposure on menus, it could result in increased consumer demand and desire for the product.

Alfalfa sprout production on-site is not feasible for restaurants and institution by the methods described in this research. Although consumers have expressed interest in the product, until alfalfa sprouts are as common as lettuce as a salad item, it is doubtful that on-site production would be feasible.

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APPENDICES

1. Which of the following best describes the type of service your patrons can expect when they eat in your establishment?

   Table Service Self Service Take Out Other _____

2. Which of the following meals do you serve? B L D[a]

3. What is the cost of an average meal? _____

4. What is your average customer count per day? _____

5. Do you use any kinds of sprouts in your menu? Yes No
   (if no, go to question 14)

6. What variety of sprouts do you use and what is the market form? (if no alfalfa sprouts, go to question 14)

7. Where are the alfalfa sprouts used in your menu?

8. What is the portion of serving size of the alfalfa sprouts used in the areas you just listed?

9. How many portions are consumed each day? _____

10. How many pounds a week do you purchase? _____

11. Do you purchase your alfalfa sprouts from a:

    Food Distributer Produce Broker Other

12. How many times a week are the alfalfa sprouts delivered?

13. Are you satisfied with the quality and the condition of the alfalfa sprouts upon delivery? Yes No

14. Are you interested in the different ways alfalfa sprouts can be incorporated into your menu? Yes No

15. Would you be interested in growing alfalfa sprouts, if it could be done with materials commonly found in foodservice establishments?
    Yes No

[a]B = breakfast, L = lunch, D = dinner

Figure 1. Telephone survey instrument used to collect information on alfalfa sprout usage from restaurant managers.

1. Of the following classifications, which best describes the type of menu used at your facility?

   _____ Cycle Menu _____ Selective Cycle

   _____ Semi-Selective _____ Other

2. How many beds does your facility serve? _____

3. How many meals do you serve each day? _____

4. Do you use any kinds of sprouts in your present menu? Yes No
   (if no, go to question 13)

5. What variety of sprouts do you use and what is the market form?
   (if no alfalfa sprouts go to question 13)

6. Where are alfalfa sprouts used in your menu?

7. What is the portion size of the alfalfa sprouts used in the areas you just listed?

8. How many portions are consumed each day? _____

9. How many pounds a week do you purchase? _____

10. Do you purchase your alfalfa sprouts from a:

    Food Distributer Produce Broker Other

11. How many times a week are the alfalfa sprouts delivered?

12. Are you satisfied with the quality and the condition of the sprouts upon delivery? Yes No

13. Are you interested in the different ways alfalfa sprouts can be incorporated into your menu? Yes No

14. Would you be interested in growing alfalfa sprouts, if it could be done with materials commonly found in foodservice establishments?
    Yes No

Figure 2. Telephone survey instrument used to collect information on alfalfa sprout usage from institutional managers.

Name _____ Product Alfalfa Sprouts

Date _____

I. A - Which is the different sample? _____

B - Is the difference:

	Color	Aroma	Texture	Flavor
1. Great	_____	_____	_____	_____
2. Moderate	_____	_____	_____	_____
3. Slight	_____	_____	_____	_____
4. Very Slight	_____	_____	_____	_____
5. No Difference	_____	_____	_____	_____

II. Is the different sample's:

	Color	Aroma	Texture	Flavor
A. More Acceptable	_____	_____	_____	_____
B. Comparable	_____	_____	_____	_____
C. Less Acceptable	_____	_____	_____	_____

III. Which is the preferred sample? _____

IV. What words would you use to describe its outstanding characteristics?

V. Comments: _____

_____

_____

Figure 3. Alfalfa sprout scorecard used by the sensory panelists during the storage phase of the study.

Yield: 454 grams (1 pound) sprouted alfalfa seeds

Number of Portions: 40
Size of Portions: 1.5 grams
1/4 cup

Total Sprouting Time: 80 hours

Labor Time: 30 minutes

Equipment:

1 gallon glass jar
cheese cloth to fit jar opening
1 - 12 quart bowl

Ingredients	Weights		English Measure	Time	Procedure
	Metric	English			
Alfalfa Seeds	50 g	2 oz	1/4 c	0 hr	1. Place seeds in a clean gallon glass container. Add water, cover jar opening with clean cheese cloth and secure with a rubberband. Let soak for 8 hours.
Warm Water 45°C(80°F)	500 ml	1 lb 4 oz	2 c		
Warm Water	3	8 lb	1 gal	8 hrs	2. Discard the soaking water. Fill the glass jar with warm water. Rinse using a twirling motion. Drain the water, invert the jar at a 45° angle, set aside for 8 hr in a warm, dark place (21°C, 70°F).
Warm Water	3	8 lb	1 gal	16 hrs 24 hrs 32 hrs 40 hrs 48 hrs 56 hrs 64 hrs	3. Fill the container with water, rinse seeds using a twirling motion. Drain the water, invert the jar at a 45° angle. Set aside in a warm, dark place. Repeat at 8 to 12 hour intervals.
Warm Water	3	8 lb	1 gal	72 hrs	4. Rinse as above. Invert container and place in a warm lighted area.
Warm Water	9 to 12	24 to 32 lb	3 to 4 gal	80 hrs	5. Place alfalfa sprouts in a large bowl. Fill the container with warm water. Stir the sprouts to loosen the hulls. Let the sprouts stand in the water for 5-10 minutes. Skim the hulls from the top. When the hulls have been removed, Drain the water from the sprouts. Let the sprouts dry for 30 min. When dry, package the sprouts in clean plastic bags. Store in the refrigerator up to 4 days at 2°C (39°F).

Figure 4. The Glass Container Method (GC) for alfalfa sprout production.

Yield: 454 grams (1 pound sprouting alfalfa seeds

Number of Portions: 40

Size of Portion: 1.5 grams 1/4 cup

Total Sprouting Time: 80 hours

Labor Time: 30 minutes

Equipment: 1 two quart glass container
1 fiberglass tray (45x24x2 cm)
Paper toweling or cheese cloth to cover tray
1 large sieve
1 - 12 quart bowl

Ingredients	Weights Metric	Weights English	English Measure	Time	Procedure
Alfalfa Seeds	50 g	2 oz	1/4 c	0 hr	1. Place seeds in a glass container, add water & let seed soak for 8 hours.
Warm Water 45°C(80°F)	500 ml	16 oz	2 c		
Warm Water	3	8 lb	1 gal	8 hrs	2. Drain the soaking water by placing the seeds in a metal sieve. Rinse seeds with 1 gal of water. Place seeds on a clean tray. Distribute seeds to a single layer. Cover seeds with a piece of dampened PT or CC cut to cover tray. Place seeds in a warm dark area for 8 hours (21°C, 70°F).
Water Water	3	8 lb	1 gal	16 hrs 24 hrs 32 hrs 40 hrs 48 hrs 56 hrs 64 hrs	3. Remove PT or CC and redampened it. Place seeds/sprouts in sieve and rinse with water. Return to tray and cover with PT or CC. Store in a warm dark area. Repeat at 8 hour intervals.
Warm Water	3	8 lb	1 gal	72 hrs	4. Repeat step 3. Store in indirect light for 8 hours.
Warm Water	9 to 12	24 to 32 lb	3-4 gal	80 hrs	5. Place alfalfa sprouts in a large bowl. Fill container with warm water. Stir sprouts to loosen hulls. Let sprouts stand in water for 5-10 mins. Skim hulls from top. When hulls have been removed, drain water. Let sprouts dry for 30 min. When dry, package in clean plastic bags. Store in refrigerator upto 4 days at 2°C (39°F).

[a] Time in hours

Figure 5. The Paper Towel and Cheese Cloth Methods of alfalfa sprout production.

Yield: 454 grams (1 pound) sprouted alfalfa seeds

Number of Portions: 40

Size of Portion: 1.5 grams
1/4 cup

Total Sprouting Time: 80 hours

Labor Time: 30 minutes

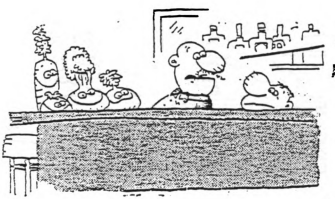
Equipment:

Fiberglass tray (45x25x2 cm)
Paper towels to line tray
1 - 12 quart bowl

Ingredients	Weights		English Measure	Time	Procedure
	Metric	English			
Alfalfa Seeds	50 g	2 oz	1/4 c	0 hr	1. Line a tray with 2 layers of brown paper toweling. Evenly distribute seeds on toweling. Add enough water to saturate the toweling. Drain excess water. Set aside in a warm dark place for 8 hours (21°C, 70°F).
Warm Water* 45°C(80°F)	500 ml	1 lb 4 oz	2 c		
Warm Water	300-500 ml	8-16 oz	1-2 c	8 hr 16 hrs 24 hrs 32 hrs 40 hrs 48 hrs	2. Check the seed/sprouts, add water to moisten paper toweling. Store in a warm, dark place. Check at 8 to 12 hour intervals.
Warm Water	300-500 ml	8-16 oz	1-2 c	72 hrs	3. Repeat procedure 2 and place sprouts in indirect light for 8 hours.
Warm Water	9-12	24-32 lb	3-4 gal	80 hrs	4. Place sprouts in a large bowl. Fill container with water. Stir sprouts to loosen hulls. Let sprouts stand in water 5-10 minutes. Skim hulls from top. When hulls have been removed, drain water. Let sprouts dry for 30 minutes. When dry, package sprouts in clean plastic bags. Store in refrigerator up to 4 days at 2°C (39°F).

Figure 6. The Paper Towel on the Bottom Method for alfalfa sprout production.

Figure 7 - 18. Reproductions of alfalfa sprout posters used the consumer phase of the study.



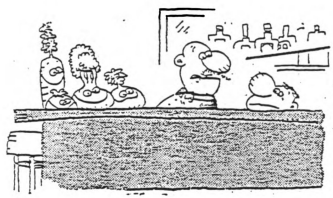
Try

HOME-GROWN

ALFALFA

SPROUTS

you'll like them!



Try them

you'll like them!

Try

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ALFALFA SPROUTS

on your next SALAD

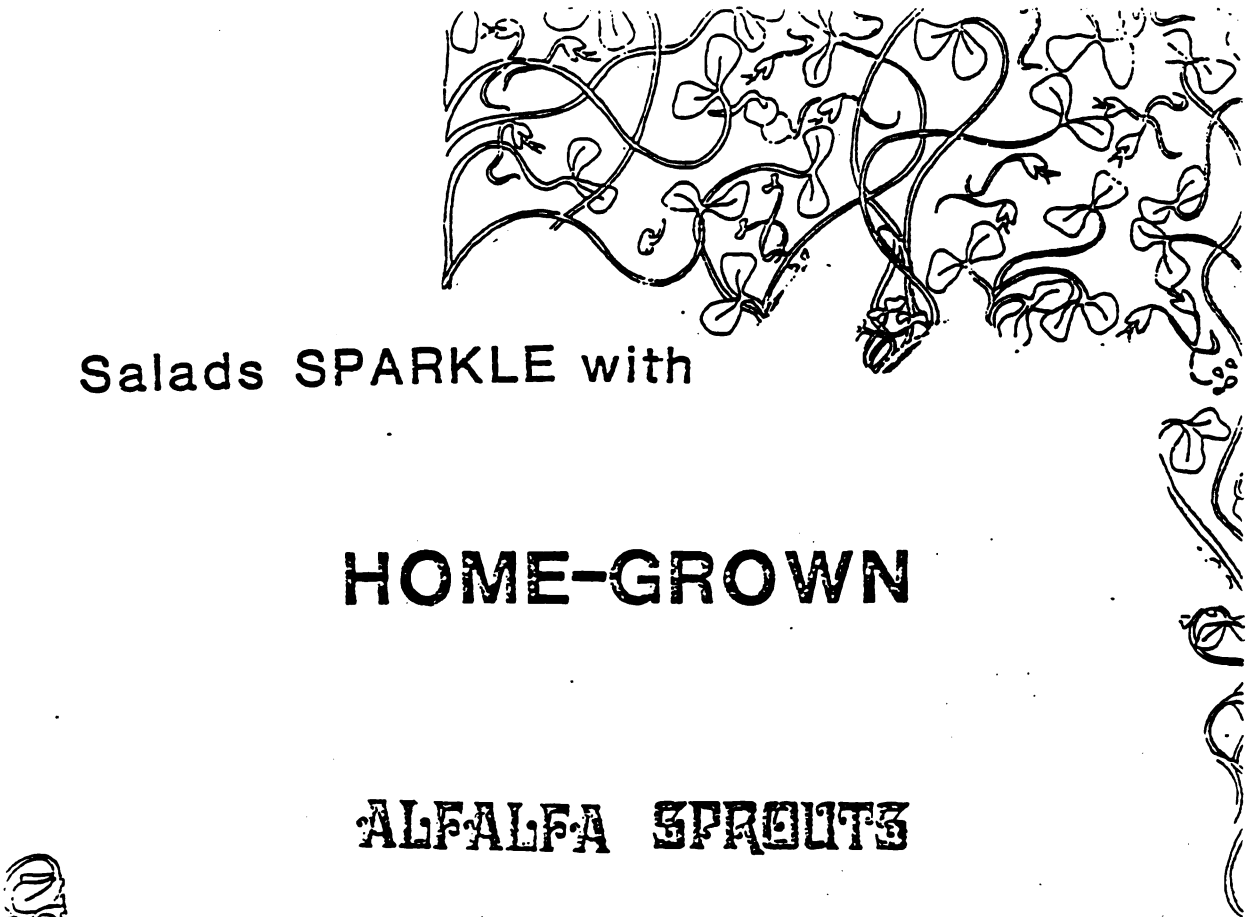
The TREAT everyone LOVES to HATE

Try

ALFALFA SPROUTS

on your next SALAD

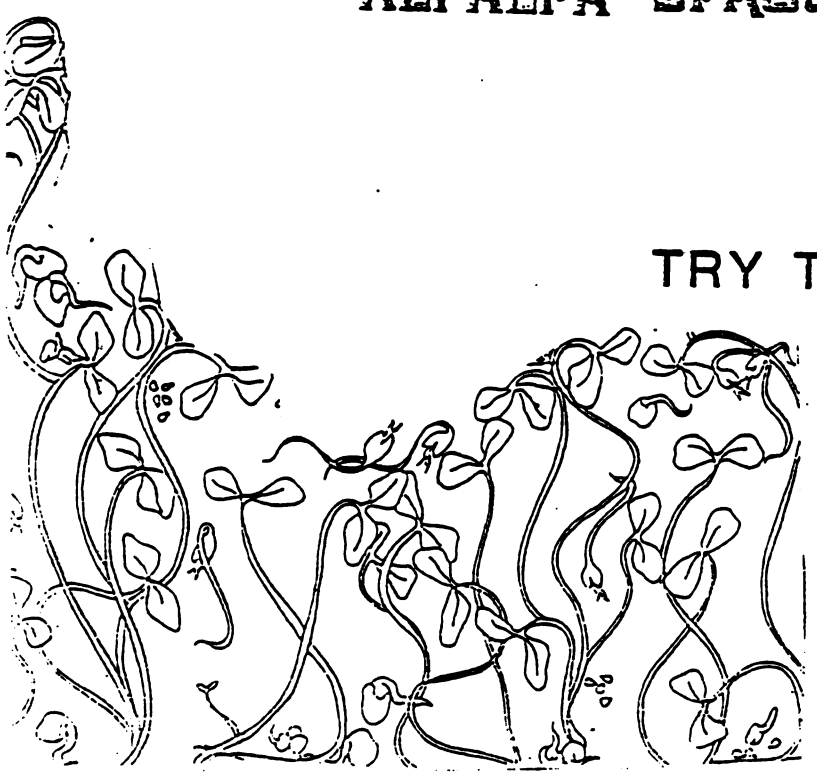
The TREAT everyone LOVES to HATE



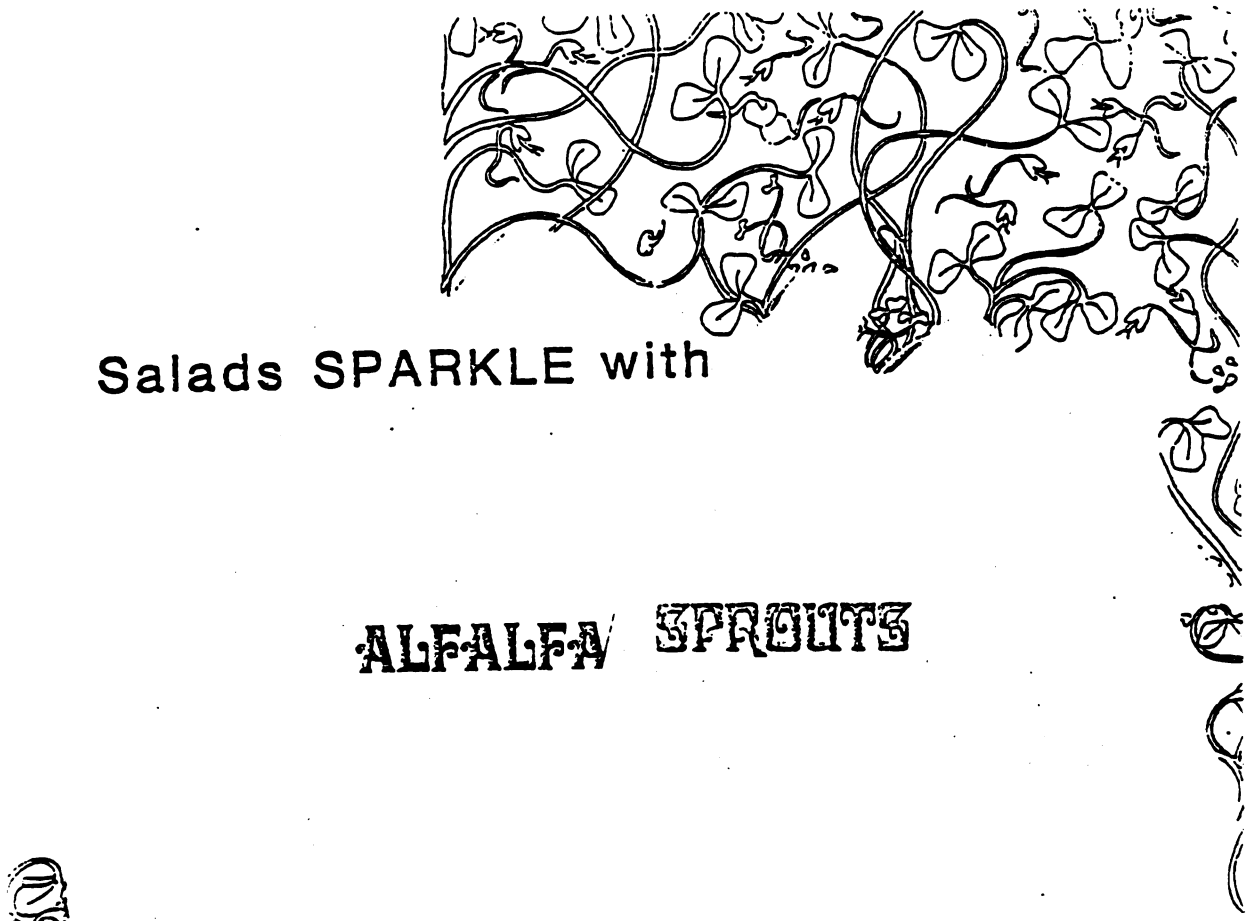
Salads SPARKLE with

HOME-GROWN

ALFALFA SPROUTS

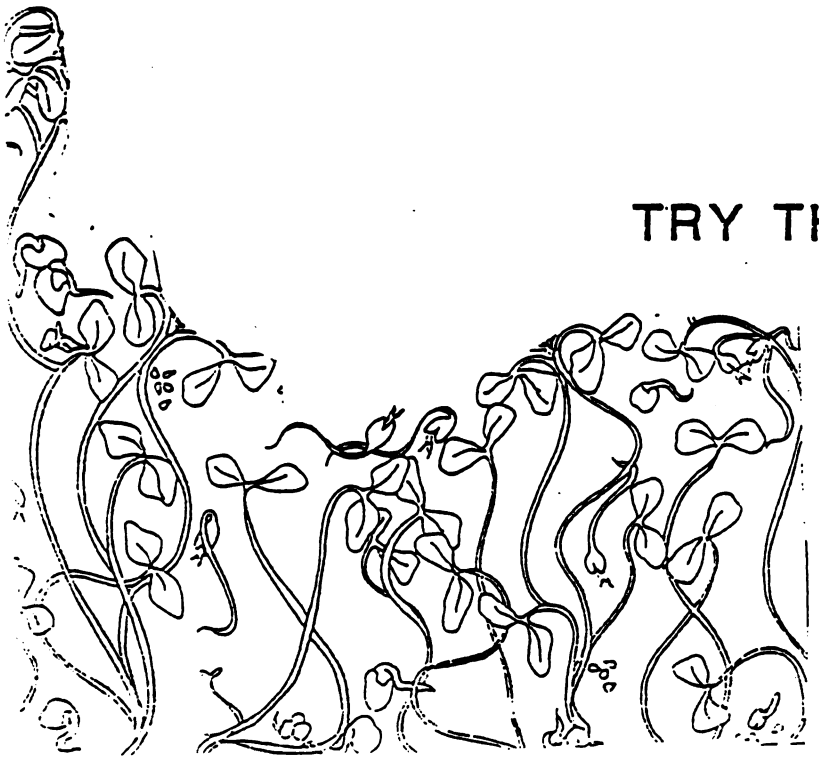


TRY THEM TODAY



Salads SPARKLE with

ALFALFA SPROUTS



TRY THEM TODAY

Sammy Sprout Suggests:

HOME-GROWN

ALFALFA SPROUTS

They're fresh

and nutritous

but most of all

DELICIOUS

Sammy Sprout Suggests:

ALFALFA SPROUTS

They're fresh

and nutritous

but most of all

DELICIOUS

Spring has SPROUTED

and so has

the Salad Bar

Try

HOME

GROWN

ALFALFA SPROUTS

They're DELICIOUS

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Try

ALFALFA SPROUTS

They're DELICIOUS

HOME-GROWN

ALFALFA SPROUTS

NATURAL NUTRITION

ALFALFA SPROUTS

NATURAL NUTRITION

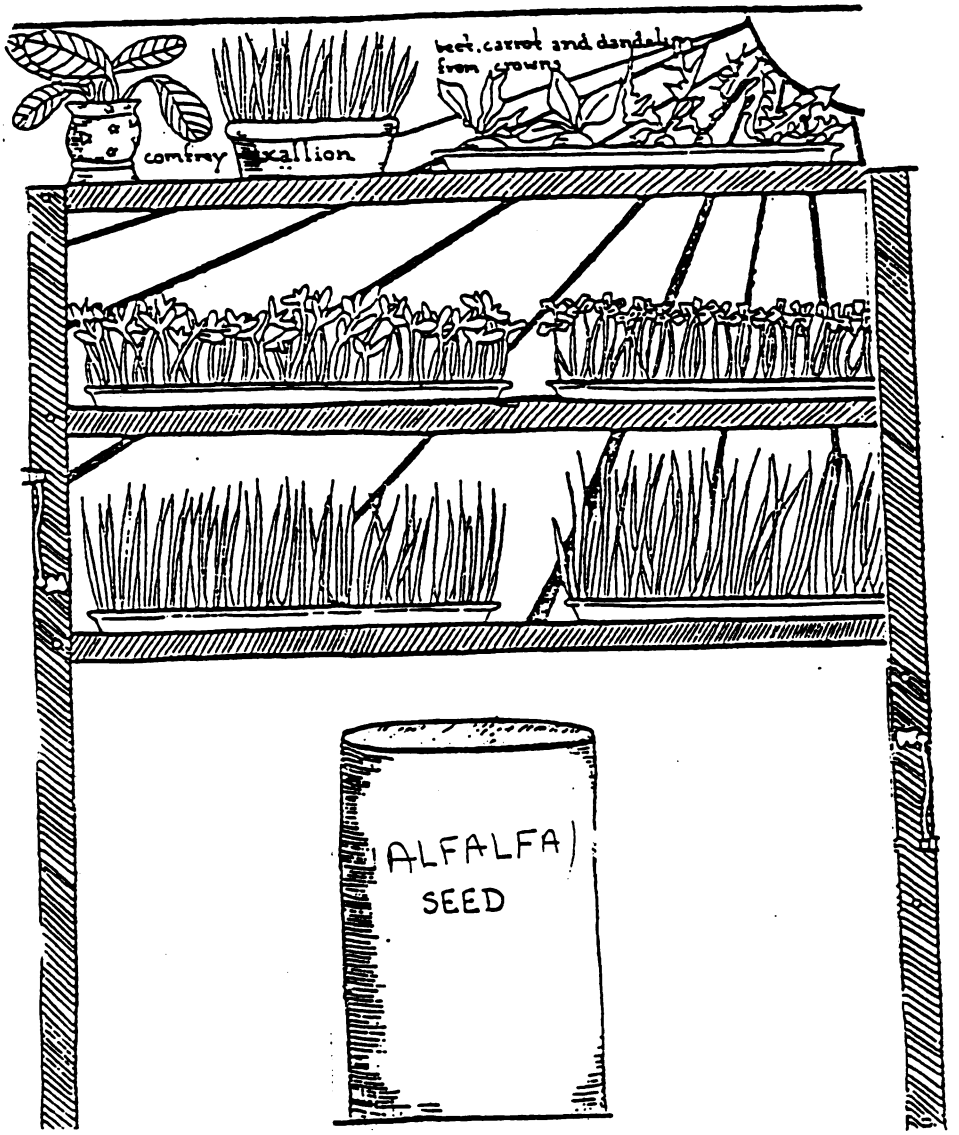

Table 7. Phase 1: Responses of restaurant managers[a] serving and not serving alfalfa sprouts on their current menu.

Question		Number of responses from managers serving (not) serving alfalfa sprouts[b]
1.	Type of service	64 (50) Table Service 11 (4) Self Service 0 (7) Take Out 25 (39) Other
2.	Meals served	0 (0) Breakfast 6 (3) Lunch 0 (2) Dinner 94 (95) combination of two or more of above
3.	Cost of average meal	$4.50 ($5.00)
4.	Customer count	300 (300) people
5.	Sprout use?	100 (0) Yes 0 (100) No
6.	What type?	100 Alfalfa sprouts
7.	Uses for sprouts	75 Salad bar 25 Sandwiches
8.	Serving size	36 Varied 36 1 oz. 28 No answer
9.	Servings sold per day	
10.	Weekly Purchases	11 2lb 25 7lb 8 10lb 28 No answer
11.	Source of sprouts	47 Produce Broker 22 Food Distributor 31 No answer
12.	Deliveries per week	17 One 14 Two 8 Three 19 On demand 28 No answer
13.	Satisfied with quality	100 Yes 0 No
14.	Alfalfa sprout incorporation	28 (14) Yes 72 (86) No
15.	On-site production	6 (3) Yes 94 (97) No

[a] N = 36 (85).

[b] Responses in % unless otherwise indicated.

[c] Questions 7-15 only related to restaurants serving alfalfa sprouts.

Table 8. Phase 1: Responses of institutional managers[a] serving and not serving alfalfa sprouts on their current menu.

Question		Number of responses from managers serving (not) serving alfalfa sprouts[b]
1.	Type of menu	43 (100) Cycle menu 29 Selective Cycle 29 Week to week basis
2.	Average number of beds	90 (100)
3.	Average number of meals served	300 (330)
4.	Serve alfalfa sprouts	100 (0) Yes 0 (100) No
5.	What type?	43 Alfalfa sprouts 57 Mung bean sprouts
6.	Where used?	100 Salad bar
7.	Portion size	100 Varies
8.	Portion served daily	30 Servings
9.	Pounds purchased weekly	33 .25lb 33 14lb 33 None[c]
10.	Purchased from	100 Produce broker
11.	Deliveries per week	100 Any day desired
12.	Satisfied with quality	100 Yes 0 No
13.	Interested in incorporation	43 (58) Yes 57 (42) No
14.	On-site production	28 (8) Yes 72 (92) No

[a] N = 7 (12).

[b] Responses in % unless otherwise indicated.

[c] Questions 5-12 only related to institutions serving alfalfa sprouts.

[d] One site produced alfalfa sprouts on-site at time of study.

Table 9. Phase 2: Ascorbic acid values of alfalfa sprouts during four replications of the nine day assay.

Replication	Day								
	1	2	3	4	5	6	7	8	9
1	13.92	L.A.[a]	12.49	12.33	12.17	10.12	9.96	11.39	10.44
2	14.07	L.A.	12.02	12.65	11.86	11.07	9.94	11.07	9.65
3	15.18	14.71	13.92	12.54	13.13	13.76	12.81	11.23	11.39
4	17.08	15.02	12.97	12.44	11.70	13.13	11.39	10.44	11.70

[a] L.A. indicated laboratory accident.

Table 10. Phase 3: Alfalfa sprout yield from four alfalfa sprout production methods when 50 grams of seeds were used.

Replication	Methods			
	Glass Container	Tray with Cheese Cloth	Tray with Paper Towel	Paper Towel on Bottom
	----------grams of sprouts----------			
1	240	213	224	217
2	245	214	220	220
3	248	217	219	219
4	235	220	225	212