

A PRINTED BROCHURE AS AN EDUCATIONAL  
INTERVENTION IN THE PECAN HANDLING  
PRACTICES OF OKLAHOMA FOOD  
SERVICE OPERATORS

By

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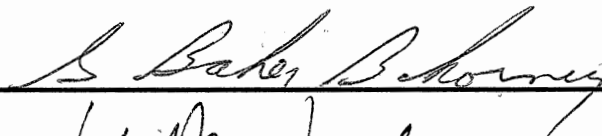
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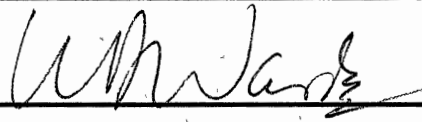
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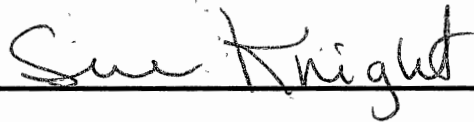
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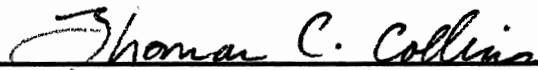


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## CHAPTER I

### INTRODUCTION

Oklahoma possesses all the necessary growth conditions for native, as well as, improved variety pecans: geography, climate, and soil conditions. These ideal conditions have contributed to pecans being the number one horticulture crop in the state (*Attitudes and usage*, 1980) The quality of the nuts after harvest is influenced by many factors such as handling and storage. Under optimum post harvest conditions, high quality pecan food products can be accessible all year to persons outside of the state, as well as Oklahomans.

Pecans are a seasonal food product. The pecans fall from the trees from September to December when the pecan market is most active. Also, the size of the pecan crop tends to fluctuate from year to year. Thus, a large amount of nuts come to market during a short period of time, and unless properly stored, will lose their fresh flavor, color, and aroma.

Pecan nuts, which contain high levels of unsaturated oil, also show high levels of flavor instability, since unsaturated oil is susceptible to rancidity. Unshelled pecans held at 75-80°F will retain their fresh flavor and texture for only about one month; shelled pecans stay fresh an even shorter period of time. Rancidity is accelerated as the storage temperature increases and humidity remains low. At the present time, the most effective way of retarding rancidity is by refrigeration (Woodroof,

1967). Therefore, several million kilograms of shelled and in-shell pecans are usually cold stored to meet market demands throughout the spring, summer, and early fall.

Rancidity is the major cause of flavor deterioration in pecans and is of major interest and concern to the industry. Researchers have attempted to improve the post-harvest quality of pecans and to make recommendations as to the processing, handling, and storage in order to maintain optimum quality and retard rancidity. Despite the storage problems associated with pecans, the quantity and quality of the nut has increased since 1967 when Woodroof (1967) suggested refrigeration as a means of keeping pecans fresh year-around.

Although vast improvements have been made in preserving kernel quality, current estimates are that more than 50% of the pecan kernels in the market are of substandard quality. A study conducted by Waters, Stokes and Knight (1988) indicated that many food service managers were not familiar with proper conditions necessary for pecans. Most participants did not inquire about how the pecans had been stored before delivery, and they did not properly store the pecans after they were received. Pecans can be kept in optimum condition year-around, however, if the public is not aware of these necessary conditions, food service establishments will continue to use low quality pecans.

Although Oklahoma possesses the conditions necessary for ideal pecan growth, problems associated with poor flavor quality continue to keep pecans an underutilized and seasonal food product even in commercial food service. Methods for maintaining quality have been developed, but inferior pecans still reach the consumer. Restaurant and food service patrons often refuse to order items containing pecans out of

season because of poor flavor. The assumption is that many food service professionals are not informed on how to buy and maintain quality in pecans, therefore products including pecans may not reach high standards of quality.

### Statement of the Problem

For reasons unknown to the investigator, the public consumes food products containing bad tasting pecans. Perhaps food service managers are unaware of how to purchase, receive, and store pecans in order to insure that pecans will taste good in the products in which they are used. The specific problem in this study was to determine whether or not an educational intervention, informative brochure, could make a difference in the pecan purchasing, receiving, and storing practices of food service managers. The informative brochure on pecans was the independent variable and the participant's score on the posttest administered after receipt of the educational brochure was the dependent variable.

### Purpose and Objectives

The purpose of this study was to determine whether the pecan purchasing, receiving, and storing practices of food service personnel would improve after receiving an educational brochure.

The specific objective of the study was to assess the pecan purchasing, receiving, and storing practices of food service personnel before and after receiving an educational brochure.

### Statement of the Hypothesis

The following hypothesis was postulated for this research:

There will be no significant difference in the responses of food services personnel on an assessment of knowledge and practice regarding purchasing, receiving, and storing pecans before and after receiving a printed brochure designed as an educational intervention.

### Assumptions

The following assumptions were made for this study:

1. The sample selected for the study was representative of all food service operators in Oklahoma.
2. Those who returned the questionnaire accurately reflected the beliefs and attitudes of those who received the questionnaire.

### Limitations

At the outset of the study the investigator was cognizant of the following limitations:

1. A high turn over rate in food services personnel will affect the number of responses received in the survey.
2. Results obtained from food services operators in Oklahoma may not be generalized to food service operators in other states.
3. Responses on the posttest if different from responses on the pretest construed as differences attributable to the educational intervention alone. Other factors beyond the investigators control may also affect results on the posttest.

## Definition of Terms

*Abscission*: To cut off or depart (*Webster's new universal*, 1983).

*Dehisce*: To split open, as the seed capsules of plants (*Webster's new universal*, 1983).

*Linoleic acid*: An unsaturated fatty acid,  $C_{18}H_{32}O_2$ , a glycerol ester often found in linseed oil (*Webster's new universal*, 1983).

*Monounsaturated fatty acid*: Chains of fatty acids which contain only one double band between the carbon molecules in the chain (Jones, Netterville, Johnson, & Wood, 1980).

*Oleic acid*: An unsaturated fatty acid,  $C_{17}H_{33}COOH$ , a glycerol ester found in most animal and vegetable oils and fats (*Webster's new universal*, 1983).

*Organoleptic*: Capable of receiving a sense impression (*Dorland's illustrated medical dictionary*, 1981).

*Saturated fatty acid*: Chains of fatty acids which do not contain double bonds between the carbon molecules in the chain (Jones, Netterville, Johnson, & Wood, 1980).

*Tannin*: Tannic acid, polyphenolic structures having molecular weight of  $>500$ . All tannates are astringent (*Dorland's illustrated medical dictionary*, 1981; Zapsalis & Beck, 1985).

*Unsaturated fatty acid*: Chains of fatty acid which contains one or more double or triple bonds between the carbon molecules in the chain (Jones et al., 1980).

## CHAPTER II

### REVIEW OF LITERATURE

#### Introduction

Pecans are the most popular of all the nuts and are the number one horticulture crop in the state of Oklahoma (*Attitudes and usage*, 1980). Pecans are highly perishable but if properly stored pecans can be held for long periods of time. However, bad tasting pecans are still used in food products that are marketed to the public. As a highly perishable product, pecans are not always properly handled and stored. In order to make a change in the overall practice of pecan handling, food handlers need to be informed of the storage conditions necessary to keep pecans in optimum condition.

#### Factors Relating to Pecan Quality

The pecan can be traced back to the Cretaceous period, according to paleontological evidence, but only in the last four centuries has this plant become a cultivated crop (Stuckey & Kyle, 1925). The pecan tree is classified as a hickory (*Carya illinoensis*) and is a member of the walnut family (*Juglandaceae*) (Peterson & Johnson, 1978). It is native to the southeast portion of North America, and the trees are common along natural waterways (Woodroof, 1967). In its most favorable environment, the majestic tree can grow to a height of 150 feet with a trunk of six to seven feet in diameter. When grown in the open, the limb spread of

branches can be 120 feet or more, and the shape of the tree is somewhat globular (Woodroof, 1967). The history of the pecan is closely linked with the American Indian (Stuckey & Kyle, 1925; Woodroof, 1967).

There is historical evidence that nuts are the oldest form of food source of man, birds, and wild animals (Woodroof, 1978). DeVaca wrote in 1541 that the pecan nut was the favorite food of the American Indian, and that persists to the present day (Brison, 1974). The pecan is still the preferred nut of all the nuts eaten in America (*Attitudes and usage*, 1980).

Geographically, the native habitat of the pecan tree lies along the southern portion of the United States which includes the state of Oklahoma. Oklahoma and Texas possess the highest number of native trees of all the pecan producing states (Atwood, 1949; Peterson & Johnson, 1978). Availability of ideal conditions leads to pecans being the leading horticulture crop for the state of Oklahoma.

In the last 50 years there has been an phenomenal increase in the number of pecan trees and the quality of pecans produced. Development of improved machinery, fertilizers, pest control methods, and grafting techniques have been instrumental in increasing the quantity and quality of nuts reaching the market place. The United States Department of Agriculture (USDA) has established standards of quality in fresh pecans. These standards are: light color, crispness, and the absence of rancidity and stale taste (Forbus, Senter, Lyons, & Dupuy, 1979).

The pecan market is most active when the pecans fall from the trees from September to December, however, the pecan crop experiences alternate year bearing which produces a large crop one year and a low

crop the next year (Brison, 1974; Sparks, 1976; Stein, 1980) with storage of surplus to even out the supply. However, pecan nuts, which contain high levels of unsaturated oil, show high levels of flavor instability, since the oil is susceptible to rancidity (Senter, Horvat, & Forbus, 1980; Woodroof, 1967). Therefore, pecans must be properly stored under controlled conditions to provide a large supply of good quality nuts to the consumer (Forbus & Senter, 1976; Forbus, Tyson, & Ayres, 1979; Heaton & Woodroof, 1970; Heaton, Worthington, & Shewfelt, 1975; Senter, Horvat, & Forbus, 1980).

In 1980, the National Pecan Marketing Council (NPMC) conducted a national survey of consumers (Attitudes and usage, 1980), commercial users and retailers and found that the pecan was the preferred nut. Pecans have also become the number one horticulture crop in the state of Oklahoma (Attitudes and usage, 1980). Pecans today are known as the "King of Nuts" (Powell, 1979, p. 16), however, instead of the market increasing, it has declined. Poor storage procedures led to this decline (Hubbard, Purcell & Ott, 1987a). Since the special storage conditions necessary to maintain pecan quality are too often not followed, pecans have become a seasonal food product. More is known today about the proper keeping quality of pecans but poor quality pecans still reach the market place. Williams, LaPlant, and Heaton (1973) estimate that more than 50% of the pecan kernels in the market are of substandard quality. This would indicate that proper storage conditions at all stages, from harvest, through wholesale channels, and with the final user are not known, or not followed, since such a large percentage of inferior pecans reach the market.



### Nutritive Composition of Pecans

Pecans are a nutritious food source (Considine & Considine, 1982); like olive oil, they are high in monounsaturated fat, the type of fat that many health authorities recommend for inclusion in the daily diet (Watt & Merrill, 1963). The amount of oil in pecans varies more than any other component, from less than 60% to slightly more than 70% (Brison, 1974). Pecans contain approximately 14% carbohydrate and 9% protein and approximately 3% water (Woodroof, 1978). They contain substantial amounts of the minerals phosphorus and potassium; moderate levels of magnesium; and a limited supply of iron, sodium, and calcium (Woodroof, 1978). A complete analysis of the composition of pecans may be found in Table I.

### Pecan Oil and Rancidity

Little research was done on pecans before the twentieth century. In 1910, Deiler and Frads reported that there was 70.4% oil in pecan kernels. Pyriadi (1968) cited, that in 1926 George and Gertler analyzed pecan oil but found only oleic and linoleic fatty acids.

Since the development of gas chromatography and ultraviolet spectrophotometry, more is known about the composition of pecans and pecan oil. More fatty acids were identified in pecan oil in the 1960's (French, 1962; Senter and Horvat, 1976; Woodroof, 1967), and the fatty acid content was further updated in the 1970's (see Table II).

Oleic (18:1) and linoleic (18:2) acid are the two principal oils, usually comprising about 95% more of the total oil. The low percentage of either oil is invariably accompanied by a high percentage of the other oil (Odell, 1971). The amount of linoleic acid varies in different varieties,

as well as, year to year in the same varieties (Brison, 1974). It is also reported that this same linoleic acid is responsible for oxidation, and eventually rancidity, of pecan kernels.

TABLE I  
COMPOSITION OF PECAN MEATS

<b>Proximate Analysis</b>	<b>g/100g</b>
Fat	71.2
Saturated - 3.5%	
Unsaturated - 93-95%	
Carbohydrate	14.6
Protein	9.2
Moisture	3.4
Fiber	2.3
Ash	1.6
<b>Mineral Content -</b>	<b>mg/100g</b>
Potassium	603.0
Phosphorus	289.0
Calcium	73.0
Iron	trace
Sodium	trace
<b>Vitamin Content in 100g</b>	
Vitamin A	130 IU
Ascorbic Acid	2.00 mg
Thiamin (B)	0.86 mg
Riboflavin (B)	0.13 mg
Niacin	0.90 mg
Vitamin E	15-50 mg
<b>Calories in 100 g (approximately one cup)</b>	<b>689</b>

*Note.* From *Composition of Foods*, by B. K. Watt and A. L. Merrill, 1963, Washington, DC: Agriculture Research Service, US. Department of Agriculture.

TABLE II  
FATTY ACID COMPOSITION OF PECAN OIL\*

Total Oil (%)	73.3
Fatty Acids	As % of Total Oil
16.0	5.7
16.1	0.1
17.0	trace
17.1	trace
18.0	2.2
18.1	66.9
18.2	22.1
18.3	1.1
20.0	0.2
20.1	0.4
Trace and Unidentified	1.3
TOTAL	100.0

*Note.* From "Fatty Acid Composition of Tree Nut Oil" by L. R. Beuchat and R. E. Worthington, 1978, *J. of Food Technology*, 13.

\* Unsaturated : Saturated Ratio -- 11:2

### Maintaining Pecan Quality

Much has been learned about how to properly harvest pecans and protect them from mold, souring, insects, staleness, discoloration, and rancidity, so that now if proper procedures are followed, pecans can be a year around food product. Pecan nuts are harvested over an eight-to-ten

week period from late September to mid December (Heaton & Beuchat, 1980). Mechanical harvesting, which includes shaking the mature nuts from the trees, can allow for complete harvest at an earlier date and minimizes the effects of adverse weather conditions on the fallen pecans.

After harvest, pecans left at ambient conditions normally become rancid in four to six weeks (Holiday, Pearson, & Slay, 1979); thus, the most common method of maintaining quality of both in-shell and shelled pecans is refrigeration (Heaton, 1974; Woodroof, 1967). Before 1961, freezing was thought to be detrimental and impractical for pecans, but because of a large crop in that year, processors were encouraged to freeze nuts for storage (Woodroof, 1967). Experiments have shown that frozen storage of  $<0^{\circ}$  C and 65 to 68% relative humidity arrests insects, prevents molding, retards development of staleness and rancidity, and preserves natural color, flavor, and texture of pecans for up to eight years. Storage at  $0^{\circ}$  C or less does not damage pecans nor does it increase the deterioration rate upon thawing (Woodroof, 1967) or even refreezing.

Kernel moisture is approximately 30% when nuts dehisce (shuck splits), but gradually decreases before abscission (falling from the tree) (Heaton & Woodroof, 1970). But even after falling, moisture levels may be 15% or more. High moisture in freshly fallen pecans is a major source of deterioration and can result in their becoming inedible within two weeks (Woodroof, 1967). Drying pecans to a kernel moisture of about 4.5% is necessary to avoid molding and/or flavor deterioration.

Frozen pecans are brittle and should be "tempered" by increasing the temperature slowly over a period of time (Woodroof & Heaton, 1967). Broken pecan pieces have a shorter shelf life due to an increase of

exposed surface area (Wagner, 1980), and tempering will reduce pecan breakage. Also, pecans that are low in moisture are brittle. To increase the yield of unbroken halves and larger pieces, unshelled pecans may be soaked in water before shelling, although this will require that nut meats be dried back to a moisture level of about 4.5%.

Pecans may be stored shelled or in the shell, although shelling pecans has been found to reduce the storage life by one-half at any given temperature (Woodroof, 1967). If pecans are too moist when stored in the shell, the excess moisture can result in leaching of tannins, which are water soluble, from the shell lining and corky middle. Tannins will cause nut meats to have a bitter flavor (Polles, Hanny & Harvey, 1981; Wagner, 1980). Shelling pecans before storage reduces the weight and volume to about one-half, and substandard nuts may be graded out before storage. Therefore, virtually all pecans sold for commercial food service are shelled. Pecans are known to be "odor eaters;" they will absorb odors present in storage rooms which lower their quality (Stein, 1980). They will absorb off-odors shelled or in the shell, as well as in ambient or refrigeration storage.

Alternate form of packaging materials have failed to prove successful in increasing the shelf life of pecans. Pecans stored in bulk and unsealed packaging are subject to deterioration, however, kernels sealed in tin cans are protected from most elements except temperature. Cardboard boxes are often suitable if they are waxed or lined with plastic. Moisture proof cellophane bags are also suitable when held at 70° C, however, under both conditions the quality of the kernels deteriorate (Stein, 1980). Overall, the packaging of pecans must be impermeable to oil, air, moisture, and ultraviolet light. "Metal, foil, glass,

and flexible films are usually adequate and practical" (Stein, 1980, p. 16). The objective of any storage practice is to maintain the initial quality of the pecan. Storage will never improve the quality; quality can only be reduced during storage.

### Marketing Pecans

The poor keeping quality of pecans has harmed the marketability of pecans. This area of concern has brought about legislation which may bring in funds to promote pecan marketing.

A marketing agreement, drafted by the Federated Pecan Growers Association in conjunction with the National Pecan Shellers Association of the United States, has passed the US. Senate and the House of Representatives. The bill institutes a national crop check-off to collect funds which will be used exclusively for promotion and research designed to strengthen the industry's position in the market place. However, researchers speculate that "the pecan industry still will not be able to launch a major advertising campaign" (Hubbard, Florkowski & Purcell, 1990). With or without the formation of this National Pecan Marketing Council, the industry must make a commitment to quality and availability (Hubbard et al., 1990).

In 1985 through 1988, Hubbard, Florkowski and Purcell (1989) asked 104 Georgia pecan growers and first level buyers (accumulators and shellers) to rank their three major purchasing and marketing problems with no parameters suggested. Nut quality and selling at a marketable price were the prime problems of both pecan accumulators and shellers, however, both of these problems were ranked highest by accumulators. Also, of interest in this same study, interviewees ranked

their three major research priorities. Two-thirds of the growers listed marketing as their primary problem, however, fewer than one-half considered marketing as a research problem. In contrast, only 34% of the growers named a production problem as their primary problem and 56% specified a production issue as their primary research priority. Hubbard et al. (1989) concluded that many pecan industry experts associate pecan research primarily with production, perhaps production occurs before marketing. Although, production research does need to be continued, more emphasis needs to be placed on pecan marketing.

Another survey conducted by Hubbard, Purcell and Ott (1987b) of 80 commercial pecan growers from Georgia's 20 leading pecan counties indicate that one-third of the shellers marketing problem was inadequate advertising and promotion. They indicated that too little was being done to increase consumption and use of pecans, particularly in non-pecan producing areas. Further, 50% of the accumulators and 67% of the shellers expressed a need for "accurate, marketing information" (p. 10). The study by Hubbard et al., (1989) also indicated that product promotion was suggested by 75% of the respondents as a means of increasing domestic consumption and expanding export markets. Twenty-five percent felt that increased production would increase consumption since all pecans presently produced are currently moving through the market. It was further concluded that pecans need more promotion, particularly in non producing areas.

Consumers need to be educated concerning the merits of pecans which are available for a wide variety of uses. However, the industry must make a commitment to quality and availability (Hubbard et al., 1990).

## Studies of Adult Learning

Post-harvest rancidity can be controlled by proper storage and handling procedures. These procedures are known, but are often not used. Changing this behavior will involve causing adults to accept change and a study of the change process. But how do adults learn, and how can written materials impact their learning and behavior changes?

### Influencing Adults to Change

Lifelong learning, becoming more accepted as a concept and a new social mandate, has been defined as "the process by which individuals continue to develop their knowledge, skills and interests throughout their lifetimes" (Wedemeyer, 1981). Lifelong learning implies that individuals continue to learn outside of formal education and do not all learn according to certain periods of life.

In a rapidly changing society an adult, in order to survive and develop, must continue to learn. What one learns and the way that one learns depends on the present need and the learning situation. The adult learner is a non-traditional learner for they must "learn and act at [their] own level, in their own situation, with independence, responsibility, and autonomy" (Wedemeyer, 1981, p. 166). However, the learning must be relevant to the problem.

### The Change Process

Change is the least understood of all management functions and the most difficult to achieve. In the past, change was something that most people sought to minimize and hopefully endure (Huseman, Alexander & Driver, 1980). People preferred to follow established ways of



doing things--they could follow along the same path without having to make decisions. People perceived upcoming changes as challenges to their self-interest and well-being (Lippert, 1981). They resisted out of fear (Berry, 1983). Pascarella (1986) noted that "it is hard to change habits you want to change, let alone habits you don't even know you have" (p. 64). But gradually people have come to the realization that change is not only inevitable but also a key to survival (Lippert, 1981). In a fast growing society, we no longer question if change will occur; change is a fact of life. The world is in continuous change, but it is urgent that its inhabitants know how to manage change.

Arbitrary change for the sake of change, totters on the brink of extension or rebellion (Menkus, 1988). Change is not synonymous with progress, the two should never be confused. Menkus stated, "change simply is the act of making things different" (p. 5). However, progress can be realized through judicious change.

In the past, experience has been the successful component in organizational management, but this experience depends upon the recognition that the primary force in change is knowledge. Organizations are employing professionals who are trained in problem solving by drawing on their knowledge of change rather than their experience. This transition can increase the speed with which trends and new events are recognized and promises to give much tighter control of organizations (Gruber & Niles, 1973). Therefore, when change becomes necessary, it is best to draw on the expertise of change-agents, and to understand certain aspects of change if it is to be carried out successfully.

Menkus (1988) reported change is only successful when these aspects are understood. Once the change process has been started,

there is no way to turn back and return to the way things were before. Change is a traumatic event to most people, they want things to be the same as yesterday and to be the same tomorrow. Most change-agents trick or con people into the change; this is usually not successful. Changes that are most successful are small changes rather than large ones. People will usually agree on changes that are easily understood, or changes that can easily fit into their work schedule or routines. Change with the greatest asset is when genuine value is realized. "No change is truly effective if its end result is not the creation of something better" (Menkus, 1988, p. 5).

Rigid thinking can be overcome by realizing that what worked in the past does not always work in the present. Growth and change are a result of a constant blend of new experiences, ideas, and changing relationships. A changing environment can create innovative ideas for an organization that fosters unlimited growth and productivity (Miller, 1983). When the organization's atmosphere begins to improve as a result of change, it is easy for the professional to take pride in the outcome. According to Krell (1981) "efforts to improve should help all bottom lines" (p. 80).

### How Adults Learn

The desire to learn, like other human characteristics, is not shared equally by everyone. It appears that most people possess it only in modest amounts. However, some people seek the rewards of increasing knowledge; they read, they create, they join groups who reward acquisition of knowledge, they visit museums and exhibits, and they

travel to enlarge their horizons. To these persons, knowledge seems to pervade their existence. Gagne (1985) stated that:

The fellow human beings we know and associate with got the way they are largely because of learning. Their habits of living have been learned and can be changed by learning; so too can their stores of knowledge, their skills, and the human qualities that characterize them as individuals (p.1).

Adult human beings manage to progress from highly dependent and relatively incapable infants to highly sophisticated, marvelously adaptable, functioning persons. Questions about this process are of great interest to researchers. Answers to these questions are divided into two areas: one is in the human genetic makeup and an understanding of the process of development through growth; the other area is learning. Human development not only depends upon the twin factors growth and learning, but on their interaction with each other. Therefore, to observe human development as a mere natural occurrence of growth and learning is overlooking the most important difference between them. The factors that influence growth are largely genetically determined. From conception, genetic characteristics are virtually unaltered. However, the factors that influence learning are determined largely by environmental events in a person's life, and members of human society have a tremendous amount of control over the events that influence learning (Gagne, 1985).

The Learning Process. The term "learning" is used quite broadly by psychologists. There are no exact definitions of learning that are

generally acceptable, however, Hill (1985) notes certain phenomena to which the term is or is not applied.

In psychological usage, what is learned need not be correct or adaptive (we learn bad habits as well as good), need not be conscious or deliberate (one of the advantages of coaching in a skill is that it makes us aware of mistakes we have unconsciously learned to make), and need not involve any overt act (attitudes and emotions can be learned as well as knowledge and skills). (p. 1)

Gallagher and Reid (1981) defined one principle of learning as "an internal process of construction" (p. 2), and George Kimble (cited in Houston, 1981) defined learning as "a relatively permanent change in behavior potentiality that occurs as a result of reinforced practice" (p. 5). Houston commented that this same definition has been proposed by many others (1981). There are many different definitions currently in the field of psychology, some quite specific and others diffuse and general.

The human animal begins learning from the time of conception and does not stop learning until death. A newborn begins to learn while kicking in the crib, he/she learns that crying will bring help, and his/her mother's presence will bring relief from hunger and pain. In the months that follow the child becomes a human learning machine, who learns to crawl, walk, run, talk, and also begins to question.

Through early research, knowledge of conditioning was observed through studies on animals. Most psychologists studied conditioning in order to learn more about the way people learn. They looked upon it as a process that helped analyze behavior. Their research showed that

heredity had a powerful effect on what was learned and how it was learned.

Conditioning techniques are now widely put to use to teach people new kinds of behavior through the use of reward. The system of reward and punishment reinforced desired behavior, helping the child to perform tasks he probably could not learn in any other way. These same conditioning techniques are used by the whole human race, by adults, children, parents, learning institutions, and perhaps the most widespread use is within the advertising industry (Edson, 1975).

Concept learning is different from classical learning. Classical conditioning teaches humans what to expect from the world and how to react. Another type of learning is operant learning which teaches humans that for an action there is a reward. Concept learning operates in a different way, it teaches people about the world around them, how to organize experiences and how to understand them (Edson, 1975).

Jean Piaget, a Swiss psychologist, is known for his painstaking effort into conceptual learning of children. He reported his finding from his observation of his own three children, and later from hundreds of other children. Piaget was convinced that children learn to form concepts and develop intellectually in a sequence of four principal stages. All children go through the same stages and all in the same order, however, not all in the same time sequence. The brain has the ability to make certain intellectual connections only in an exact sequence depending on age and experience (Edson, 1975; Hill, 1985; Piaget, 1972).

To Piaget, the mind is constantly active, reaching out, experimenting to achieve a balance between that which is coming in and

the inner world. It is a constant process as natural and inevitable as the digestion of food. Piaget and other psychologists agree that "man is born with a mind that is incurably vital, active and investigative on its own" (Edson, 1975, p. 81).

Characteristics of Adult Learners. Mankind is born with few innate abilities, mainly the ability to suck which gains nourishment. Almost all other abilities which make us human are learned behavior, from motor abilities, to speaking and to writing. Man appears to have an almost limitless ability to learn, to absorb vast amounts of knowledge, to acquire knowledge from other human beings and use this knowledge to master the world around him which no other creature on earth can do. Some other animals do have limited abilities to learn, however, they appear to be unable to transmit this learning to other animals of their same species. "Man is preeminently the learning animal" (Edson, 1975, p. 8). Man alone has learned how to create continuity of learning so that the species not only can survive but continue to build on previous learning.

Despite this knowledge explosion, the human mind absorbs an amazing amount of knowledge. Edson (1975) stated that today the ordinary person "accumulates a vocabulary of well over 50,000 words" (p. 19) as well as two or more languages. He further stated that:

he learns not only to talk, but also to read and write, to measure and calculate and to express abstract thoughts. Even in high school modern-day students are taught as a matter of course scientific theories that go far beyond the

knowledge of understanding of Aristotle or Isaac Newton.

(p. 19)

Most people learn mechanical and physical skills and amass the dexterity to perform many skills at the same time.

Adults continually learn information as they adjust to their role change. Many engage in some sort of self-directed learning activities and many enroll in some area of formal educational program. Many adults tend to underestimate their educational abilities. Cross-sectional studies of learning abilities indicate that their abilities gradually decline during adulthood, however, their abilities hold constant for the more able adults and for familiar topics. Performance on tests of fluid intelligence, short term memory and abstract reasoning tend to decline during adulthood but tests showing formal reasoning and general information increases throughout adulthood (Knox, 1977).

It is assumed that children have a subject-centered orientation to most learning, where adults have a problem-centered orientation to learning. The child learns information for the future, he learns to pass a test in order to go to the next grade, and then to the next school, and finally, in order to get a job. The adult enters an educational activity because he is experiencing some inadequacy in coping with a life problem. He wants to learn today and apply the knowledge immediately or tomorrow, therefore, his knowledge is a problem-centered orientation to learning (Knowles, 1978). Therefore, effective adult learning can be heightened if new information is relevant to the learner and if it builds on current competence.

Why adults participate in learning experiences has been examined by various researchers, however, findings of Houle (1961) remain the

most influential motivational study today (Cross, 1981). Houle's findings indicate that adults are goal-oriented learners, they use learning in order to reach a specific goal, such as learn to speak to the public, learn business practices, or learn how to deal with certain family problems. Some adults are activity-learners, participating mainly for the enjoyment of learning. These people use the learning experience as diversion from their everyday living. They may take a class or join a group to escape loneliness or boredom or an unhappy relationship or employment, find a husband or wife, accumulate credits for a degree or continuing educational credits, or just because that seems the right thing to do. The third reason Houle found for advanced learning in adults was learning oriented, these persons pursued learning for its own sake. These persons had an ardent desire to learn and to grow through learning and their learning desires were consistent and lifelong. Many of their daily activities were centered around learning, avid reading, watching educational television programs, or choosing jobs by the challenge of future learning. They also research trips thoroughly in order to appreciate what they see. This research also concluded that most learners had more than one reason for adult learning experiences (Cross, 1981).

Childhood has been observed and reported by many researchers and psychologists and each has placed all of the many changes that have occurred during this period into neat and orderly packages. Each period has been identified, labeled, and explained. They can not be changed, the order can not be reversed, and until the child or adolescent moves into that stage, he/she is incapable of behaving in a more adult manner.



Adulthood is not an endless journey with no adventures or mishaps. People do not simply launch into adulthood and coast along into old age. There are as many problems to solve and new situations to face as there were during childhood and adolescence. Adulthood has its transition periods and its crises. It is a developmental stage in very much the same sense as the developmental stages that occur during the first 16 years of life. Gail Sheehy (1976) called these somewhat predictable periods of adulthood, "passages".

Despite the fact that many myths have existed in past years about the inability of adults to learn, in 1928, E. L. Thorndike asserted that all adults can learn (Kidd, 1959). Thorndike stated that adults can learn all that they want to learn and that the quality of their learning is substantial. However, it was not until the onset of World War II that adult educators had scientific evidence that adults possessed interests and abilities that were different from those of children (Knowles, 1978).

Living in a growing society that is forever changing would be difficult without constantly learning new things. Now the world changes faster than the generations and people must live in many worlds. The world in which one is born will be a different world before he becomes an adult, and will again be a different world before his death. Change is now so great that no amount of education during youth can prepare adults to meet the demands which will be made upon them. The increased demand for lifelong learning has brought about a change in the way societies think about education and learning. Evidence of this lifelong learning becomes more recognized in the 80's; schools no longer have a monopoly on education. Businesses encourage employees to become involved in education, conduct on-the-job training, workshops,

and think-tanks for employees. Numerous organizations in communities conduct educational activities. Travel packages are offered for increasing knowledge. This spread of educational offering in the society and within organizations is a phenomenon that shows evidence of a learning society (Cross, 1981).

### Using Printed Material to Influence Adult Behavior

A wide array of media materials are now available for education, however, the printed word is one of the oldest forms of communication (Wagner, 1982). Printed information allows an educator to reach a wide audience and allows a division of labor to occur within an institution. Printed information is still somewhat inexpensive (in comparison to other forms of media), it allows learners to learn at their own pace, and it is easier to revise. In addition, a learner can at any time go back over any information not understood or to be recalled.

Printed material is also used as an art of persuasion by many. Politicians seeking your vote are trying to persuade you, the saleswomen or salesman is trying to solicit a sale. Some 6,000 advertising agencies devote extensive hours to the art of persuasion promoting the services or products of some 13 million business enterprises in the United States (Holtz, 1983). However, according to Holtz, what is of consequence is:

. . . whether the writer is capable of thinking the matter out coherently, deciding what the main point or points is or are, and organizing the writing to march to the objective in an orderly way, bringing the reader along. (p. xi)

There are many important rules when writing persuasive information, such as, style, language usage, elegance, and fluency,

however, of utmost importance, is sending information that will be received as intended. You can not persuade others of anything if they do not understand your message. The receiver cannot understand the message if the sender failed to first conceive and organize a clear message, and then select the right model for transmitting the message.

The Art of Reading. When writing a technical bulletin or information sheet, having basic knowledge of what readers read and how they read would be helpful when deciding what type and design to use for any printed information. Most of verbal communication is necessarily vague, whether we are conversing or reading. What is important is to grasp the general shape of what we are reading and to tie it to what we already know. If details are necessary, we rely upon the communicator to develop them. Therefore, successful communication requires that people know something of what they are talking about and the receiver of the information must also have some general background (recall) information about the subject being conveyed in order to understand the information being communicated (Hirsch, 1987).

A minimum level of information is possessed by any normal person who lives in the United States and who speaks elementary English. But a minimum level of information is not sufficient to be able to read the newspaper or other forms of printed information. Cultural literacy lies somewhere between everyday levels of knowledge that everyone possesses and the expert level of knowledge known only by experts (Hirsch, 1987). It is important to know the cultural literacy level of an audience that will receive information.

Knowledge Recall. Reading and recall have been identified as a complex and interactive action. Hirsch (1987) stated that a limited amount of short-term information is stored for instant recall. Long-term memory can store vast amounts, however, we have bad memory for words and good memory for meanings. The readers mind is highly active, the reader is a decoder of printed information but at the same time is supplying information that is not written. "The reader's mind is constantly inferring meanings that are not directly stated by the words of a text but are nonetheless part of its essential content" (Hirsch, 1987, p. 33). This would indicate that the printed information is but a "tip of the iceberg" (Hirsch, 1987, p.34) compared to what lies within the reader's own previous knowledge. This recent research shows that a reader's background knowledge is far more important than the reading process which has been of much concern in decades past.

Because of the power that prior knowledge has upon learning new information, writers need to make predictions as to how much prior knowledge the reader possesses. This prior knowledge needs to be considered before beginning to write. Writers can activate the readers former knowledge by the use of titles, major and minor headings, checklists, or key words or concepts at the beginning of the text. Writers can also enhance the readers knowledge by designing flowcharts or reading maps or by designing a one-way flow of information that is easy to follow (Duin, 1989).

Learning technical information through printed information is not easy. Designing and writing for the reader is also not easy. But knowing the factors that are needed for the reader to get the most from technical information can guide the writer through an otherwise difficult process.

The Art of Persuasion. Holtz (1983) stated that "the art of persuasion is the art of understanding and satisfying human emotional needs" (p. xiii). You can hardly persuade someone to do something if they do not understand the message. The receiver cannot understand the message, if first they do not understand the meaning of the message, and if their long-term memory does not recall the right symbols for transmitting a clear message. According to Holtz, the major reason for failed communication is failure to first decide exactly what the message is to be. Therefore, if a writer wishes to persuade others, the idea must be thought out clearly. He or she must know precisely what is to be expressed, so it will first be clear in the writer's mind (Holtz, 1983).

The latter part of Holtz's statement, satisfying human emotional needs, is of utmost importance for emotion can be more important than reason or logic. Unless the emotional need is satisfied, the persuasion will never come about. The verbiage used in written information needs to reach a person's basic emotional appeal to cause the subject to want to be persuaded.

Obviously, if written communication is to be used for the art of persuasion, the writer must use salesmanship and emotional methodologies in order to deliver the message. However, persuasion will not succeed if the message is not clearly stated.

Writing for Adult learners. Writing for adult readers requires narrowing the information down to one central topic. The use of too much information inhibits the amount of information that will be internalized. Duin (1989) states that organization of a text "influences the way we acquire, remember, and use information; it promotes

efficient learning; it produces better recognition and recall; and it increases the likelihood of transfer of new knowledge to future tasks" (p. 98). Because of this need for clear organization, writers need to assess their readers knowledge level and design an organizational technique that best suits their audience. If the technical information is highly organized, the reader can assess the information by the use of headings, tree charts, or other means used for organizing the literature. It also allows the reader to assess the information in relation to their prior knowledge.

Technical Writing. When getting an assignment, the first inclination may be to rush into print. However, that may be premature. First, much information needs to be known about the product. Researching the information is important to the consumer. Decide what benefit the consumer will gain from this product. The writer needs to remember that the public does not want to know what they do not know by a person to seem to have all of the answers. The writer possesses certain facts just like the reader needs information. In the end, match the needs of the reader and the writer, difficult as that may be (Malickson & Nason, 1977).

Writers in the field of technical writing and education make various and somewhat conflicting suggestions. Most authorities do agree that, on the first draft one should throw away all rules, the first draft is only the beginning. However, "changing, correcting, adding, deleting, substituting, polishing--in short, rewriting and re-rewriting" (Hill and Cochran, 1977, p. 10) will follow the first draft. At this point writers will

find that the suggestions of experienced writers are monumental, however, they can be helpful to new writers.

Most authors of the 1980's use active voice (Bush, 1981; Hill & Cochran, 1977; Tichy, 1988). Authorities on writing feel that passive voice weakens sentences, however, passive voice has its place and should not be eliminated completely (Bush, 1981). Other rules suggested by writers include: (1) avoid sexism (Hill & Cochran, 1977); it is not fair to imply that one sex is better than the other, which can be implied by the use of specific genders. This is a distinct problem in writing, for there is no one pronoun used to imply either sex, and terms most used by writers often seem pedantic. (2) Omit needless words; write the information needed in the fewest possible words (Hill & Cochran, 1977). (3) Be precise; use short sentences, substitute specific words for general terms, place words you want to stress at the beginning of the sentence, or at the end. Break up long paragraphs; only use one topic per paragraph (Hill & Cochran, 1977; Malickson & Nason, 1977). (4) Do not over punctuate; do not use too many commas. This causes the reader to jump around the text and disturbs the flow of information (Malickson and Nason, 1977). (5) Use contractions whenever possible; people naturally talk that way and it's faster and more personal. (6) Do not brag; write from the reader's point of view (Malickson & Nason, 1977), however, show emotion and enthusiasm with flair and excitement. (7) Allow your feelings to come through (Holtz, 1983).

Graphics can be used in addition to textual information. Holtz (1983) stated that most people mistrust that which they do not understand, therefore, graphics not only helps people understand what you are saying, but it encourages them to continue reading through the

text. Newspapers are a good example of this, they often use pictures, pie-charts, graphs, maps, diagrams, tables, or drawings for emphasis (Laster & Pickett, 1974).

The list of things to watch for is endless. There are complete volumes (Duffy & Waller, 1985; Malickson & Nason, 1977) written for persons who aspire to write.

Targeting an Audience. Often people think that what they have to say is important to everyone on this earth, in reality an audience needs to be a small group. Even commercial advertisements for products such as gasoline and soft drinks are targeted to a small percentage of the population. It is important that writers step back and make a mental picture of the face, the institution, the home, and the bankbook of the person to whom they are speaking. The writer needs to know the "wants" and "needs" of the audience to be reached (Glenn, 1987).

When trying to reach a vast audience, or an audience that cannot be seen, this task can become difficult. One way of handling this task is to try to anticipate all of the questions that an audience might ask and including the answers of all of their questions. This should help to bridge any communication barriers before they happen (Grey, 1972).

After the audience has been recognized, the knowledge level needs to be identified. It is helpful to empathize with the reader on their likely level of interest and to identify their confusion. "The reason is simple. A message cannot be communicated unless it is received; and to have a chance of being received, a message must be aimed in the direction of the intended audiences" (Grey, 1972, p. 25). Grey further suggested that a valid working assumption is "never to underestimate the general



intelligence of your audiences but never overestimate their levels of knowledge on any one subject, either" (p. 25).

### Pecans in Food Service

Consumers often report bad pecan products. However, little has been reported about the knowledge of food service operators and managers concerning proper storage conditions. Hospital and institutional food service operations have some purchasing standards (M. Butler, personal communication, April, 1991) but purchasing procedures are less specific in most restaurants. Storage procedures are even less specific.

The level of knowledge of food service operators and managers should be identified in order to make a change in their food handling operations. By knowing their knowledge level, educational material could be developed with the adult learner in mind.

### Summary

Although Oklahoma possesses the conditions necessary for ideal pecan growth, problems associated with poor quality continue to keep pecans an underutilized and a seasonal food product. Methods for maintaining quality have been developed, but pecans of inferior quality still reach the marketplace. Food service personnel, being consumers of pecans throughout the year, seem to be unaware of how to keep the product in optimum quality by proper storage conditions. Not only are specific storage conditions necessary in the food service operation itself, it is also important for the operator to be aware of how the pecan is

handled before being purchased. Change is needed in the storage conditions of pecans to maintain top quality.

Most people are resistant to change, they would like for things to run today like they did yesterday and tomorrow to run like today. However, change is inevitable, and for the change to be accepted a plan should be logical and must take into consideration the personal concerns of others involved. In order for the change to be accepted, the changes must be small ones, readily understood and assimilated into the work schedule, and be able to utilize equipment already on hand. Every operation has to implement change and the innovative leader "expects it, fosters it, plans it, directs it, and uses it for competitive advantage" (Schoonover & Dalziel, 1986, p. 56).

Characteristics of adult learners are different from those of pre-adults for many reasons, primarily, experience. Adults perceive information based on their own experience. Pre-adults lack much or all of that experience which makes their perception of the same information different.

Brookfield (1986) stated that "developing in adults a sense of their personal power and self-worth is seen as a fundamental purpose of all education and training efforts" (p. 283). Only if this sense of well being is instilled will adults possess the emotional strength to challenge behaviors, values, and beliefs which are accepted. It is the responsibility of the educator to challenge the learner to question previous behaviors and critically analyze them. Brookfield (1986) further stated that "through presenting alternative ways of interpreting and creating the world to adults, the educator fosters a willingness to consider alternative ways of living" (p. 284).

Since the adult is an active and eager learner, a change in adult learning is possible if the new information is relevant to the learner. One means of reaching the adult learner is through printed educational information. Printed information reaches a wide audience along with being somewhat inexpensive as compared to other forms of communication. However, to reach this eager audience, the writer needs to be knowledgeable of the receiving audience, as well as, knowledgeable of writing printed information.

## CHAPTER III

### METHODS AND MATERIALS

Methods and materials used for data collection and analysis are contained in this chapter. This chapter includes the selection of subjects, instrument used, pretest and posttest procedure, and data collection.

#### Subjects

The survey population included all persons who purchased and stored pecans, who were members of the Oklahoma Restaurant Association (ORA), in 1990. The ORA membership list contained 1400 members, however, many of these members were not affiliated with a food service operation. Only one person was selected to represent a single food service operation if it had more than one member. With the elimination of these subjects from the original list, 824 remained. These were used as the subjects in this research.

Questionnaires were mailed to 824 persons in June, 1991. Two hundred forty three persons replied to the questionnaire, and of those respondents 52 used pecans in their food service operations. Brochures were sent to these 52 food service operators. After a period of four weeks, another questionnaire, the same as the first, was sent to each of the 52 persons. Twenty-three respondents returned the second

questionnaire but one was not usable. Therefore, there was a final sample size of 22 participants who completed all steps of the research.

### Instrument

The questionnaire developed for this study was adapted from one used in an earlier survey (Waters, Stokes & Knight, 1988). This original survey was used to obtain pecan purchasing, receiving, and storage data from 52 food service operators who attended the Oklahoma Restaurant Association/Oklahoma Dietetic Association Annual Meeting at the Myriad Convention Center in Oklahoma City, Oklahoma on April 19-20, 1988.

The adapted questionnaire measured purchasing, receiving, and storing procedures of pecans by food service personnel. The questionnaire was divided into three sections, purchasing, receiving, and storing pecans, with each section directly related to the hypothesis. The questionnaire was attractive, brief, and easy for respondents to answer (see Appendix B). A structured list of questions was used, each with a list of alternative responses. Each question dealt with a single concept and was simply worded for the target audience. Directions accompanied the questionnaire to inform the subject how and where to respond. Each respondent was coded by the researcher in order to facilitate a follow up of non respondents and to send the brochure and posttest to the same person that filled in the first questionnaire.

### Pretest and Posttest Procedure

The 824 members of Oklahoma Restaurant Association were each used as the population for this study. Each food service manager

received the questionnaire as a pretest. The respondent was sent an educational brochure. This was followed by another questionnaire, which was the same as the first questionnaire, which served as a posttest. A pretest-posttest design was used in this research (Gay, 1987).

The population was chosen from the approximately 1400 ORA members. However, all Oklahoma Restaurant Association members who were not food service operators were removed, and only one member from the same food service was chosen. After these were eliminated, the population included 824 members. Mailing labels were computer printed by Oklahoma Restaurant Association office staff.

The 824 restaurant managers were sent a questionnaire (pretest) asking about their purchasing, receiving and storing practices of pecans used in their food service. An educational brochure was sent to all persons who responded to the first questionnaire, and this was followed by a posttest. The posttest was the same as the pretest.

The educational brochure covered purchasing, receiving, and storing practices that could increase the quality of pecan products utilized by the food service operation. The brochure served as an independent variable. It contained current information available pertaining to purchasing, receiving, and storing pecans. The brochure was an attractive, and easy to read single page trifold (see Appendix C).

The educational brochure was mailed to the food service personnel who reported using fresh pecans on the pretest. Four weeks after the brochure was mailed, the posttest was mailed. This enabled the recipient ample time to receive the brochure and time to implement a change in operation, if a change was to be made. Respondents whose

questionnaires were not returned in two weeks from the mailing date, received a postcard reminder of the importance of their response (see Appendix A).

An application to use human subjects in this research, as described above, was approved by the Oklahoma State University Institutional Review Board (see Appendix C).

### Follow-up of Non Respondents

In order to determine how non respondents differed from respondents, a telephone follow-up of a 33% random sample of non respondents was conducted. An abbreviated form of the questionnaire was used in the follow-up survey.

### Data Analysis

The data were analyzed to determine if behavior changed after receiving an educational brochure. The test of the research hypothesis involved comparisons of pretest and posttest scores. The difference in the posttest scores was tested by paired comparison *t* test. The level of significance established by the researcher for inferring the operation of non chance factors was  $p < .05$ .

A 2 x 2 table was used and the column totals were small, therefore the Fisher Exact Test (Fisher, 1972; Steele & Torrie, 1980) was used to evaluate the data collected from this research. This form of evaluation is only used when there is a limited amount of data. When small numbers are collected it is best to compute exact probabilities rather than to rely upon an approximation.

Chapter IV will present the findings of the research.

## CHAPTER IV

### FINDINGS AND DISCUSSION

This study was designed to determine if behaviors of food service personnel changed after receiving an educational brochure. Findings reported in this chapter include the food service personnel's responses concerning their practices regarding purchasing pecans, receiving pecans, and storage of pecans. The complete list of all responses are given in Appendix E.

#### Purchasing Pecans

When food service operators purchase pecans, it is important that they purchase pecans that have been stored under the proper conditions to maintain a superior food product. Proper storage means cold storage from the time the nut falls from the tree up to the time that it is consumed. The pretest sent to Oklahoma food service operators asked about their pecan management practices. If the food service operators reported use of pecans in their food service, they received an educational brochure describing conditions to maintain optimum quality pecans. Four weeks later they were sent a posttest asking the same questions about their pecan purchasing and storage practices. These findings describe the responses to both tests and the changes reported by the food service operators after receiving the educational brochure.



Of the 22 persons who used pecans in their food service operations and who responded to both pre and post questionnaires, all reported that they knew what characteristics should be a part of purchasing specifications; but only about half of them had either written or verbal specifications. As indicated in Table III, 12 respondents to the pretest had set specifications; only three of those had written specifications and nine had verbal specifications. The posttest indicated even fewer (seven) respondents had set specifications; one used written and six used verbal specifications. This could reflect actual reduction in their use of specifications; or it could mean that, after reading the brochure, five of them realized they actually did not have even minimal specifications.

TABLE III  
PRE - POST COMPARISON OF RESPONDENTS  
WHO REPORTED SPECIFICATIONS  
FOR PURCHASING PECANS

Questionnaire	Type of Specifications		Total
	Written	Verbal	
Pre	3	9	12
Post	1	6	7

n = 12

Many criteria can be included in specifications for purchasing pecans for a food service operation; however, there are four important criteria that should be included when buying pecans in order to be certain of freshness. These include (1) *the most recent crop*, (2) *storage condition since harvest*, (3) *temperature since harvest*, and (4) *storage container since harvest*. These four criteria were included on the questionnaire and brochure. The least important of these four criteria, as far as freshness is concerned, is most recent crop if the nuts have been properly held since harvest.

Of those who had specific criteria for their pecan purchases, eight respondents indicated the characteristics which were included in these specifications. Table IV shows that most recent crop was included and important to five respondents on the pretest and posttest. Four respondents included storage condition since harvest in their specifications on the pretest and posttest. The pecan temperature since harvest was included on the specifications of two respondents on the pretest and posttest. One respondent included storage container since harvest as important on the pretest; however, no respondents included that characteristic on the posttest.

Encouraging food service operators with the use of a brochure to check on the prior storage conditions of pecans before they are received did not seem to make a difference in their actions as indicated by the posttest. This could be due to: (1) food service operators depend upon their food products to be properly handled by growers and distributors, (2) one exposure to printed information is not the type of educational material that is effective with this audience, or (3) adult learners learn through need and perhaps these learners had not perceived a need.

TABLE IV  
PRE - POST COMPARISON OF ITEMS  
INCLUDED IN SPECIFICATIONS

Criteria	Pre	Post
Most Recent Crop	5	5
Storage Conditions Since Harvest	4	4
Temperature Since Harvest	2	2
Storage Container Since Harvest	1	0

n = 12

### Receiving Pecans

Pecans stay their freshest when kept in cold temperatures, so it is important to know the temperature of pecans at all stages of transportation and storage. The questionnaire included questions asking the respondents about the type of transportation used to deliver their pecan purchases and about their receiving practices.

Nine respondents stated that they used *cold storage transportation* for their pecan products on the pretest and ten used cold storage transportation on the posttest (see Table V). Three persons changed to colder temperature transportation after receiving the brochure. This indicates that many of the respondents were aware that pecan products should be stored in cold temperatures.

TABLE V  
 PRE - POST RESPONSES REGARDING TEMPERATURE  
 DURING TRANSPORTATION

Temperatures	Pre	Post
Room	9	6
Cold	9	10
Frozen	2	4

n = 20

In addition to the type of transportation used for shipping pecans, the questionnaire asked what characteristics the food service operators inspected and rejected when an order of pecans was received. The characteristics listed on the questionnaire were: *type of storage container*, *condition of container*, *temperature of product*, *pecan odor*, *pecan color*, and *pecan flavor*. The first three characteristics are easily measured objective tests for the quality of pecans, but the last three characteristics are subjective, or judgmental, measures of freshness.

The first of the objective characteristics was type of storage container. As shown on Table VI, 10 respondents indicated that they inspected their pecans for the type of container upon receipt on the pretest and 11 on the posttest. Nineteen respondents indicated that this same characteristic was checked by the distributor upon shipment to the food service operation on the pretest as well as the posttest. Eight respondents stated that they would reject a shipment upon receipt if not in the proper type of container. Fifteen respondents indicated that they

checked for the condition of container upon receipt of their order of pecans on the pretest. However, 17 indicated that they inspected the condition of containers on the posttest. Eighteen responded that they depended on their distributor to inspect for the condition of container on the pretest and 19 on the posttest. Eighteen operators reported that they would reject a shipment on the condition of container on the pretest and 20 reported that they would reject a shipment for the same reason on the posttest.

TABLE VI

PRE - POST COMPARISON OF ITEMS RESPONDENTS  
INSPECT/REJECT UPON RECEIPT OF SHIPMENT:  
OBJECTIVE EVALUATION

	Food Service Operator Inspects		Distributor Inspects		Item That Could Cause Rejection	
	Pre	Post	Pre	Post	Pre	Post
Type of Container	10	11	19	19	8	9
Condition of Container	15	17	18	19	18	20
Temperature of Product	3	11 <sup>a</sup>	16	19	4	10

n = 22, responses to more than one item allowed

<sup>a</sup> Significantly different at the  $p < .05$  level as analyzed by the Fisher Exact Test

Another of the objective tests which indicates freshness in pecans is the temperature of product upon receipt since pecans should be kept in cold storage at all times. On the pretest, only three respondents indicated that they inspected for the temperature of product upon receipt, however, 11 indicated that they inspected for temperature on the posttest. Using the Fisher Exact Test, significance was shown at a probability level of  $p=.009$ . Sixteen respondents indicated that they depended upon their distributor to inspect the temperature of product upon delivery; this increased to 19 on the posttest. Four respondents indicated that they would reject a shipment of pecans if they were not at the proper temperature; this increased to 10 on the posttest.

The next three characteristics listed on the questionnaire were the more subjective qualities of evaluation. These qualities are determined through personal perception and judgments, and there is no exact guide for analysis. These three characteristics, as shown in Table VII, are pecan odor, pecan color, and pecan flavor. For pecan odor, 13 respondents indicated that they inspected for this quality on the pretest, but only, 11 on the posttest. Sixteen stated that they depended upon their distributor to inspect for odor on the pretest and 18 on the posttest. Nineteen reported on the pretest they would reject a shipment if there was an indication of off-odor and 19 also indicated the same on the posttest. It is noted that about a third of the respondents said they would reject for a characteristic for which they did not inspect.

The second subjective variable was pecan color. Eleven respondents indicated that they inspected for off-color on the pretest and the same number inspected on the posttest. On the pretest, 18 respondents indicated they depended upon their distributor to inspect

for pecan color and 17 on the posttest. Sixteen indicated they would reject for off-color on the pretest and 13 on the posttest.

TABLE VII

PRE - POST COMPARISON OF ITEMS RESPONDENTS  
INSPECT/REJECT UPON RECEIPT OF SHIPMENT:  
SUBJECTIVE EVALUATION

	Food Service Operator Inspects		Distributor Inspects		Item That Could Cause Rejection	
	Pre	Post	Pre	Post	Pre	Post
Pecan Odor	13	11	16	18	19	19
Pecan Color	11	11	18	17	16	13
Pecan Flavor	16	13	17	18	19	18

n = 22, responses to more than one item allowed

The last subjective variable was pecan flavor. On the pretest, 16 respondents indicated that they would inspect the flavor of the pecans that they received; however, only 13 would inspect for pecan flavor on the posttest. Seventeen persons indicated they would have their distributor inspect for pecan flavor on the pretest compared to 18 on the posttest. Nineteen respondents reported that they would reject a shipment for off-flavor on the pretest, and 18 would reject a shipment for off-flavor on the posttest. Again, some were reporting rejecting for something for which they did not inspect.

Although organoleptic qualities are the most important aspect of food to customers, these food service operators seem unsure of their ability to make organoleptic judgments about odor, color, and flavor. This is evidenced by a heavy reliance on distributors to inspect for these characteristics. Also, after receiving the brochure respondents seemed to have less faith in their ability to judge, since fewer of them reported inspecting and rejecting for off-odor, off-color, and off-flavor on the posttest than the pretest. Perhaps university extension programs in sensory evaluation for food service operators are needed.

#### Storage of Pecans

The educational brochure, sent to those food service operators that reported using pecans in their operation, explained the necessity of keeping pecans stored in cold storage from the time the pecans fall from the tree to the time that they are used in food products. The pretest determined the storage methods the food service operators were using before receiving the educational brochure; results on the posttest indicated the storage conditions being used after receiving the educational brochure.

The posttest indicated that of the 22 total respondents, 12 persons made improvements in their storage temperatures used for pecans (see Table VIII). One respondent indicated in the pretest that an order of pecans was split with one portion stored in dry storage, above 60°F, for less than one week and the remainder of the pecans stored in the freezer for an indefinite period of time. After receiving the brochure, this respondent stored all of the pecans in the freezer. This shows an



improvement in storage conditions, since pecans will stay fresh longer if they are kept in cold storage at all times.

On the pretest, another respondent indicated that pecans were stored in dry storage, above 60°F, for an indefinite period of time. On the posttest, and after receiving the brochure, the respondent changed to refrigerated storage. This is a positive change since pecans stored in the refrigerator stay fresh for one year, or more.

A third respondent reported storing part of the shipment in dry storage, over 60°F, for between one and two weeks and stored the remainder in refrigeration for an indefinite period of time. After receiving the brochure, this respondent split the order storing part in the refrigerator and the remainder in the freezer. This also is an improvement since dry storage, for any length of time, will rapidly decrease the shelf life of the pecans.

Two other respondents reported they froze pecans even before receiving the brochure. However, they did report a longer frozen storage time in the posttest. This shows they are now aware of the length of time pecans successfully keep in frozen storage, allowing them to take advantage of buying larger amounts when the price is best.

Four respondents indicated storing their pecans in dry storage but below 60°F. After the brochure, these same respondents indicated storing their pecans in refrigeration. This is an improvement in storage conditions since pecans left in dry storage, even if heat is not extreme, will become rancid over a period of time.

Before the brochure another respondent stored the pecans in dry storage indefinitely, and after the brochure they stored the pecans for only one to two weeks. Depending on how the pecans were stored before

they were received in this food service operation, two to three weeks may be a short enough time period for the pecans to be utilized before they become rancid. Cold storage is still a better storage condition, but if dry storage is the only option, a short period of time is the next best option for optimum quality pecans.

Four other respondents indicated storing their pecans in refrigerated storage on the pretest and after receiving the brochure, changed to freezer storage. Freezer storage is the preferred storage condition because this method retains optimum quality indefinitely.

Two respondents reported storing pecans in the refrigerator both before and after receiving the brochure. However, after receiving the brochure, they stored part of an order in refrigeration and the other part in the freezer. The part of the order that is in the refrigerator can be used for immediate use and is more convenient when used often. The part in the freezer can be stored until needed, and the food service operator can purchase large quantities.

Seven respondents indicated no change in their storage conditions in the posttest from the pretest, however, five of these, as reported above, were already following approved procedures and using freezer storage even before receiving the brochure. The remaining two respondents used refrigerator storage before and after the brochure. Freezer storage and refrigerator storage both will keep pecans in optimum quality, the only difference is the pecans will keep for a longer period of time in the freezer.

An overall examination of storage procedures after the brochure shows that none of the changes in each separate area was significant (Fisher Exact Test,  $p < .05$ ). This is illustrated in Table VIII which

compares the number of respondents' changes between pretest and posttest for temperature of storage. The pretest storage conditions are identified on the vertical axis and the posttest storage conditions are identified on the horizontal axis. Table VIII shows the change of the food service operators' storage conditions from the pretest to the posttest storage condition. As an example, two operators reported storing pecans in dry storage,  $>60^{\circ}\text{F}$ , on the pretest; then, after receiving the brochure,

TABLE VIII  
FREQUENCY OF PRE - POST RESPONSES  
FOR TEMPERATURE OF STORAGE

		Posttest Responses			
		Dry $>60^{\circ}$	Dry $<60^{\circ}$	Refrigerator	Freezer
Pre- test Responses	Dry $>60^{\circ}$	0	0↑	4↑	2↑
	Dry $<60^{\circ}$	1↓	0	1↑	0↑
	Refrigerator	0↓	0↓	3	5↑
	Freezer	0↓	0↓	0↓	6

Legend

 = better procedures, respondents = 12

 = no change, respondents = 9

 = worse procedures, respondents = 1

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Total = 22

they moved the pecans to freezer storage. This move ( $>60^{\circ}\text{F}$  to freezer) is shown on the top row, last column of Table VIII.

As stated, Table VIII indicates the total number of respondents that reported changes in temperature storage from pre to posttest. The unshaded squares in the table proceeding from the upper left-hand corner to the lower right-hand corner, indicate no change in storage conditions. However, it is noted that all nine respondents included in the unshaded area were storing pecans in cold storage, either refrigeration or freezer, before receiving the brochure.

The squares above the unshaded squares, marked by diagonal shading, indicate an improvement in storage conditions. Table VIII indicates that four food service operators changed from dry  $>60^{\circ}\text{F}$  to refrigerator storage, one moved from dry  $<60^{\circ}\text{F}$  to refrigerator, and five moved from refrigerator to freezer storage. All of these shifts in storage conditions are an improvement over the previous procedure. A total of 12 respondents indicated a change to better storage conditions.

The squares that lie below the unshaded squares are shaded with black dots. These squares indicate a shift in a negative direction. These squares show only one food service operator who moved in a negative direction; from dry storage, less than  $60^{\circ}\text{F}$  to dry storage, more than  $60^{\circ}\text{F}$ . Pecans stored above  $60^{\circ}\text{F}$  will become rancid in a very short period of time and will produce a poor quality food product. However, only one of the 22 respondents reported a detrimental change, and 12 reported a positive change. This indicates the brochure had a beneficial effect on storage behavior.

In addition to these 12 respondents that showed improvement in their storage temperature, an additional 3 respondents showed

improvement in the length of time pecans are stored, although they showed no improvement in temperature storage.

Table VIII indicates that 54.57% of the respondents improved their storage procedures after receipt of the brochure. A 95% confidence interval on the estimate given by 33.73% to 75.35% implied that the population as a whole improved their storage procedures after having received the brochure.

#### Follow-up of Non Respondents

A follow-up was made of 33% of the non respondents. The list of all persons who responded to the first questionnaire, who used pecans in the food service operation, who received a brochure, and who did not respond to the second questionnaire, included 29 persons. From this list, 9 persons were selected for a telephone interview. An abbreviated questionnaire was used for the non respondent questioning. Of the non respondents who were selected, one could not be contacted and three were no longer working in the same establishment. One person used canned pecans, therefore did not check the temperature of incoming pecans and stored them in dry storage. Of the other four, two reported checking the temperature of pecans upon receipt and two did not check the temperature. All four stored pecans in either cold, refrigerator storage, or freezer storage. Therefore, the non respondents answered approximately the same as those who did respond to the second questionnaire.

## Discussion

The purpose of this study was to determine if an educational brochure sent to food service managers provided the information needed to promote positive change in purchasing, receiving and storage of pecans. The results of this study are included in this chapter and these results can be summarized as follows.

### Pecan Purchasing

Food service operators' purchasing specifications were analyzed before receiving the brochure and after receiving the brochure. According to Fisher Exact Test, there were no significant increases in food service operators using set specifications and no significant increase in the use of certified specifications over verbal specifications. There was no significant difference reported by food service operators in using specifications when ordering pecans.

### Pecan Receiving

There was no significant difference reported by food service operators for use of transportation temperature. Of all of the six items for inspection included in the questionnaire, temperature of product was the only item that showed a significant difference (Fisher Exact Test,  $p < .05$ ), but type of container, condition of container, pecan odor, pecan color, and pecan flavor showed no significant difference. However, more persons inspected and rejected for objective criteria than for subjective criteria.

### Pecan Storage

Storage conditions were also examined and measured using the Fisher Exact Test. There were no significant differences in improvement of storage practices in each specific category.

Overall, most food service operators seem to know how to keep pecans fresh. The brochure made little or no difference on purchasing and receiving practices, but it did seem to make an important difference in improving storage procedures according to a 95% confidence interval.

Based on the significant results obtained in the comparison of pretest and posttest procedures regarding receiving pecans, the following null hypothesis is rejected: There will be no significant difference in the responses of food services personnel on an assessment of knowledge and practice regarding purchasing, receiving, and storing pecans before and after receiving a printed brochure designed as an educational intervention.

Chapter V will present a brief summary of the research findings, conclusions, and recommendations.

CHAPTER V  
SUMMARY, CONCLUSIONS, AND  
RECOMMENDATIONS

Summary

This study is summarized in this chapter. Information is provided about the statement of the problem, purpose and objectives, hypothesis, sample and population, instrument development, data collection, findings, conclusions, and recommendations.

Statement of the Problem

Often, the public consumes food products containing bad tasting pecans in food service establishments. Food service managers may be unaware of how to purchase, receive, and store pecans to ensure that the pecans stay in optimum quality. Therefore, the problem of this study was to determine if an educational intervention could be used to improve practices related to purchasing, receiving, and storing pecans.

Purpose and Objectives

The purpose of this study was to determine whether the pecan purchasing, receiving, and storing practices of food service personnel will improve after receiving an educational brochure.



The specific objective of the study was to assess the food service pecan purchasing storing and receiving practice of food service personnel before and after receiving an educational brochure.

### Hypothesis

One null hypothesis was tested in this study. The hypothesis was: There will be no significant difference in the responses of food service personnel on an assessment of knowledge and practice regarding purchasing, receiving, and storing pecans before and after receiving a printed brochure designed as an educational intervention.

### Sample and Population

The survey population for this study were persons, who purchased and stored pecans, who were members of the Oklahoma Restaurant Association (ORA) in 1991. The ORA list contained 1400 members; however, many of these members were not affiliated with a food service operation, and only one person was selected to represent a single food service operation if it had more than one member. With the elimination of these subjects from the original list, the number of subjects in the final list totaled 824. All 824 members were sent a questionnaire (pretest).

### Instrument Development

The instrument used for this study was a questionnaire derived from one used in an earlier study by Waters, Stokes and Knight (1988) that measured purchasing, receiving and storing procedures of pecans by food service personnel. The questionnaire was divided into three

sections; purchasing, receiving, and storing of pecans. A copy of the questionnaire is included in Appendix B.

An educational brochure was also used in this study. The brochure, developed by this researcher, contained information useful to food service operators on keeping pecans fresh. The brochure was a single page trifold and was sent to all persons who responded to the first mailing by returning their completed questionnaire. A copy of the brochure is included in Appendix C.

During the questionnaire and brochure development, the investigator sought input from many areas. A prestudy questionnaire had been used earlier on a limited number (n=52) of persons who attended the Oklahoma Restaurant Association/Oklahoma Dietetic Association Annual Meeting in 1988. Changes and revisions were suggested from this prestudy for the design of the instrument and format of the questions. The information on the brochure was obtained from current research and from members of the Oklahoma Pecan Growers Association who grow and sell pecans on a yearly basis. To ensure subject protection, the questionnaire and brochure were approved by the Oklahoma State University Institutional Review Board (see Appendix D).

### Data Collection and Analysis

Questionnaires were coded and sent to 824 persons who were identified as members of Oklahoma Restaurant Association. Two weeks after the pretest was mailed, a follow-up postcard was sent to all non respondents (see Appendix A). Survey instruments were returned by 220 individuals, of which 52 identified themselves as using pecans in their

food service operation. These 52 persons who used pecans were sent an educational brochure. Four weeks later, another questionnaire was sent to the same 52 persons. The questionnaires were coded with the respondents number and with the addition of a number indicating a posttest. A follow-up postcard was sent to all non respondents. Posttest instruments were returned by 23 persons of which 22 were usable instruments.

Instruments were coded and the analysis of data was conducted using the SAS computer program. The Fisher Exact Test was chosen for computing probabilities because of the small number of responses, using a probability level of  $p < .05$  as significant. A 95% confidence interval was used to evaluate overall change in storage procedures.

### Findings

The results of this study, as consistent with the objective and the hypothesis, are reported as follows.

Pecan Purchasing. Approximately half of the respondents reported having any type of set specifications for their pecan purchases and this number decreased after receiving the educational brochure. Of the respondents that had set specifications, more had verbal than written specifications.

The qualities that insure fresh pecans, e.g., free of rancid odor and flavor, were included in set specifications by only a few respondents. Of the variables included in the questionnaire, *most recent crop* was included by the most respondents, the *type of storage condition* the pecans were stored under since harvest was less important to them, as

was the *temperature* of the pecans *since harvest*, and the *storage container* the pecans were stored in *since harvest* was the least important. There was no improvement in their set specifications or the criteria included in their specifications after receiving the brochure.

Pecan Receiving. Over half of the respondents reported using cold storage for transporting pecans to their food service facility. There was an increase in persons using cold storage transportation for their pecans after receiving the brochure.

Of the six items that were included in the questionnaire, temperature of the product was the only item that showed a significant difference ( $p < .05$ ). More food service operators inspected and rejected items which required objective evaluation and fewer operators inspected and rejected items which required subjective evaluation. It was also noted that some food service operators reported rejecting a shipment for a quality that they had earlier reported that they did not inspect.

Pecan Storage. Food service operators showed an improvement in storage conditions of pecans. A larger number of the respondents showed an improvement in some area of storage or in the length of time pecans remained in storage.

### Conclusions

Because of the change in inspection for temperature and the improvement in storage practices, the research hypothesis was rejected. It can also be concluded that most food service operators are aware of the proper storage conditions necessary for optimum quality pecans. However, despite the fact that most operators are aware of the conditions

necessary for good quality products, they depend upon other persons to ensure they receive good products. The brochure had little or no relationship to purchasing and receiving practices, but it did seem to have an important relationship to improving storage procedures.

### Recommendations

The brochure sent to food service operators made limited differences in their purchasing and receiving practices of pecans. Perhaps other educational methods will produce better results. Additionally, the questionnaire response was low. Therefore, recommendations for further studies could include:

1. Investigate the use of other educational tools such as, video or sessions at professional meetings.
2. Send educational tools to the middle-managers in the food service industry, such as, buyers, storage operators, and suppliers.
3. Complete questionnaires by personal contact to increase response rate. However, this increases the cost of gathering data and answers can be influenced by the person gathering the data.
4. Wait a longer time period between the brochure and the second questionnaire. This would give the food service operator more time to change their ordering and storing practices.
5. Develop university extension programs in sensory evaluation for food service operators.

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**APPENDICES**

**APPENDIX A**  
**CORRESPONDENCE**



*Oklahoma State University*

SCHOOL OF HOTEL AND RESTAURANT ADMINISTRATION  
COLLEGE OF HOME ECONOMICS

STILLWATER, OKLAHOMA 74078-0337  
HOME ECONOMICS WEST 210  
(405) 744-6713

Dear Oklahoma Restaurant Association Member:

As a researcher, I am asking your support in obtaining new information about purchase and storage practices in the food service industry. To help in my research with pecans, would you, or your purchasing agent, please take about 10 minutes to complete the enclosed questionnaire. A postage paid self-addressed envelope is included for your convenience.

When I receive your questionnaire, I will send you a brochure containing information on purchasing, receiving and storing pecans. This brochure will provide you with helpful information in order to receive maximum value from your pecans. Therefore, it is important for you to answer Question #1 on the questionnaire so this information can be sent to the correct person. A follow-up questionnaire will be sent to you at a later date.

Be assured that your comments on both this questionnaire and the follow-up will remain completely anonymous and will never be ascribed to you. Could you please return the completed information to me as soon as possible.

Thank you very much for your cooperation and your valuable time. If you have any questions, please contact me at (405) 744-8486.

Sincerely,

A handwritten signature in cursive script that reads 'Marilyn B. Waters'.

Marilyn B. Waters, M.S., R.D.  
Teaching Associate



*Oklahoma State University*

SCHOOL OF HOTEL AND RESTAURANT ADMINISTRATION  
COLLEGE OF HOME ECONOMICS

STILLWATER, OKLAHOMA 74078-0337  
HOME ECONOMICS WEST 210  
(405) 744-6713

Dear Oklahoma Restaurant Association Member:

Remember me? I am the researcher that sent you a questionnaire in June, 1991 on your storage, purchasing and receiving of pecans. You indicated that you use pecans in your food service, therefore, I sent you a brochure on the proper care of pecans. It was the one with the green pecan tree on the front. I hope you received your brochure, if not, please inform me at your earliest convenience and I will send you one.

As a follow-up for this research project, I need one more favor. Will you please complete the following questionnaire and return it to me as soon as possible. Yes, it is the same questionnaire that you filled out before, but please read the questions carefully and answer it as it applies to you now.

Thank you very much for your help with Oklahoma State University research. I hope that you benefit from the information in the brochure.

Sincerely,

A handwritten signature in cursive script, appearing to read 'Marilyn B. Waters'.

Marilyn B. Waters, M.S., R.D.  
Teaching Associate

OKLAHOMA STATE UNIVERSITY  
School of Hotel and Restaurant Administration  
210 Home Economics West  
Stillwater, OK 74078

### MY, HOW TIME FLIES

Three weeks ago you should have received a questionnaire from Oklahoma State University researchers on purchasing and storing PECANS and I would like to hear from you. This was the second questionnaire in a series and it is very important that we have your response in order to complete our study.

Would you please send the completed questionnaire at your earliest convenience. If you did not receive yours, or if you misplaced it, please let me know and I will send you another.

Thank you very much for your fantastic help in this research project.

Marilyn B. Waters  
Teaching Associate  
(405) 744-8486

**APPENDIX B**

**RESEARCH INSTRUMENT:**

**QUESTIONNAIRE**



PECANS USED BY FOOD SERVICE OPERATORS

We would appreciate it if the person responsible for purchasing raw food products in your food service operation would please complete this questionnaire. Answer the following questions with the most appropriate answer for your food service facility.

1. The person filling out this questionnaire is?

Name	Position
------	----------

2. Does your menu include pecan products?

Yes  
 No

If your answer to question 2 is "No", you do not need to continue, but please return your questionnaire to assist us in the follow up phases of the study. Thank you for your part.

If your answer to question 2 is "Yes", please continue.

3. Do you have set specifications for pecan purchases?

Yes  
 No (go to item 7)

4. Do you have written specifications for pecan purchases?

Yes  
 No

5. Do you make verbal specifications with your supplier?

Yes  
 No

6. Which of the following are included in your specifications concerning pecan purchases? (Check "Yes" or "No" for each)

Yes	No	
<input type="checkbox"/>	<input type="checkbox"/>	The most recent crop
<input type="checkbox"/>	<input type="checkbox"/>	Storage conditions since harvest
<input type="checkbox"/>	<input type="checkbox"/>	Temperature of storage since harvest
<input type="checkbox"/>	<input type="checkbox"/>	Storage container since harvest

7. In what form do you receive pecans? (check all that apply)
- Room Temperature Transportation  
 Cold storage Transportation  
 Frozen Transportation  
 Other (please specify) \_\_\_\_\_
8. Which of the following are inspected when an order of pecans is received? (Check "Yes" or "No" for each)
- | Yes                      | No                       |                           |
|--------------------------|--------------------------|---------------------------|
| <input type="checkbox"/> | <input type="checkbox"/> | Type of storage container |
| <input type="checkbox"/> | <input type="checkbox"/> | Condition of container    |
| <input type="checkbox"/> | <input type="checkbox"/> | Temperature of product    |
| <input type="checkbox"/> | <input type="checkbox"/> | Pecan odor                |
| <input type="checkbox"/> | <input type="checkbox"/> | Pecan color               |
| <input type="checkbox"/> | <input type="checkbox"/> | Pecan flavor              |
9. Which of the following do you trust your distributor to inspect before delivery? (check "Yes" or "No" for each)
- | Yes                      | No                       |                           |
|--------------------------|--------------------------|---------------------------|
| <input type="checkbox"/> | <input type="checkbox"/> | Type of storage container |
| <input type="checkbox"/> | <input type="checkbox"/> | Condition of container    |
| <input type="checkbox"/> | <input type="checkbox"/> | Temperature of product    |
| <input type="checkbox"/> | <input type="checkbox"/> | Pecan odor                |
| <input type="checkbox"/> | <input type="checkbox"/> | Pecan color               |
| <input type="checkbox"/> | <input type="checkbox"/> | Pecan flavor              |
10. Which of the following would cause you to reject a shipment of pecans? (check "Yes" or "No" for each)
- | Yes                      | No                       |                           |
|--------------------------|--------------------------|---------------------------|
| <input type="checkbox"/> | <input type="checkbox"/> | Type of storage container |
| <input type="checkbox"/> | <input type="checkbox"/> | Condition of container    |
| <input type="checkbox"/> | <input type="checkbox"/> | Temperature of product    |
| <input type="checkbox"/> | <input type="checkbox"/> | Pecan odor                |
| <input type="checkbox"/> | <input type="checkbox"/> | Pecan color               |
| <input type="checkbox"/> | <input type="checkbox"/> | Pecan flavor              |
11. Do you store the whole order under the same conditions?
- Yes (Answer questions 12 and 13 only)  
 Yes, I store it under one condition, however, I move it at a later time. (Answer questions 14 and 15)  
 No, I split the order and store part under one condition and the rest under another condition. (Answer questions 16-19)

12. If your answer to the preceding question (# 11) is "Yes", how do you store an order of pecans after you receive them? (check one)

Dry storage (over 60 degrees F)  
 Dry storage (40 to 60 degrees F)  
 Refrigerated (32 to 40 degrees F)  
 Subfreezing (0 to 32 degrees F)  
 Freezer (below 0 degrees F)  
 Other (please specify) \_\_\_\_\_

13. How long do you keep pecans at this temperature?

Less than a week  
 Between one and two weeks  
 Between two weeks and a month  
 Between one and twelve months  
 Indefinitely, until they have been used

Since you store your pecans under one condition, you may exit at this point of the questionnaire.

14. If your answer was yes, however, you move them at a later date, what type of storage do you use for the first storage area:

Dry storage (over 60 degrees F)  
 Dry storage (40 to 60 degrees F)  
 Refrigerated (32 to 40 degrees F)  
 Subfreezing (0 to 32 degrees F)  
 Freezer (below 0 degrees F)  
 Other (please specify) \_\_\_\_\_

15. What type of storage do you use for the second storage area:

Dry storage (over 60 degrees F)  
 Dry storage (40 to 60 degrees F)  
 Refrigerated (32 to 40 degrees F)  
 Subfreezing (0 to 32 degrees F)  
 Freezer (below 0 degrees F)  
 Other (please specify) \_\_\_\_\_

If you store your pecans under one condition then move them to another storage area, and you answered questions 14 and 15, you may exit the questionnaire at this point.

16. If your answer to question 11 was "No", at what temperature do you store the smaller portion of pecans?

Dry storage (over 60 degrees F)  
 Dry storage (40 to 60 degrees F)  
 Refrigerated (32 to 40 degrees F)  
 Subfreezing (0 to 32 degrees F)  
 Freezer (below 0 degrees F)  
 Other (please specify) \_\_\_\_\_

17. How long do you keep pecans at the temperature indicated above?

Less than a week  
 Between one and two weeks  
 Between two weeks and a month  
 Between one and twelve months  
 Indefinitely, until they have been used

18. What temperature do you store the remainder of the pecans?

Dry storage (over 60 degrees F)  
 Dry storage (40 to 60 degrees F)  
 Refrigerated (32 to 40 degrees F)  
 Subfreezing (0 to 32 degrees F)  
 Freezer (below 0 degrees F)  
 Other (please specify) \_\_\_\_\_

19. How long do you keep pecans at this temperature?

Less than a week  
 Between one and two weeks  
 Between two weeks and a month  
 Between one and twelve months  
 Indefinitely, until they have been used

Thank you, I appreciate your time and support of this research project. Please return this completed questionnaire in the postage-paid envelope.

Marilyn B. Waters

**APPENDIX C**  
**EDUCATIONAL BROCHURE**

# 1774!?

**Pecans are an American tradition.**

- **George Washington** planted pecan trees at Mount Vernon in **1774** that are still standing. He always carried pecans in his pocket.
- The American Indian traveled many miles to harvest pecans,

and continuing with this American tradition

**Pecans are still America's favorite  
NUT.**

**And Healthy TOO !!!**

Studies have shown that the monounsaturated portion of olive oil seems to be beneficial in lowering total blood cholesterol. But better still, it raises the level of good cholesterol (HDL -cholesterol), which protects against heart disease.

**Pecans**, too, are high in monounsaturates. They provide protein, carbohydrate, dietary fiber, vitamins, and minerals as well.

**Pecans** can make a positive contribution to a healthful, well-balanced diet.

**Continue the tradition,  
your customers deserve the best.**

Nonprofit  
Organization  
U.S. POSTAGE  
PAID  
Stillwater, OK  
Permit No. 191

OKLAHOMA STATE UNIVERSITY  
**School of Hotel & Restaurant Administration**  
College of Home Economics  
Stillwater, Oklahoma 74078-0337



**Still standing since 1774**

# YOUR CUSTOMERS DESERVE THE BEST CONTINUE THE TRADITION

## STORING

Pecans are used year round but only harvested once a year, in the Fall. Therefore year round care of this seasonal commodity is very important to the consumer. Sustaining the freshness is vitally important to customer satisfaction.

- Pecans should be kept in cold storage at all times.
- Pecans can be refrigerated for up to six months or frozen indefinitely.
- Store in an opaque container.
- Store in tightly sealed container to avoid the absorption of odors.
- Store in low humidity.

### STORAGE TIPS !

Pecans can be refrozen many times without loss of quality.

No need to thaw pecans before adding to recipes

Before chopping frozen pecans, try warming them slightly and there will be less shattering.

## PURCHASING

Before purchasing pecans, a reliable distributor should be located and certain information needs to be available, such as:

- In what year were the pecans harvested?
- In what temperature were the pecans stored?
- In what type of containers were the pecans stored?
  - opaque or transparent?
  - airtight or not?
- Were the pecans transferred from one storage area to another and if so,
  - were they left out of cold storage?

and if so,

- how long?

## RECEIVING

When your pecans are delivered, be very careful to inspect them thoroughly. Due to the inconsistency of the handling of pecans it should never be assumed that they have been cared for properly

- Check the odor. They should smell fresh
- Check the appearance. They should look fresh
- Check the flavor. They should taste fresh, no rancid flavor.

**REJECT THE SHIPMENT IF  
THE PECANS ARE NOT TO  
YOUR SATISFACTION!**

*Prepared by:*

*M.B. Waters*

*Oklahoma State University*

*Support from:*

*The Noble Foundation*

**APPENDIX D**  
**INSTITUTIONAL REVIEW BOARD**



OKLAHOMA STATE UNIVERSITY  
INSTITUTIONAL REVIEW BOARD  
FOR HUMAN SUBJECTS RESEARCH

Proposal Title: Development of Educational Material Covering Purchasing,  
Receiving, and Storage of Oklahoma Pecans

Principal Investigator: Beulah Hirschlein/Marilyn B. Waters

Date: March 28, 1991 IRB # HE-91-022

-----  
This application has been reviewed by the IRB and

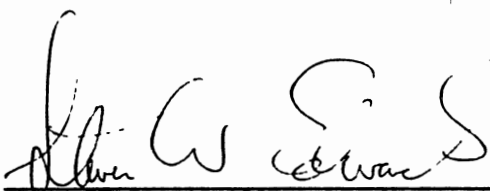
Processed as: Exempt  Expedite  Full Board Review   
Renewal or Continuation

Approval Status Recommended by Reviewer(s):

Approved  Deferred for Revision   
Approved with Provision  Disapproved

Approval status subject to review by full Institutional Review Board at  
next meeting, 2nd and 4th Thursday of each month.

-----  
Comments, Modifications/Conditions for Approval or Reason for Deferral or  
Disapproval:

Signature:  Date: March 29, 1991  
Chair of Institutional Review Board

**APPENDIX E**  
**STATISTICAL DATA**

**Survey Question Numbers**

Respondent		2	3	4	5	6*				7*				8*					
						a	b	c	d	a	b	c	d	a	b	c	d	e	f
12	Pre	1	1	2	1	-	-	-	-	1	-	-	-	-	-	-	1	1	1
	Post	1	2	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
17	Pre	1	1	2	1	2	2	2	2	1	-	-	-	2	2	2	2	1	1
	Post	1	1	2	1	1	-	-	-	1	-	-	-	1	1	1	-	1	1
31	Pre	1	1	2	1	1	2	2	2	-	1	-	-	2	1	2	1	1	1
	Post	1	1	2	1	1	1	2	2	-	1	-	-	2	2	2	1	1	1
65	Pre	1	1	2	1	1	1	1	2	1	-	-	-	2	1	2	2	1	1
	Post	1	1	2	1	1	1	1	2	1	-	-	-	2	2	2	1	1	1
125	Pre	1	2	-	-	-	-	-	-	1	-	-	-	1	1	-	1	-	1
	Post	1	2	-	-	-	-	-	-	1	-	-	-	1	-	1	1	1	1
188	Pre	1	1	1	2	2	2	2	2	1	3	3	3	1	1	2	2	2	2
	Post	1	1	1	2	2	2	2	2	1	-	-	-	1	1	2	2	2	2
211	Pre	1	1	1	2	2	1	1	1	-	1	-	-	1	1	-	1	1	1
	Post	1	2	-	-	-	-	-	-	-	-	-	-	1	1	-	1	1	1
224	Pre	1	2	2	2	2	2	2	2	-	-	1	-	2	2	2	2	2	2
	Post	1	2	2	2	2	2	2	2	-	-	1	-	-	1	1	-	-	-
251	Pre	1	1	2	1	2	2	2	2	-	1	-	-	2	1	1	1	2	1
	Post	1	1	2	1	2	2	2	2	-	1	-	-	2	1	1	2	2	1
274	Pre	1	2	-	-	-	-	-	-	1	-	-	-	2	1	2	1	1	1
	Post	1	2	-	-	-	-	-	-	-	-	-	1	2	1	1	1	1	1
340	Pre	1	2	-	-	-	-	-	-	1	-	-	-	1	-	-	1	1	1
	Post	1	2	-	-	-	-	-	-	1	-	-	-	1	1	-	-	-	-
375	Pre	1	1	1	1	2	2	2	2	-	1	-	-	2	2	2	2	2	1
	Post	1	2	-	-	-	-	-	-	-	-	1	-	1	1	1	1	2	2
391	Pre	1	2	-	-	-	-	-	-	3	3	3	1	1	1	2	2	2	2
	Post	1	2	-	-	-	-	-	-	1	-	-	-	1	1	2	2	2	2
397	Pre	1	1	2	1	1	-	-	-	-	1	-	-	-	-	-	1	1	1
	Post	1	2	-	-	-	-	-	-	-	1	-	-	1	-	-	1	1	1

- = missing data or answer not applicable

\* multiple responses within one question are sequentially represented by lower case letters in column headings.

**Survey Question Numbers**

Respondent	2	3	4	5	6*				7*				8*					
					a	b	c	d	a	b	c	d	a	b	c	d	e	f
445 Pre	1	2	-	-	-	-	-	-	-	1	-	-	2	1	1	1	2	1
445 Post	1	2	-	-	-	-	-	-	-	1	-	-	2	1	1	2	2	2
469 Pre	1	2	-	-	-	-	-	-	-	1	-	-	2	1	2	1	2	2
469 Post	1	2	-	-	-	-	-	-	-	1	-	-	1	1	2	1	1	1
499 Pre	1	2	-	-	-	-	-	-	-	-	1	-	1	1	1	1	1	1
499 Post	1	1	2	1	1	1	-	-	-	-	1	-	1	1	1	-	-	-
576 Pre	1	1	2	1	1	1	-	-	-	1	-	-	1	1	2	-	-	1
576 Post	1	2	2	1	1	1	1	2	-	1	-	-	2	1	1	1	1	1
579 Pre	1	2	-	-	-	-	-	-	-	1	-	-	2	1	2	2	2	2
579 Post	1	2	-	-	-	-	-	-	-	1	-	-	2	1	2	2	2	1
594 Pre	1	1	2	2	1	1	2	2	-	1	-	-	1	2	2	2	2	2
594 Post	1	2	-	-	-	-	-	-	-	1	-	-	-	1	1	1	1	1
696 Pre	1	2	-	-	-	-	-	-	1	-	-	-	-	-	-	1	1	1
696 Post	1	2	-	-	-	-	-	-	-	1	-	-	-	1	-	1	1	1
726 Pre	1	1	2	1	2	2	2	2	1	-	-	-	1	1	2	2	2	2
726 Post	1	1	2	2	2	2	2	2	-	1	-	-	1	1	1	2	2	2

- = missing data or answer not applicable

\* multiple responses within one question are sequentially represented by lower case letters in column headings.

**Survey Question Numbers**

Respondent		9*						10*						11	12	13	14	15	16	17	18	19
		a	b	c	d	e	f	a	b	c	d	e	f									
12	Pre	-	-	-	-	-	-	-	-	-	-	-	-	1	4	2	-	-	-	-	-	-
	Post	1	2	1	1	1	1	-	1	-	1	-	1	3	-	-	-	-	1	1	4	5
17	Pre	1	1	2	2	1	1	2	2	2	1	1	1	1	2	5	-	-	-	-	-	-
	Post	1	1	1	1	1	1	1	1	1	1	-	-	1	3	3	-	-	-	-	-	-
31	Pre	1	1	1	1	1	1	1	1	2	1	1	1	3	-	-	-	-	1	2	3	5
	Post	12	1	2	1	1	1	1	1	1	1	1	1	2	-	-	4	3	-	-	-	-
65	Pre	1	1	1	1	1	1	2	1	2	2	1	1	1	4	4	-	-	-	-	-	-
	Post	1	1	1	1	1	1	2	2	2	1	1	1	1	4	4	-	-	-	-	-	-
125	Pre	1	1	2	2	2	2	-	1	-	1	-	1	2	-	-	4	1	-	-	-	-
	Post	1	1	1	1	1	1	-	1	1	-	1	-	2	-	-	4	3	-	-	-	-
188	Pre	1	1	1	1	1	1	1	1	2	2	2	2	1	1	2	-	-	-	-	-	-
	Post	1	1	1	1	1	1	1	1	2	1	2	1	1	3	2	-	-	-	-	-	-
211	Pre	1	1	1	1	1	1	-	-	-	1	1	1	1	2	5	-	-	-	-	-	-
	Post	1	1	1	1	1	1	1	-	1	1	1	1	1	1	2	-	-	-	-	-	-
224	Pre	1	1	1	1	1	1	2	1	1	1	1	2	1	4	3	-	-	-	-	-	-
	Post	1	1	1	-	-	-	-	1	1	-	-	1	1	4	3	-	-	-	-	-	-
251	Pre	1	1	1	2	2	2	2	1	1	1	1	1	1	3	4	-	-	-	-	-	-
	Post	1	1	1	1	1	1	2	1	1	1	1	1	1	4	4	-	-	-	-	-	-
274	Pre	1	1	1	1	1	1	2	1	2	1	1	1	1	3	3	-	-	-	-	-	-
	Post	1	1	1	1	1	1	2	1	2	1	1	1	1	4	3	-	-	-	-	-	-
340	Pre	-	-	-	-	-	-	1	1	-	1	-	1	1	4	4	-	-	-	-	-	-
	Post	1	1	1	1	1	1	1	1	-	1	-	1	1	4	5	-	-	-	-	-	-
375	Pre	2	2	2	1	1	1	2	2	2	1	1	1	1	3	3	-	-	-	-	-	-
	Post	2	2	2	2	2	2	1	1	1	1	1	1	3	-	-	-	-	3	2	4	3
391	Pre	1	1	1	1	1	1	1	1	2	1	2	1	1	1	5	-	-	-	-	-	-
	Post	1	1	1	1	1	1	2	1	2	1	1	1	1	3	5	-	-	-	-	-	-
397	Pre	1	1	1	1	1	1	-	1	-	1	1	1	1	3	3	-	-	-	-	-	-
	Post	1	1	1	1	1	1	-	-	-	2	2	2	2	3	5	3	4	-	-	-	-

- = missing data or answer not applicable

\* multiple responses within one question are sequentially represented by lower case letters in column headings

**Survey Question Numbers**

Respondent		9*						10*						11	12	13	14	15	16	17	18	19
		a	b	c	d	e	f	a	b	c	d	e	f									
445	Pre	1	1	1	1	1	1	-	1	-	1	1	1	1	3	1	-	-	-	-	-	-
	Post	1	1	1	1	1	1	2	1	1	1	1	1	1	4	2	-	-	-	-	-	-
469	Pre	1	2	1	2	1	2	2	1	2	1	2	1	1	1	3	-	-	-	-	-	-
	Post	1	1	1	2	2	2	2	1	2	1	2	1	1	3	3	-	-	-	-	-	-
499	Pre	1	1	1	1	1	1	1	1	1	1	1	1	1	4	3	-	-	-	-	-	-
	Post	1	1	1	1	-	1	1	1	1	-	-	1	4	3	-	-	-	-	-	-	-
576	Pre	1	1	1	1	1	1	1	1	1	1	1	1	1	3	3	-	-	-	-	-	-
	Post	1	1	1	1	1	1	2	1	1	1	1	1	1	3	2	-	-	-	-	-	-
579	Pre	1	1	1	1	1	1	2	1	2	1	1	1	1	4	3	-	-	-	-	-	-
	Post	2	1	1	1	1	1	2	1	2	1	2	1	1	4	3	-	-	-	-	-	-
594	Pre	1	1	1	1	1	1	1	1	2	1	1	1	1	3	3	-	-	-	-	-	-
	Post	1	1	1	1	1	1	-	1	1	1	1	1	1	4	3	-	-	-	-	-	-
696	Pre	1	1	1	1	1	1	-	-	-	1	1	1	3	-	-	-	-	3	3	4	4
	Post	1	-	-	-	-	1	1	1	-	1	1	1	2	-	-	4	3	-	-	-	-
726	Pre	1	1	2	2	2	2	1	1	2	2	2	2	1	1	3	-	-	-	-	-	-
	Post	1	1	1	1	1	1	1	1	2	1	1	1	1	3	2	-	-	-	-	-	-

- = missing data or answer not applicable

\* multiple responses within one question are sequentially represented by lower case letters in column headings.

VITA

Marilyn B. Waters

Candidate for the Degree of  
Doctor of Philosophy

Thesis: A PRINTED BROCHURE AS AN EDUCATIONAL INTERVENTION IN THE PECAN HANDLING PRACTICES OF OKLAHOMA FOOD SERVICE OPERATORS

Major Field: Home Economics

Biographical:

Personal Data: Born in Bartlesville, Oklahoma, September 1, 1939, the daughter and first child of Walter and Nadine Baugh; one brother, Thomas Walter Baugh; three children: Jamie Lyn Waters, Jana Susanne Waters, and Robert Thomas Waters.

Education: Attended public schools in Bartlesville, Oklahoma and graduated from College High School, Bartlesville, Oklahoma, in May, 1957; received Bachelor of Science degree with a major in Home Economics Education and Community Services from Oklahoma State University in May, 1981; received Master of Science degree in Food, Nutrition and Institution Administration from Oklahoma State University in July, 1985; completed requirements for the Doctor of Philosophy degree at Oklahoma State University in July, 1992.

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