ACCEPTABILITY OF POTATOES GROWN IN WEST TEXAS

by

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CHAPTER I

INTRODUCTION

Purpose and Scope

The potato is the world's most important vegetable (Lowenburg et al., 1974) and is the major vegetable crop in the United States (Smith, 1968). The potato originated in South America. Possibly 2,000 years before the Spanish conquest South Americans cultivated the potato. The potato was probably introduced into Spain from Peru early in the sixteenth century. It was introduced into Ireland about 1586 and was cultivated as a field crop before 1663. Gaspard Bauhin gave the potato its botanical name, Solanum tuberosum. In 1719 the potato was brought from Ireland to the United States (Smith, 1968).

The acceptability of potatoes is affected by the variety, cultural and environmental conditions during the growing season, storage conditions, and processing methods. Information regarding the acceptability of potato varieties would be useful in selection of variety, planning production, marketing, and in meeting consumer preferences. Specific gravity determination has been shown to be the objective measurement most closely related to potato eating quality (Smith, 1968).

The West Texas potato crop is classified as an early summer crop and accounts for about 20% of the U.S. early summer acreage harvested. West Texas potatoes are largely used for fresh market consumption and usually are not stored for extended periods of time (Graves and Smith, 1974).

The purposes of this research were: 1) to determine how consumers in West Texas prepare fresh potatoes, 2) to determine the acceptability of two varieties of potatoes commonly grown in West Texas and cooked by two methods, 3) to determine the specific gravity of the potatoes and the relationship of specific gravity to acceptability of the potatoes, and 4) to determine the effect of storage time on the acceptability of the potatoes. A survey of the literature revealed very little information concerning the two potato varieties used in this study and no published studies concerning acceptability of West Texas grown potatoes or of these two potato varieties.

Review of Previous Research

Culinary Quality of Potatoes

Factors which affect the culinary quality of potatoes are varieties, cultural and environmental conditions during the growing season, storage conditions, and methods and techniques of processing. The quality-determining factors of potatoes are texture, color, and flavor and odor (Smith, 1968). Texture has been the subject of much of the research concerning acceptability of potatoes. Very mealy potatoes are preferred for baking. Potatoes that hold their shape well and do not slough (or fall apart) are preferred for boiling (Cecil et al., 1959). Factors related to mealiness are generally divided into two groups: those of a physical nature and those of a chemical nature (Barrios et al., 1961; Barrios et al., 1963).

Specific gravity or dry matter content of the raw potatoes is highly correlated to texture of cooked or porcessed potatoes (Smith, 1968). A mealy texture is associated with high solids and starch content. Determination of specific gravity by the potato hydrometer

is an inexpensive, rapid, and accurate method of determining the texture of potatoes before they are cooked or processed and predicts mealiness of boiled or baked potatoes as well as yields of dehydrated products and of potato chips.

In a study involving ten varieties of potatoes, Bettelheim and Sterling (1955) found a highly significant correlation between specific gravity and texture as assessed by a sensory panel. Cecil et al. (1959) conducted a study to determine consumer response to cooking qualities of Russet Burbank potatoes of high and low specific gravity. Specific gravity had a highly significant effect on mealiness and sloughing scores by both consumer and laboratory panels. Potatoes of high specific gravity were more mealy, while potatoes of low specific gravity sloughed less when boiled.

Although Smith (1968) reported that dry matter content as determined by specific gravity measurements is commonly used by processors as an indication of quality, or mealiness, some studies have pointed out discrepancies in this relationship (Greenwood et al., 1952; Schark et al., 1956). Greenwood et al. (1952) concluded that specific gravity alone cannot be used as a measure of mealiness. This study reported a close association of specific gravity and mealiness in six varieties of potatoes grown on one farm and little association in the same varieties grown at a different location. Schark et al. (1956) studied the relationship of specific gravity and mealiness in seven varieties of potatoes. They reported variations in mealiness scores of potatoes of identical specific gravity but of different varieties.

Smith (1968) suggested that some of the exceptions to correlations between specific gravity and mealiness may be due to the

subjective nature of sensory panel evaluation. He stated that dry matter, alcohol insoluble solids, starch content, and specific gravity are all equally good indicators of cooking quality and that use of more than one factor increases the accuracy of predictions only slightly. Specific gravity is most frequently used because it is most easily determined.

Porter et al. (1964) found a direct relationship between specific gravity and total solids. It was suggested that the differences in solids for the same specific gravity may be due to a volume or structure factor such as tissue air space.

Bettelheim and Sterling (1955) emphasized that starch content is the major determinant of potato texture. They found the correlation between starch content and texture to be highly significant. They did not find, however, any relationship between the chemical nature of the starch and the texture.

Studies concerning the relationship of starch grain size to mealiness have produced conflicting results. Unrau and Nylund (1957) did not find starch size to be correlated with mealiness. Barrios et al. (1963), however, found a significant relationship between cell size and specific gravity and between cell size and mealiness scores. Taste panelists scored potatoes of varieties containing the largest cells highest in mealiness. Potatoes of larger cell size and starch content were also highly correlated. The grain size of tubers was found to be influenced by variety and environment.

Although certain varieties of fresh potatoes are more suitable for specific methods of preparation than others, consumers sometimes prefer to purchase one all-purpose potato (Foytik and Hertzendorf,

1971). Consumers to whom variety mattered preferred russet and long white potatoes, especially for baking, mashing, and frying. Round white and red potatoes were the preference of 36% of the consumers for boiling and 25% for potato salad (Foytik and Hertzendorf, 1971).

High quality baked potatoes are described as dry and mealy, a creamy-white color, and having a distinctive mild potato flavor. Sub-standard quality potatoes are described as soggy and moist, a gray or yellow color, and having a strong or sweet flavor (Cunningham and Zaehring, 1972). Consumer panels preferred mealy potatoes for baking and potatoes that did not slough for boiling purposes (Cecil et al., 1969). For potatoes to be mashed, moderate sloughing was acceptable. Homemakers and processors prefer a mealy potato for baking, frying, dehydrating and for chip manufacture. Less mealy potatoes are frequently used for boiling and for salad purposes (Barrios et al., 1961; Talburt and Smith, 1975).

Mature potatoes are higher in dry matter content and more mealy than immature potatoes of the same variety. The tendency for potatoes to slough during cooking increases with the length of the growing season or increasing stages of maturity. Increases in disintegration of the cooked potato are high early in the season but increase at a slower rate later in the season (Smith, 1968).

Consumer Surveys

A consumer survey conducted in California in 1968 (Foytik and Hertzendorf, 1971) indicated that two-thirds of the sample households served baked and mashed potatoes more frequently than any other style of potato. Baked potatoes were preferred slightly. Boiling was the preferred method of preparation of 13% of the households and

French frying was preferred by 7%. These findings contrasted those of earlier studies. A nationwide survey of 1948 (Stevenson, 1948) noted preparation methods in order of preference to be mashing, boiling, frying, baking, and creaming.

In the California survey consumers were asked what factor was most important to them in selecting fresh potatoes. Forty-three per cent replied they wanted potatoes that were free from defects. Eighteen per cent indicated price was the most important factor, 11% intended use, 8% cleanliness, and 7% packaging.

Norgold Russet Potatoes

The Norgold Russet is a relatively new potato variety released in 1964 by the North Dakota Agricultural Experiment Station and the North Dakota Seed Department (Johansen, 1965). Norgold Russet potatoes are early maturing, oblong to long, and heavily netted with uniform russeting. Eyes are shallow and very well distributed. The flesh is very white. The foliage is compact and medium in size. This variety is susceptible to late blight, verticillium wilt, and to most common potato viruses. These tubers are highly resistant to common scab and are not susceptible to growth cracking or second growth. Hollow heart may occur when adequate moisture is not provided.

Field trials showed the Norgold Russet to be well adapted to the midwest regions of the United States and Canada. Yield trials conducted in the midwest found the variety to compare favorably in yield to Irish Cobbler and superior to Early Gem and Russet Burbank. Dry matter as indicated by testing in North Dakota averaged 21.5% (Johansen, 1965).

Culinary qualities of Norgold Russet potatoes are excellent for baking and boiling. The cooked product is white and mealy and does not slough or show after-cooking darkening when boiled. Preliminary tests proved this variety to be suited for dehydration and French frying but not suitable for chipping.

Viking Potatoes

The Viking potato also is a relatively new potato variety released in 1963 by the North Dakota Agricultural Experiment Station (Johansen et al., 1964). Viking potatoes have mid-season maturity, are oblong round in shape, and have a smooth medium red to bright red skin color. Eyes are shallow and well-distributed. Flesh is very white. Because this variety may have a tendency to produce jumbo or oversize tubers under some conditions, special cultural treatment such as spacing, dates of planting and harvest, and timing of killing vines is required. This variety is drought resistant and has a tolerance to adverse weather conditions.

Field trials indicated Viking yields are high and are comparable to Red Pontiac and Red LaSoda and higher than Norland. Total solids usually average 20% or higher.

Good culinary qualities are reported to be one of Viking's outstanding characteristics. This variety is excellent for boiling and, when grown in the midwest as a late fall potato, is a good baker. Viking potatoes, however, are not satisfactory for chipping.

CHAPTER II

METHODS AND PROCEDURES

Supermarket Survey

A search of the literature revealed only one survey on homemakers' preferences of preparation methods for fresh potatoes conducted within the last twenty years. The survey was conducted in California in 1968 (Foytik and Hertzendorf, 1971). In order to determine which methods to use to prepare potatoes to assess acceptability of potatoes grown in West Texas, it was decided to determine how West Texans usually prepare fresh potatoes.

A survey was conducted at two supermarkets in Lubbock, Texas, on May 26 and June 2, 1976. Fifty shoppers were surveyed in each of the two supermarkets. Two types of potatoes were available at both stores: 1) russet baking potatoes available in 5 pound and 10 pound bags and sold individually per pound, and 2) new potatoes sold individually per pound. Shoppers were observed discretely. When a shopper had selected potatoes and placed them in the shopping cart, the observer recorded which type and quantity of potatoes were selected. The observer then approached the shopper and asked how frequently the shopper prepared potatoes by four methods of preparation: 1) baking, 2) boiling, 3) frying, and 4) mashing. A sample of the data form used for this survey is included in Appendix A.

Sensory Panel Selection and Training

To establish the intensity of sensory characteristics and the overall quality of the potatoes (Amerine et al., 1965) a ten member sensory panel was used. Nine judges were females and one was a male.

Seven of the judges were 20 to 29 years of age, and three were 30 to 50 years old. All judges were students, faculty, or staff of Texas Tech University. The judges were selected and were trained the day before the study began and were used throughout the entire study.

Principles and procedures for sensory evaluation of food as recommended by Amerine et al. (1965) were used in selecting and training judges and in sensory panel testing.

Judges were first given a card thanking them for serving on the sensory panel and listing dates the testing would be conducted (Appendix B). Judges were then given a form telling them that they would be given six plates of samples and six scorecards that day (Appendix C).

Potatoes used for panel selection and training were of the russet baking and new types purchased at a local supermarket and were prepared by baking and boiling. A triangle test was used to determine that judges could distinguish between new and baking types of potatoes prepared by the two methods of preparation to be used in the study. Judges were given the first plate with three samples--two slices of the baking type baked and one slice of the new type baked. With the plate they were given a form instructing them to sample these and explaining which potatoes were the same type and which was different (Appendix D). The second plate the judges were given contained the same samples. The judges were required to fill out a second form (Appendix E) indicating which sample was different. Then the judges were given the third plate with three samples. These were two slices of baking potatoes boiled and one slice of new potato boiled. Again judges were given a form (Appendix D) explaining the difference in

samples. The fourth plate contained the same samples as the third. Judges were instructed to fill out the fourth form (Appendix E) indicating which sample was different. With all triangle tests, samples were served in a circular arrangement to avoid a bias toward the middle sample (Amerine et al., 1965).

To train the judges the following procedure was used. The fifth plate given the judges contained two samples--one slice of each type baked. Plate six contained two samples also--one slice of each type boiled. With plates five and six, judges were given the scorecard used in all future testing sessions and asked to judge the potatoes on color, texture, flavor, and overall acceptability on a rating scale of 1 to 7. A sample of the scorecard is included in Appendix F.

Specific Gravity and Acceptability Testing

West Texas grown potatoes were obtained from a packing shed in Hereford, Texas. For the study 99 Viking and 99 Norgold Russet potatoes were used. Potatoes of each variety were divided into three lots of 33 potatoes each. The potatoes were washed, dried, and numbered. Each potato was weighed in air and in distilled water on a Mettler top loading scale P 1000 weighing to .01g. The specific gravity was calculated using the formula
$$\frac{\text{weight in air}}{\text{weight in air minus weight in water}}$$
 (Talburt and Smith, 1975).

For the first test session lot 1 of each variety was used. Lots 2 and 3 were stored at conditions similar to those in the home (in plastic bags with holes, at room temperature of approximately 80° F., and with no unnecessary exposure to light). The second test session was conducted after 28 days storage using the potatoes from lots 2. Potatoes from lots 2 and lots 3 were weighed again in air and water,

and specific gravity was calculated. The final test session was conducted after 56 days of storage using potatoes from lots 3. These potatoes were also weighed in air and water, and specific gravity was calculated.

For each of the three sensory panel sessions each variety was prepared by baking and boiling. Sixteen of the experimental potatoes were used from each lot. These were selected by choosing potatoes from the middle weight range and then pairing these in twos by closest specific gravity differing no more than .003. Judging of each of the groups was replicated four times during each session. Each session was conducted over two consecutive days with two replications each day.

Thirty-three control potatoes of each type (russet baking and new) were purchased from a local supermarket the first day of each session. These were selected and paired in the same manner as the experimental potatoes. Eight supermarket control potatoes of each type were used for each session.

Potatoes that were baked were placed on a rack in a home-type oven preheated to 425^o F. After baking approximately 30 minutes a thermometer was inserted lengthwise to the midpoint of the largest potato in the baking lot. Potatoes were considered to be done when the internal temperature reached 208^o F. (after cooking approximately 45 minutes.) They were then removed from the oven, and each potato was cut into five lengthwise slices. Each judge received one slice. Potatoes were served warm without salt or other seasoning.

Potatoes that were boiled were peeled and weighed. Each potato was then cut into five lengthwise slices. Each pair of potatoes was

placed in a saucepan and covered with an amount of distilled water equal to the weight of the two potatoes. The potatoes were brought to boiling, covered, and simmered (or gently boiled) over medium heat until tender when pierced with a fork (approximately 20 minutes). They were then poured over a screen placed in a strainer and weighed again for cooked potato weight. These were also served warm without salt or other seasoning.

Paper plates were used and divided into sections. Samples were coded with a black felt tip pen. Three digits from a random table of numbers were used for coding as recommended by Amerine et al. (1965). Testing was conducted in midmorning as this may be the best time to avoid warmup and fatigue effect. Environmental conditions were controlled. Judges rinsed their mouths with water between samples to reduce variability of scores, as recommended by Amerine et al. (1965).

The sensory panel testing began on the day following panel training. Each judge sampled and judged six plates of two samples each. Standards, or controls, are important in many sensory tests (Amerine et al., 1965). Control potatoes were the two types of potatoes purchased at a local supermarket and prepared by the two methods used in the study, baking and boiling. Samples on the first two plates were the supermarket control potatoes. This was done to counteract any warmup effect (Amerine et al., 1965). Plates three (Norgold Russet and Viking baked) and four (Norgold Russet and Viking boiled) were the first replicate, and plates five and six the second replicate. The following day each judge again sampled and judged six plates of two samples each. The first two plates were supermarket control potatoes. plates three and four were the third replicate. Plates five and six

were the fourth replicate. The same procedure was followed for the two days of testing with potatoes from lots 2 (stored 28 days) and the testing of potatoes from lots 3 (stored 56 days). Amerine et al. (1965) recommended using 3 to 10 trained or 8 to 25 semi-trained panelists and three or four replications per panelist per treatment. These recommendations were fulfilled because 10 trained panelists were used and four replications per panelist per treatment were used.

Statistical Methods

The data were analyzed by the method of least squares analysis of variance for unequal subclass members (Harvey, 1960). The statistical design was factorial: 2 sources X 2 varieties X 2 cooking methods X 3 storage periods X 2 days in a sensory panel session X 10 judges. For the data other than acceptability scores (i.e., weights and specific gravities) judge was not a factor.

CHAPTER III

RESULTS AND DISCUSSION

Supermarket Survey

Thirty-three percent of the shoppers purchased russet potatoes sold loose, 30% of the shoppers purchased russet potatoes in 10 pound bags, 26% purchased russet potatoes in 5 pound bags, and 11% purchased potatoes of the new type sold loose.

Results of the supermarket survey of 100 shoppers regarding method of preparing fresh potatoes are tabulated in Table 1. Baking was the most popular method of preparation. Most (53%) of the shoppers responded that they usually bake fresh potatoes. Thirty-six percent said they occasionally bake fresh potatoes while only 11% responded that they seldom or never bake them. Some shoppers commented that they bake potatoes more frequently now that they own microwave ovens and therefore can bake potatoes in a short time. The next most popular method of preparation was mashing potatoes. Twenty-seven percent usually use this method, 46% occasionally do, and 27% seldom or never do. Boiling and frying potatoes each were reportedly the usual methods of preparing fresh potatoes for 12% of the shoppers surveyed. Potatoes are occasionally boiled by 41% and seldom or never boiled by 47%. Fried potatoes are occasionally prepared by 36% and seldom or never prepared by 52% of the shoppers. Some shoppers commented that when they fry French fries they use frozen French fries rather than fresh potatoes.

Table 1 - Number of 100 shoppers who use each frequency for each method of preparation for fresh potatoes

Method of preparation	Frequency		
	Usually	Occasionally	Seldom or never
Baked	53	36	11
Boiled	12	41	47
Fried	12	36	52
Mashed	27	46	27
Other		1	

In conclusion, more shoppers purchased russet type potatoes sold individually followed in order by russets sold in 10 pound bags, in 5 pound bags, and new potatoes sold individually. The most popular method of preparing fresh potatoes was baking followed in order by mashing, boiling, and frying. Thus the first purpose of this research, to determine how West Texans prepare fresh potatoes, was accomplished.

Acceptability and Specific Gravity Testing

After 56 days of storage not enough Norgold Russet potatoes remained to do the planned number of replications; therefore, no statistical analysis was available for this storage period. One judge was unable to attend the second sensory panel session; therefore, all data for this judge were omitted in the statistical analysis.

Tables 2 and 3 list the results of least squares analysis of variance for color, texture, flavor, and overall acceptability scores. Table 2 indicates source (control or experimental) was significant for color ($P < 0.01$). Potato variety was significant for color, texture, and overall acceptability ($P < 0.01$) and for flavor ($P < 0.05$). Cooking Method was significant for color and texture ($P < 0.01$).

Storage period was significant for color and overall acceptability ($P \leq 0.01$) and for flavor ($P \leq 0.05$). Day had no significant effect on potato acceptability. Judge was significant for all four variables in potato acceptability ($P \leq 0.01$).

Means for color, texture, flavor, and overall acceptability scores are listed in Table 3. The sensory panel score for color of the experimental potatoes was significantly higher than that of the control potatoes. There were no significant differences between scores of control and experimental potatoes for texture, flavor, and overall acceptability. Therefore, the conclusion was that the experimental potatoes were as acceptable as similar types of potatoes available in the local supermarket. Means for color, texture, flavor, and overall acceptability for supermarket baking and Norgold Russet potatoes were significantly higher than those for supermarket new and Viking potatoes. Therefore, baking and Norgold Russet potatoes were more acceptable than new and Viking potatoes. Boiled potatoes had better color, baked potatoes had better texture, and there was no significant difference in flavor and overall acceptability of potatoes baked and boiled. Means for color, flavor, and overall acceptability of potatoes from storage period 1 were significantly higher than those from storage period 2. However, texture means did not differ significantly for the two storage periods.

The second purpose of this research, to determine the acceptability of two varieties of potatoes commonly grown in West Texas and cooked by two methods, was accomplished. The fourth purpose of this research, to determine the effect of storage time on the acceptability of potatoes, was accomplished.

Table 2 - Mean squares for the effect of source, variety, cooking method, storage period, day, and judge on acceptability scores of potatoes

Source of variation	df	Acceptability scores			Overall acceptability
		Color	Texture	Flavor	
Source	1	55.51**	3.01	2.67	0.12
Variety	1	71.76**	13.25**	8.17*	17.80**
Cooking method	1	30.00**	27.81**	2.89	0.37
Storage period	1	13.25**	5.51	12.04*	14.00**
Day	1	3.01	0.51	6.00	1.50
Judge	8	22.48**	9.24**	16.93**	31.98**
Source X Variety	1	0.97	139.36**	7.41	14.52**
Source X Cooking method	1	0.97	0.51	0.00	0.37
Source X Storage period	1	49.59**	2.14	1.34	0.00
Source X Day	1	3.50	0.01	0.02	0.67
Source X Judge	8	3.53**	5.33**	8.91**	8.13**
Variety X Cooking method	1	0.03	4.28	0.00	0.19
Variety X Storage period	1	2.37	0.00	0.02	0.28
Variety X Day	1	0.15	2.84	0.19	0.11
Variety X Judge	8	2.09*	2.50	2.60	4.17**
Cooking method X Storage period	1	8.90**	2.22	14.45**	13.72**
Cooking method X Day	1	2.68	0.58	1.02	0.52
Cooking method X Judge	8	1.88*	10.12**	8.64**	9.74**
Storage period X Day	1	0.75	1.45	0.84	1.69
Storage period X Judge	8	7.47**	3.58*	3.64	1.30
Day X Judge	8	0.88	3.44*	2.62	2.48
Remainder	368	0.94	1.54	2.01	1.44

*p<0.05.

**p<0.01.

Table 3 - Least squares means for acceptability scores of potatoes by source, variety, cooking method, and storage period

Source of variation	Acceptability scores			
	Color	Texture	Flavor	Overall acceptability
Source				
Control	4.65 ^a	3.86	4.60	4.72
Experimental	5.41 ^b	3.68	4.77	4.75
Variety				
Baking and Norgold Russet	5.46 ^a	3.96 ^a	4.83 ^a	4.95 ^a
New and Viking	4.59 ^b	3.59 ^b	4.54 ^b	4.52 ^b
Cooking method				
Baked	4.75 ^a	4.04 ^a	4.60	4.76
Boiled	5.31 ^b	3.50 ^b	4.77	4.70
Storage Period				
1	5.21 ^a	3.89	4.86 ^a	4.92 ^a
2	4.84 ^b	3.65	4.51 ^b	4.54 ^b
Overall	5.15	3.74	4.72	4.74

a,bMeans in the same column in the same pair with different superscripts differ significantly (P<0.05).

Results concerning the weight and specific gravity of the cooked potatoes are shown in Tables 4 and 5. Table 4 shows that in the least squares analysis of variance source was significant for initial specific gravity and specific gravity on day of cooking ($P \leq 0.01$). Variety and cooking method had no significant effect. Storage period was significant for initial weight, initial specific gravity, and weight and specific gravity on day of cooking ($P \leq 0.01$). Day was significant for initial specific gravity ($P \leq 0.05$) and for specific gravity on day of cooking ($P \leq 0.01$). Table 5 lists least squares means. Means of the initial specific gravity and specific gravity on day of cooking were significantly higher for control potatoes than for experimental potatoes. Initial weight and weight on day of cooking and initial specific gravity and specific gravity on day of cooking were significantly higher for potatoes of storage period 1 than storage period 2. Initial specific gravity and specific gravity on day of cooking were significantly higher on day 2 than day 1.

Table 6 lists simple correlation coefficients among weight, specific gravity and acceptability scores for potatoes. These correlation coefficients were obtained from the same least squares analysis of variance used for Tables 4 and 5. Significant ($P \leq 0.05$) positive relationships were found between the following: initial weight and initial specific gravity, weight on day of cooking, and specific gravity on day of cooking; initial specific gravity and specific gravity on day of cooking; weight on day of cooking and specific gravity on day of cooking; specific gravity on day of cooking and texture; color and texture, flavor, and overall acceptability; texture and flavor and overall acceptability; and flavor and overall acceptability. Table 6 indicates

the relationship of specific gravity to acceptability. The only significant correlation found for specific gravity and acceptability scores was between specific gravity on the day of cooking and texture.

Results shown in Tables 4, 5, and 6 accomplished the third purpose of this study, to determine the specific gravity of the cooked potatoes and the relationship of specific gravity to acceptability of potatoes.

Table 4 - Mean squares for the effect of source, variety, cooking method, storage period, and day on weight and specific gravity of potatoes

Source of variation	df	Initial weight	Initial specific gravity	Weight on day of cooking	Specific gravity on day of cooking
Source	1	3832.32	0.00**	6813.47	0.00**
Variety	1	2975.38	0.00	3174.61	0.00
Cooking method	1	6645.52	0.00	6756.63	0.00
Storage period	1	24387.88**	0.00**	31259.71**	0.00**
Day		931.57	0.00*	867.96	0.00**
Source X Variety	1	34534.13**	0.00**	33958.07**	0.00**
Source X Cooking method	1	2742.31	0.00	2813.85	0.00
Source X Storage period	1	2018.96	0.00**	590.24	0.00*
Source X Day	1	90.58	0.00	71.52	0.00
Variety X Cooking method	1	668.57	0.00	648.20	0.00
Variety X Storage period	1	17225.55**	0.00*	16652.61**	0.00*
Variety X Day	1	8.62	0.00	15.52	0.00
Cooking method X Storage period	1	322.09	0.00	288.56	0.00
Cooking method X Day	1	5789.97	0.00	5266.20	0.00
Storage period X Day	1	1736.41	0.00*	1613.68	0.00*
Remainder	32	1798.02	0.00	1803.20	0.00

*P<0.05.

**P<0.01.

Table 5 - Least squares means for weight and specific gravity of potatoes by source, variety, cooking method, storage, and day

Source of variation	Initial weight	Initial specific gravity	Weight on day of cooking	Specific gravity on day of cooking
Source				
Control	315.56	1.069 ^a	315.56	1.069 ^a
Experimental	296.61	1.059 ^b	290.29	1.058 ^b
Variety				
Baking and Norgold Russet	297.73	1.065	294.34	1.064
New and Viking	314.44	1.063	311.51	1.063
Cooking method				
Baked	293.60	1.063	290.34	1.063
Boiled	318.56	1.065	315.51	1.064
Storage period				
1	329.99 ^a	1.067 ^a	329.99 ^a	1.067 ^a
2	282.18 ^b	1.062 ^b	279.86 ^b	1.060 ^b
Day				
1	301.41	1.062 ^a	298.41	1.062 ^a
2	310.76	1.066 ^b	307.44	1.065 ^b
Overall	302.93	1.063	298.71	1.062

a,b Means in the same column in the same pair with different superscripts differ significantly ($p < 0.05$).

Table 6 - Simple correlation coefficients among weight, specific gravity, and acceptability scores of potatoes

Variable	Initial weight	Initial specific gravity	Weight on day of cooking	Specific gravity on day of cooking	Color	Texture	Flavor	Overall acceptability
Initial weight	1.00							
Initial specific gravity	0.58**	1.00						
Weight on day of cooking	0.99**	0.59**	1.00					
Specific gravity on day of cooking	0.56**	0.99**	0.58**	1.00				
Color	0.21	0.13	0.22	0.14	1.00			
Texture	0.21	0.33	0.20	0.35*	0.35*	1.00		
Flavor	-0.11	0.19	-0.10	0.22	0.66**	0.36*	1.00	
Overall acceptability	0.06	0.29	0.06	0.32	0.72**	0.62**	0.80**	1.00

*P<0.05.

**P<0.01.

Because peel loss and yield of potatoes is of economical importance to the consumer (King et al., 1962), peeled and cooked weights of the boiled potatoes were determined. Tables 7 and 8 indicate the results of least squares analysis of variance for peeled and cooked weights of boiled potatoes. Table 7 shows storage period was significant for peeled weight ($P \leq 0.05$) and cooked weight ($P \leq 0.01$). Source and variety had no significant effect on peeled or cooked weight. Table 8 shows that peeled weight and cooked weight were greater for potatoes in storage period 1 (stored 0 days) than those in storage period 2 (stored 28 days). Tables 4 and 5 indicate, however, that potatoes put into lot 1 initially weighed significantly more than potatoes put into lot 2 and stored for 28 days.

Table 7 - Mean squares for the effect of source, variety, storage period, and day on peeled weight and cooked weight of boiled potatoes

Source of variation	df	Peeled weight	Cooked weight
Source	1	64.57	15.22
Variety	1	595.51	574.15
Storage period	1	12513.34*	15097.10**
Day	1	977.68	326.41
Source X Variety period	1	9401.56*	11144.40**
Source X Storage period	1	40.46	7.32
Source X Day	1	3105.85	3294.94
Variety X Storage period	1	7263.46*	7335.31*
Variety X Day	1	29.66	3.15
Storage period X Day	1	0.23	5.94
Remainder	13	1091.19	1134.02

* $P < 0.05$.

** $P < 0.01$.

Table 8 - Least squares means for peeled weight and cooked weight of boiled potatoes by source, variety, and storage period

Source of variation	Peeled weight (g)	Cooked weight (g)
Source		
Control	258.24	270.74
Experimental	261.72	272.43
Variety		
Baking and Norgold Russet	254.69	266.40
New and Viking	265.26	276.77
Storage Period		
1	284.19 ^a	298.19 ^a
2	235.76 ^b	244.98 ^b
Overall	260.56	271.87

^{a,b}Means in the same column in the same pair with different superscripts differ significantly ($P < 0.05$).

Results shown to this point have been for cooked potatoes. Tables 9 and 10 show data for weights and specific gravities of all 33 potatoes for each experimental variety and storage period. Variety significantly ($P < 0.01$) affected initial weight, initial specific gravity, weight on day of cooking, and specific gravity on day of cooking (Table 9). Means for Norgold Russett potatoes were significantly higher for weight and specific gravity (Table 10). Initial weight and weight on day of cooking were significantly higher for potatoes put into lot 1 and stored 0 days and those put into lot 2 and stored 28 days.

Because initial weights of the potatoes in the two storage period lots were different paired t-tests were used to determine if potatoes lost a significant amount of weight during 28 days storage. The t-tests indicated that Norgold Russet potatoes lost a significant amount of weight with 28 days storage. The calculated t value was 10.49 ($P < 0.01$) for 23 potatoes with 22 degrees of freedom. After 28 days storage 10 of the 33 Norgold Russet potatoes from lot 2 were rotten and were discarded. Viking potatoes also lost a significant amount of weight during 28 days storage. The calculated t value was 15.22 ($P < 0.01$) for 33 potatoes with 32 degrees of freedom.

Table 9 - Mean squares for the effect of variety and storage period on weight and specific gravity of potatoes

Source of variation	df	Initial weight	Initial specific gravity	Weight	Specific gravity
Variety	1	31735.63**	0.00**	23907.01**	0.00**
Storage period	1	22302.54*	0.00	33947.58**	0.00
Variety X Storage period	1	12498.57*	0.00*	8391.64*	0.00*
Remainder	128	2973.51	0.00	2785.41	0.00

*P<0.05.

**P<0.01.

Table 10 - Least squares means for weight and specific gravity of potatoes by variety and storage period

Source of variation	Initial Weight	Initial specific gravity	Weight	Specific gravity
Variety				
Norgold Russet	173.07 ^a	1.064 ^a	167.78 ^a	1.063 ^a
Viking	142.05 ^b	1.056 ^b	139.23 ^b	1.054 ^b
Storage period				
1	170.56 ^a	1.059	170.56 ^a	1.059
2	144.56 ^b	1.060	136.50 ^b	1.058
Overall	157.56	1.060	152.99	1.058

a,b Means in the same column in the same pair with different superscripts differ significantly (P<0.05).

Comparison of Findings with Results of Other Studies

Supermarket Survey

In a survey of consumption patterns for potatoes conducted in California in 1968 (Foytik and Hertzendorf, 1971), homemakers were asked what one form of potatoes they served most frequently. Two-thirds of the consumers surveyed expressed a preference for baked and mashed potatoes. There was a slight preference for baked potatoes. Boiled potatoes were preferred by 13%, French fries by 7%, and other forms by 13%. Results of the survey conducted in this study were somewhat similar. Over half (53%) of the West Texas consumers surveyed responded that they usually baked fresh potatoes, 27% usually mashed them, 12% usually boiled them, and 12% usually fried them.

A 1948 survey of U.S. households (Stevenson, 1948) stated that the most frequently served form of potatoes in order of preference was mashed, boiled, fried, baked, and creamed. Results of the current West Texas survey differ from this earlier study in indicating a greater preference for baked potatoes.

Specific Gravity and Acceptability Testing

In a study designed to evaluate ten potato varieties for boiled texture, Bettelheim and Sterling (1955) found a highly significant correlation between texture and specific gravity as assessed by a sensory panel. In another study to determine consumer response to cooking qualities of potatoes of high and low specific gravity, Cecil et al. (1959) found that specific gravity had a highly significant effect on mealiness scores as determined by consumer and laboratory panels. Smith (1968) also reported that dry matter content as determined by specific gravity measurements is an indication of quality, or mealiness.

Results of this study were similar in that a significant correlation was found between texture as assessed by the sensory panel and specific gravity on the day of cooking, Table 6. There was no significant correlation, however, between specific gravity and overall acceptability of the potatoes.

Other studies have indicated discrepancies in the relationship of specific gravity and texture. Greenwood et al. (1952) found a close association of specific gravity and mealiness in six varieties of potatoes grown on one farm and little association in the same varieties grown at a different location. Nylund and Poivan (1953) found that potatoes of different varieties and potatoes of the same variety but produced under different environmental conditions may vary considerably in mealiness even when specific gravity is identical. Schark et al. (1956) also reported variations in mealiness scores of potatoes of identical specific gravity but of different varieties.

CHAPTER IV

SUMMARY AND CONCLUSIONS

The purposes of this research were: 1) to determine how consumers in West Texas prepare fresh potatoes, 2) to determine the acceptability of two varieties of potatoes commonly grown in West Texas, 3) to determine the specific gravity of the potatoes and the relationship of specific gravity to acceptability of the potatoes, and 4) to determine the effect of storage time on the acceptability of the potatoes.

To determine how West Texans prepare fresh potatoes a survey was conducted at two supermarkets. Fifty shoppers were surveyed in each of the two supermarkets. An observer recorded the type and quantity of potatoes selected by shoppers and then questioned the shoppers as to how frequently they prepared potatoes by four methods of preparation: 1) baking, 2) boiling, 3) frying, and 4) mashing.

To determine acceptability of the potatoes a ten member sensory panel was selected and trained and used throughout the study. West Texas grown potatoes used in the study were obtained from a packing shed in Hereford, Texas. Ninety-nine Viking and 99 Norgold Russet potatoes were used and were divided into three lots of 33 potatoes each. Potatoes were washed, dried, numbered, and specific gravity was determined. For the first test session lot 1 of each variety was used. Lots 2 and 3 were stored at conditions similar to those in the home. After 28 days storage the second test session was conducted using potatoes from lots 2. The third test session was conducted after 58 days of storage using potatoes from lots 3. Specific gravity of the potatoes was determined before each test session.

Potatoes were selected from each lot by pairing potatoes from the middle weight range differing no more than .003 in specific gravity. Control potatoes of each variety purchased at a local supermarket were used for each session and were selected and paired in the same manner as the experimental potatoes. Each variety of potato was prepared by baking and boiling for each sensory panel session. Peeled and cooked weights were determined for boiled potatoes.

Judging of each of the experimental groups was replicated four times during each session. Judges scored the potatoes on color, texture, flavor, and overall acceptability using a rating scale of 1 to 7. Data were analyzed by least squares analysis of variance.

After 56 days of storage not enough Norgold Russet potatoes remained to do the planned number of replications, therefore no statistical analysis was available for this storage period. One judge was unable to attend the second sensory panel session; therefore, all data for this judge were omitted in the statistical analysis.

Results of the supermarket survey indicated that the most frequent method of preparing fresh potatoes in order of preference was baking, mashing, boiling, and frying. More consumers purchased russet type potatoes sold individually followed in order by the russet type sold in 10 pound bags, in 5 pound bags, and potatoes of the new type sold individually.

Results of least squares analysis of variance indicated that there was no significant difference except for color in the acceptability of West Texas grown Norgold Russet and Viking potatoes and similar types of potatoes available in a local supermarket. Source of potatoes (control or experimental) did significantly affect initial

specific gravity and specific gravity on day of cooking. Control potatoes had significantly higher specific gravities than experimental potatoes.

Potato variety was a significant factor in this study. Sensory panelists scored supermarket potatoes of the baking type and Norgold Russet potatoes significantly higher for color, texture, flavor, and overall acceptability than supermarket potatoes of the new type and Viking potatoes. Variety had no significant effect on weights or specific gravities of the samples used for sensory panel testing. Variety did, however, significantly affect weights and specific gravities of all the experimental potatoes included in lots 1 and 2. Norgold Russet potatoes had significantly higher weights and specific gravities than Viking potatoes.

Cooking method significantly affected color and texture but not flavor and overall acceptability scores for potatoes. Baked potatoes received lower color scores and higher texture scores than boiled potatoes.

Storage also was a significant factor in this study. Means for color, flavor, and overall acceptability were significantly higher for potatoes from storage period 1 than those from storage period 2. Potatoes put into lot 1 weighed significantly more and had significantly higher specific gravities than those put into lot 2. Peeled and cooked weights of potatoes were also significantly higher for potatoes from storage period 1 than those from storage period 2. Paired t-tests indicated that Norgold Russet and Viking potatoes lost a significant amount of weight while being stored for 28 days.

Specific gravity on the day of cooking was significantly correlated to texture of potatoes. There was no significant correlation between specific gravity and overall acceptability of the potatoes.

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APPENDIX

- A. Consumer Survey Data Form
- B. Sensory Panel Information Card
- C. Sensory Panel Information Form
- D. Sensory Panel Training Form 1
- E. Sensory Panel Training Form 2
- F. Sensory Panel Scorecard

APPENDIX A: CONSUMER SURVEY DATA FORM

Kind of fresh potatoes bought:

- A. 10 lb. bag (russet)
- B. 5 lb. bag (russet)
- C. Loose "baking" (russet)
- D. Loose "new" (red skin)

How do you prepare fresh potatoes:

	Usually	Ocassionally	Seldom/never
A. Baked			
B. Boiled			
C. Fried			
D. Mashed			
E. Other			

List other method: _____

APPENDIX B: SENSORY PANEL INFORMATION CARD

Thank you for serving on this sensory panel.

Your contribution makes research on food acceptability possible.

Sensory panel schedule

Tuesday, July 13
Wednesday, July 14
Thursday, July 15

Wednesday, August 11
Thursday, August 12

Wednesday, September 8
Thursday, September 9

APPENDIX C: SENSORY PANEL INFORMATION FORM

TODAY

You will be given:

6 plates of samples and

6 scorecards.

APPENDIX D: SENSORY PANEL TRAINING FORM 1

Date _____

Panelist _____

SENSORY PANEL TRAINING SESSION FORM 1

Look at, smell, and taste each of the three samples provided.

Rinse your mouth with water between each sample.

The two samples with the same codes are alike; the other sample is different.

APPENDIX E: SENSORY PANEL TRAINING FORM 2

Date _____

Panelist _____

SENSORY PANEL TRAINING SESSION FORM 2

Look at, smell, and taste each of the three samples provided.

Rinse your mouth with water between each sample.

Write the number of the sample which is different from the other two samples below:

APPENDIX F: SENSORY PANEL SCORECARD

Date _____

Panelist _____

SENSORY PANEL SCORECARD

Score each sample on the form below.
Rinse your mouth with water between each sample.

<u>Color</u>	<u>Texture</u>	<u>Flavor</u>	<u>Overall Acceptability</u>
7-Creamy white	7-Very mealy and dry	7-Mild	7-Like very much
6	6	6	6-Like moderately
5	5	5	5-Like slightly
4	4	4	4-Neither like nor dislike
3	3	3	3-Dislike slightly
2	2	2	2-Dislike moderately
1-Dark (grey or yellow)	1-Very soggy & moist	1-Off flavor (strong or sweet)	1-Dislike very much

Sample	Color	Texture	Flavor	Overall Acceptability