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Consumer Acceptability Of 2% Shelf-Stable Milk

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CONSUMER ACCEPTABILITY OF
2% SHELF - STABLE MILK

FRIGO

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CONSUMER ACCEPTABILITY OF

2% SHELF-STABLE MILK

(TITLE)

BY

PATRICIA A. FRIGO

THESIS

SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR THE DEGREE OF

MASTER OF SCIENCE

IN THE GRADUATE SCHOOL, EASTERN ILLINOIS UNIVERSITY
CHARLESTON, ILLINOIS

1990

YEAR

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ABSTRACT

Frigo, Patricia A. (1990). Consumer acceptability of 2% shelf-stable milk. Master of Science, Eastern Illinois University. Major professor: Mary Lou Hubbard, Ph.D.

The purpose of this study was to explore consumers' attitudes on the acceptability of 2% shelf-stable milk. The sample consisted of 187 consumers in two Illinois counties, Coles and Cook. Seventy-six males and 111 females, ranging in age from seven years to over 65 years old took part in the study with the majority of them consuming milk as a beverage daily. Data were collected using a self-administered questionnaire developed by the researcher. Participants were asked to indicate how well they liked the 2% shelf-stable and dairy case milk which was provided at the time of administering the questionnaire. They were also asked to indicate which milk they preferred to purchase. Milks were not identified until the questionnaire was completed. In addition to the blind taste test, subjects were asked to indicate frequency of consumption and the kind of milk they used most often. Statistical analyses included means and frequency distributions, t-test of independent samples, paired comparison t-tests, Pearson product-moment correlation and Chi-square tests of independence.

Acceptability of 2% dairy case milk was significantly higher than that of 2% shelf-stable milk, shelf-stable milk

was generally viewed as unacceptable, and most consumers said they would prefer to purchase dairy case milk. No practical relationships were found between acceptance of shelf-stable milk and consumer age, sex, frequency of milk consumption, or store location.

While the study sample was relatively small, several conclusions can be suggested. When sampling both milks in the same session, the participants' like the 2% dairy case milk much more than the shelf-stable milk. Based on sensory characteristics only, participants would prefer to purchase dairy case milk as compared to shelf-stable milk. The regular drinkers of 2% milk also like the dairy case milk much better than the shelf-stable milk. Based on the findings in this study, sensory characteristics are only part of consumer acceptance and milk purchase.

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Chapter I

Introduction

For many centuries, milk has been widely accepted throughout the world. Milk, as a beverage in the United States, dates back to 1611 when cows were brought to Jamestown, Virginia [Milk Industry Foundation (MIF), 1989]. As pioneers settled into new territories, cows slowly dispersed throughout the west. The first "regular" shipment of milk was delivered by rail to New York in 1841. As science and research continued, milk became readily available throughout the United States. Today, in many third world countries, milk is not easily available for many reasons, one of them being the requirement of constant refrigeration for storage.

Because of the need for milk in the human diet, reseachers have explored other types of processing methods. Dairy producers, as well as health care specialists, have been studying new ways to produce milk which does not require refrigeration. Due to technological advances, milk is now available in these countries and the United States in a nonrefrigerated pasteurized fluid form.

Milk is a natural food that can be varied to satisfy a taste or special dietary need. It is considered to be a food

of high nutrient density and "nature's most nearly perfect food" (MIF, 1989, p.3). "It is among the most perishable of all foods due to its excellent nutritive composition and its fluid form" [National Dairy Council (NDC), 1978, p.4]. Milk producers depend upon several components of milk to assure the best product. These components include food value, flavor, appearance, keeping capability and suitability for use in the manufacture of various products (Marth, 1981). Since milk is biologically produced, the flavor and quality of milk are greatly influenced by the genes and breed of the cow. The quality of milk is also affected by several other factors. One of the most important is the environment in which the milk is produced and processed. In addition, the refrigeration processes used at the stores and by the consumer are of concern and affect the quality of milk (Thomas, 1981). Environmental factors include inadequate procedures of processing the milk, insufficient refrigeration temperatures, and inadequate cooling temperatures during transportation.

"The acceptance of milk as a food is based to a large extent on its flavor and shelf-life" (Bradley, 1980, p.314). Attitudes of the consumer also affect the acceptance of dairy products (Tuorila, 1987). Milk is considered to be a bland food and one in which any deviation in flavor or consistency is readily sensed by the consumer (Deeth, 1986). Consumption of milk as a beverage is influenced by flavor more than any

other attribute (Thomas, 1981). In a consumer acceptance study of milk, Swope and Nolan (cited in Deane, Chelesvig, & Thomas, 1967) identified that taste acceptance was the most important single factor associated with drinking milk. The success of a product in the market place depends highly upon its appeal and acceptability by the consumer (Jeremiah, 1982).

The fast-paced lifestyle of many American consumers has stimulated a demand for higher quality and more convenient nutritional food items. The dairy manufacturers are generating new ideas for products to meet these needs. Innovations include creation of new packaging and processing techniques for milk.

The typical processing of milk has been pasteurization, or what is known as high temperature-short time (HTST), which requires subsequent refrigeration of the product. In the past few years, attempts have been made to expand the pasteurization technique. One specific goal of the expansion has been to increase the shelf life of pasteurized milk (Poulsen & Wainess, 1986). Therefore, to meet this goal, some dairy industries are currently using a technique of advanced pasteurization in which milk no longer requires refrigeration after processing. Consequently, the shelf life of milk is extended. This process is also known as Ultra High Temperature (UHT). Rawlings (1986) indicated the UHT process does very little to alter or impair the natural

flavor, color or aroma of the product. As a result of this technique, UHT milk is stored in an aseptic package. This milk is referred to as aseptically packaged shelf-stable milk. An aseptic package is a carton which is plastic-coated and lined with aluminum foil, ensuring that the product is not exposed to light (Porter, 1975). Aseptically packaged milk can be stored on the pantry shelf instead of a refrigerator shelf. This allows consumers to keep milk in the home longer, requiring no refrigeration prior to opening.

For the industry to be successful with this advanced product, the dairy manufacturers must be aware of consumer behavior regarding UHT milk as a beverage. Because of the change in the packaging of milk and a slight alteration in flavor and color, the product may not be acceptable to consumers as a beverage. However, Kon (1972) indicates UHT milk flavor remains the same and there is greater retention of nutritive properties when compared with pasteurized milk. Therefore, the slight flavor difference raises the question, "Would consumers purchase UHT milk if given the choice?"

Purpose

The purpose of this study was to provide additional information on the acceptability of UHT milk. This study explored consumers' attitudes toward 2% dairy case milk and shelf-stable milk. The research was conducted in a manner that would allow for direct comparison of 2% shelf-stable and 2% dairy case milk.

Objectives

Seven objectives were identified and addressed in this study.

1. To determine how well the participants like 2% shelf-stable milk as compared to the 2% dairy case milk.
2. To determine which milk the participants would prefer to purchase.
3. To determine if there is a difference in acceptance between 2% shelf-stable milk and 2% dairy case milk by the participants who regularly drink 2% dairy case milk daily.
4. To determine if there is a relationship between the participants' sex and how well they like each of the two types of milk.
5. To determine if there is a relationship between the participants' sex and which of the milks they prefer to purchase.
6. To determine if there is a relationship between the participants' age and how well they like each of the two types of milk.
7. To determine if there is a relationship between the participants' age and which of the milks they prefer to purchase.

Definition of Terms

For the purpose of clarity, the terms referred to in this study are defined as follows:

Aseptic packaging - a packaging technique which brings together a pre-sterilized container and an aseptically processed product, within a commercially sterile environment so no contamination can occur (Thrall, 1988).

Advanced pasteurization/ultra high temperature (UHT) - a treatment which preserves fresh milk by exposing it to rapid heating temperatures exceeding 135°C (Zadow, 1986).

Consumption - drinking milk as a beverage.

Dairy case milk - milk requiring immediate refrigeration after processing.

Homogenized milk - milk with fat globules broken up mechanically to the extent that they do not rise to the surface to form a cream layer (Kon, 1972).

To like - to find agreeable to one's taste (Stein, 1978).

Lowfat milk/ 2% and 1% - a sufficient amount of milkfat has been removed to produce milk with one of the following milkfat contents 0.5, 1.5. or 2.0 percent milkfat and not less than 8.25 percent solids-not-fat (NDC, 1978).

Pasteurization - a treatment which heats milk to a temperature near 75°C for 15 seconds and requires constant refrigeration after packaging (Kon, 1972).

Preference - to like "better".

Shelf-stable milk - milk which has been packaged and processed in such a way that it can be stored for a long period of time without refrigeration; non-refrigerated milk.

Skim milk - milk which contains less than 0.5 percent milkfat and contains more than 8.25 percent solids-not-fat (MIF, 1989).

Ultra high temperature (UHT) - see advanced pasteurization.

Whole milk - processed milk which contains more than 3.25 percent milkfat and 8.25 percent solids-not-fat (MIF, 1989).

Chapter II

Review of Literature

Introduction

The literature review revealed a paucity of current information on shelf-stable fluid milk. The majority of articles and research materials discussed the processing and production of dairy case milk and very rarely noted shelf-stable milk. Therefore, the following review of literature focuses on dairy case milk and the process and packaging of UHT milk.

History of Milk

Milk has played a vital role in America's history since 1611 when the first cows arrived in Jamestown, Virginia (MIF, 1989). Over the past centuries cows' milk has successfully continued to serve the nutritional needs of the world's growing population.

In 1856 Pasteur developed the pasteurization process in which every particle of milk was heated to a temperature not lower than 145° F., for not less than 30 minutes. The milk was then promptly cooled to destroy any harmful bacteria which may have been present without affecting flavor and food value (MIF, 1989). In the same year, Borden received the first patent on condensed milk from the United States and

England. In 1884 the milk bottle was invented which increased distribution and storage among the dairies, farmers and consumers. Babcock, in 1890, perfected a test for controlling the fat content of milk. Five years later commercial pasteurizing machines were introduced. In 1913, the first high temperature processing plant went into operation in England. However, satisfaction of UHT milk was not yet perfected due to several packaging problems. In 1919, homogenized milk began to be marketed in the United States. The main containers used for milk were glass bottles, until 1932 when the plastic coated paper milk cartons were introduced commercially. These containers provided more durability, ease of transportation, and nutrient retention. This advancement created many opportunities for expansion of distribution and storage life of milk. Nineteen forty-eight was when the technique for UHT pasteurization was developed in the United States. However, at this time UHT milk was not available to the public. It was not until 1958 that UHT milk began to be marketed in Europe. The success of packaging UHT milk in Europe is credited to a Swiss firm, Tetra Pak, which developed a sterilized aseptic container that would allow the milk to have the same flavors as pasteurized milk. In 1980, over half of the milk sold in Italy and Germany was UHT (Arnold & Roberts, 1982). Finally, in 1981, UHT milk was placed on the market in the United States. Presently, it can be found on

some supermarket shelves in certain regions of the country.

Due to advancements and improvements achieved by the dairy industry in the areas of processing, packaging, refrigeration and distribution, milk is readily available to many consumers. Today, dairy case milk appears on the market in several forms that appeal to the varied tastes and desires of the consumers: whole, lowfat 2% and 1%, and skim (NDC, 1978).

Because pasteurized milk is a perishable product, the Food and Agriculture Organization/World Health Organization Codex Alimentarius promotes the safety standards of milk products worldwide. Protecting the quality of milk is a shared responsibility of public health officials, the dairy industry and consumers (NDC, 1978).

Processing of Milk

"The processing involved for each form of milk is designed and controlled to protect the health of the consumer" (NDC, 1978, p.8). To ensure that the milk is a safe product of good keeping quality, it is necessary to have a system of handling and processing that destroys all the harmful microorganisms. Due to the fact that bacteria multiply more rapidly in warm than in cold milk, the first step is to minimize the rate of spoilage after it leaves the cow's udder by cooling the milk at the farm (Porter, 1975). The cold milk is then transported to the dairy company in specially designed storage tanks and is immediately subjected

to a heat treatment. This treatment preserves milk by destroying harmful enzymes and bacteria making the milk safe to consume. The three types of treatments normally employed are pasteurization, UHT and retort sterilization.

Pasteurization destroys pathogenic organisms and weakens others, enabling the product to be safely transported, distributed and consumed as a liquid milk (Kon, 1972). According to the National Dairy Council (1978), pasteurization assures the safety and enhances the keeping quality of milk without significantly changing its nutritive value.

Ultra High Temperature (UHT) is a continuous process of pasteurization in which the milk is heated at a higher temperature and held for two to four seconds. UHT procedures are based on the discovery that higher processing temperatures with shorter holding times result in a product in which all bacteria have been destroyed but little change in color and flavor has occurred (Porter, 1975). UHT processing is comparable to pasteurization in causing little loss of the nutritive value. "Storage in light-proof containers impermeable to oxygen permits UHT milk to retain almost all its nutritional merit" (Arnold & Roberts, 1982, p.4).

Using retort sterilization, milk is processed at temperatures of 117° - 120° C for 10-20 minutes (Hill, 1988). This process is similar to UHT; however, the sterilization process ensures the destruction of all microorganisms, but

the ideal aim is not always achieved (Kon, 1972).

Hedrick, Harmon, Chandan, & Seiberling (1981) believe the trend towards UHT milk will increase due to the emphasis on energy conservation and the advancements in mechanical technology. There are three major benefits generally cited for UHT milk. The first is allowing an increase in distribution. This would allow a dairy to simplify delivery schedules and to expand its market. Overall, the number of returns of outdated milk would be decreased. The second advantage is the saving of energy due to the UHT process. Without refrigeration, less electricity is required for refrigerated delivery trucks and retail store dairy shelves. The third major UHT benefit is consumer convenience. Larger quantities of milk can be purchased in advance which could limit extra trips to the supermarket (Joosten, 1985). UHT milk is the ideal convenient product for recreational use where refrigeration or other cooling is impractical or not available. In a study by Nelson (1988) it was predicted that with continued research on processing procedures for UHT milk, the product will eventually become accepted in the United States.

Composition and Production of Milk

The composition and production of milk is influenced by a number of factors. "The composition varies qualitatively and quantitatively in response to physiological factors" (NDC, 1978, p.16). Variations in composition can occur among

breeds of dairy cattle and between one milking and another. Other factors include the age of the cow, the feed and nutritional level, the environmental temperatures and season.

"Although milk from the cow is processed, it is not an engineered or fabricated food. It is about 87 percent water and 13 percent solids" (MIF, 1989, p.36). The solid nutrients include carbohydrates, protein, water and fat soluble vitamins and minerals. These nutrients in milk, help make it highly nutritious. The opaque color of milk is due mainly to the dispersion of milk proteins and the calcium salts (Kon, 1972).

The production of high-quality milk first begins with healthy cows with suitable genetic background (Marth, 1981). The production process is also determined by climatic conditions, milk yields, transport facilities, the availability of dairy machinery and equipment, marketing systems, retail prices and the purchasing power of consumer groups. Social and cultural factors such as food habits and preference, also play important roles in the production process (Kon, 1972).

Consumption and Flavor

Health value is a major influence on the drinking of milk due to milk's perceived contribution to the proper development and maintenance of the human body. Consumption recurrence varies among age and sex of the consumer. Studies have shown that male consumers drink milk as a beverage more

often than females during the teenage years due to female obsession with controlling calorie and fat intake (Mann, 1989).

Thomas (1981) noted that flavor is the most important attribute of milk as a beverage. Consumer acceptance and preference is highly dependent upon this factor and consumers drink milk regularly because they enjoy the flavor. A flavor change can occur as a consequence of the severity of the heating procedure to which the milk has been subjected. In pasteurized milk the cooked flavor is slightly detected and becomes more pronounced with the increased time of heat treatment. Bradley (1980) reported that the development of the "off-flavor" in UHT milk is related to the length of exposure, the strength of the light and the size of the milk surface exposed. According to Price and Manning (1983), both pasteurized and UHT milk have a cooked flavor. However, in a comparison study of four direct UHT-processed milks, Rerkrai, Jeon, & Bassette (1987) concluded that various heat treatments did not significantly affect the flavor of UHT milk.

Milk stored in aluminum foil lined cartons is able to retain its desirable flavor for a longer period than milk stored in polyethylene lined cartons. Bradley (1980) established that any paperboard laminate containing an aluminum foil layer would minimize the amount of light transmitted and increase the shelf-life flavor of the product

contained. Price and Manning (1983) also confirmed that the type of storage carton of UHT milk can effect the formation of stale off-flavors.

Storage and Packaging of Milk

The storage and packaging of milk are critical procedures to retain the freshness and quality of milk. The proper handling of dairy products and open dating are designed to assure consumers of a high quality product. The open dating refers to the length of time in which the milk should be used, if all suitable conditions are met after processing (NDC, 1978). In the packaging and storage of milk, the first essential objective is "the safety of the consumers and the quality of the product. No deleterious effect on shelf stability or shelf life of the pasteurized milk product should be acceptable" (Poulsen & Wainess, 1986, p.64). Over the last decade, the dairy industry has been involved in research methods to increase the shelf life of refrigerated pasteurized milk. The use of refrigeration at temperatures less than 5° C in the dairy plant, during transportation, and in retail outlets has permitted the shelf life of pasteurized dairy case milk to increase (Poulsen & Wainess, 1986). Because of processing and packaging of UHT milk, the shelf life is automatically extended.

The packaging process is an essential form and an indispensable part of the liquid milk industry (Poulsen & Wainess, 1986). The arena of packaging milk is clearly

dynamic and is vital to both the consumer and distributor. Until the UHT process was introduced, all pasteurized dairy case milk was sold in similar containers. These containers were either glass bottles, plastic jugs or plastic coated paper cartons. However, due to the processing of UHT milk, the higher temperatures used, and the extended shelf life, the package needed to be changed. The new packaging concept was aimed at giving consumers a "price/ value relationship" that provided the following attributes: shelf-life extension, inertness, versatility, lightness of weight, shatterproof design, clarity, sturdiness, direct usage, opening ease, flavor/aroma protection and tamper evidence (Ott, 1988).

The container for UHT milk is an aseptic carton. Aseptic packaging is a process which enables liquids to be packaged and stored for extended periods without refrigeration. Aseptic packaging is becoming popular because it provides benefits for the packers as well as the consumers. The package is less expensive to distribute, the product has increased shelf stability, and the milk maintains product quality without the expense of refrigeration (Ott, 1988). The package also prevents spoilage and can minimize thermal damage to products. Aseptically packaged milk is a product which can be transported, stored and displayed in stores at ambient temperatures and is not dependent on refrigeration (Rawlings, 1986). Delivery schedules can also

be arranged to meet consumer demand patterns. Aseptic packaging provides the features of convenience, visual impact, high product quality and customer appeal.

Summary

Milk, "nature's mostly nearly perfect food", serves as an important source of nutrients in the human diet (MIF, 1989, p.3). As a beverage, milk has been widely accepted throughout the world. The advancement in technology has allowed pasteurized milk to be produced, stored and distributed in many ways. Europe was one of the first countries to sell UHT milk and the demand for the product continues. In the United States the National Dairy Council (1978) and Arnold and Roberts (1982) noted UHT milk has not been as readily accepted by American consumers because the process leaves a stronger cooked flavor which affects the taste. However, continuous research is being conducted on UHT processing to eliminate differences in flavor and color.

Chapter III

Methodology

Selection of Sample

This research was to provide additional information on the acceptability of UHT milk. The study explored consumers' attitudes toward 2% dairy case and shelf-stable milk. The sample was obtained from consumers in the Coles and Cook counties of Illinois. Recruitment was conducted in the dairy section of two grocery stores in Coles county and one grocery store in Cook county. The sample consisted of consumers who were purchasing milk and any other consumers who volunteered. Consumers were asked to participate in a blind taste test of two milk samples and complete a brief questionnaire. To include a sample of consumers who work full-time and/or attend school during the week, the recruitment period included one weekend day. The days selected for the study were days predicted by the store management to be the heaviest milk shopping days of the week which were Friday and Saturday. The time of day changed for each store as indicated by the store managers as the heaviest shopping hours.

Questionnaire Development

A self-administered questionnaire was developed by the

researcher and consisted of seven questions (Appendix A). The questionnaire was reviewed for content validity by four east central Illinois home economics professors and a milk distributor consultant. Prior to administering the questionnaire, it was pilot tested by 17 consumers. Minor changes were made.

Questions one and two ascertained how well the participant liked each milk sample. A seven point hedonic scale with one representing "dislike very much" and seven representing "like very much" was used for the participant to rate his/her response. Participants were encouraged to give their reasons for each response. The third question asked which milk the participant would prefer to purchase. The fourth question asked the frequency of milk consumption followed by the kind of milk the participant drank most often. The sixth question assessed regularity of milk drinking for four life cycles stages: childhood (6-11), adolescence (12-18), young adulthood (19-34), and middle adulthood and older. Participant age was obtained in question seven. The sex of each participant was noted by the researcher on each returned questionnaire.

Data Collection

Initial contact was made with the store manager of the selected supermarket to approve the administration of the blind taste test and questionnaire. The data were collected for three hours on each of the two days scheduled per store.

A table was set up in the dairy section of each store. A banner reading "Milk Study" was used to invite consumers to participate. The researcher also requested participation of customers as they passed the dairy case section.

During the collection of the data, a brief explanation of the milk study was provided followed by the administration of the blind taste test of each milk sample. Participants responded after each milk was tasted. The identity of each milk was not revealed to participants until the entire questionnaire was completed (Appendix B). Approximately two fluid ounces of each milk sample was presented to each participant in a plastic cup coded with a colored dot. The colored dots on the questionnaire were alternated to randomize the sampling order. Customers were requested to sample the milk type that was listed first on their questionnaire. Thus about half of the participants tasted the shelf-stable milk first; the other half tasted the dairy case milk first. The milk samples were chilled to similar temperatures. Shelf-stable milk from the same production lot was used throughout the study. An unsalted cracker was provided for each participant to eat between the milk samples. The cracker was used to lessen any influence of taste one milk might have upon the other.

Data Analysis

Data from the questionnaires were coded and entered into the computer. The Statistical Package for Social Sciences

was used for all data analyses (SPSS User's Guide, 1986). Frequencies, percentages, and measures of central tendency were calculated for all data. Tables and figures were developed to represent the calculations. Open-ended responses of the participants' reasons for their acceptability ratings were summarized.

Paired-comparison t-tests were used to compare acceptability of shelf-stable and dairy case milk for all respondents and separately for those participants who drank 2% milk daily. T-test analyses were used to examine the relationships between participants' acceptability of the shelf-stable and of the dairy case milk to the individual's sex. T-tests were also used to compare the overall acceptance of the milks by store and county. Chi-square analyses were used to determine whether the milk the participants preferred to purchase was related to the individual's sex. Pearson product-moment correlational analysis was used to determine potential relationships between the participants' age and how well they liked each of the two milks.

Chapter IV

Results and Discussion

One hundred and eighty-seven consumers, 76 males and 111 females participated in the study. To achieve this sample three different grocery stores in Illinois, Coles and Cook county, were used. Characteristics of these consumers are presented in Table 1. The respondents' ages ranged fairly evenly from seven years to over 65 years of age. The majority (72%) of participants indicated they have consumed milk as a beverage throughout their life span.

Acceptability of the Two Milks

The first objective of this study was to determine how well the participants liked 2% shelf-stable milk as compared to 2% dairy case milk. A hedonic scale was used for the participants to check the appropriate number which indicated how well they liked each type of milk. The participants responded on a scale of one (dislike very much) to seven (like very much) for each milk sample.

The participants' responses to the shelf-stable milk were evenly distributed on the hedonic scale with a mean score of 3.95 (Table 2). Participants' responses to the dairy case milk ranged from seven to two on the hedonic scale

Table 1

Participants' Characteristics: Sex, Age and Milk Consumption Pattern

	Male		Female		Total	
	N ¹	%	N ¹	%	N ¹	%
Participants	76	41	111	59	187	100
Age (years)						
7-15	16	53	14	47	30	16
16-20	8	62	5	38	13	7
21-30	16	52	15	48	31	17
31-40	9	31	20	69	31	16
41-50	11	38	18	62	29	15
51-64	6	25	24	75	30	16
65+	10	40	15	60	25	13
Milk consumption patterns						
	Years ²				N ¹	%
Childhood	6-11				17	9
Adolescence	12-18				4	2
Young adulthood	19-34				4	2
Middle adulthood and older	35+				4	2
All their life					134	72
Does not apply					3	2
Other ³					21	11

¹Number of participants.

²Only during years indicated.

³Consumed regularly in two or three stages of life.

Table 2

Consumer Acceptability of 2% Shelf-Stable and Dairy Case Milk

	Shelf-Stable		Dairy Case	
	N	%	N	%
Like				
Very Much				
7	28	15	89	47
6	22	12	51	27
5	27	14	22	12
4	32	17	18	10
3	25	14	4	2
2	19	10	3	2
1	34	18	0	-
Dislike				
Very Much				
Total	187	100%	187	100%
Mean \pm S.D.	3.95	\pm 2.04	6.04*	\pm 1.20

*Significantly higher, $p=.001$

with a mean score of 6.04. Subjects rated the dairy case milk significantly higher ($p=.0001$) than the shelf-stable milk. Substantially more of the participants (42%) disliked (response ≤ 3) the shelf-stable than disliked the dairy case milk (4%).

The participants' verbal and open-ended responses about the two milks varied. The majority of participants who liked the shelf-stable milk said that the milk was "richer, creamier, and had a fresh taste." One boy responded, "Mmm, this is good, tastes like baby formula." In general, participants who did not care for shelf-stable milk believed that the milk tasted like canned milk. Aesthetic quality responses included "salty", "sweet", "powdery", "chalky", "too milky" and "too creamy." Color and flavor was frequently noted; however, the majority stated that the milk had a bad after taste. "Hee haw", "yuck", "whoa", and "gross" were some of the verbal comments. Responses concerning the acceptability of dairy case milk included that the milk possessed a "fuller taste". Overall open-ended responses were that the milk tasted rich, creamy, and smooth. Two respondents stated the milk had a "sweet, pleasant, and refreshing taste." Numerous respondents stated that the dairy case milk tasted "more familiar" to them.

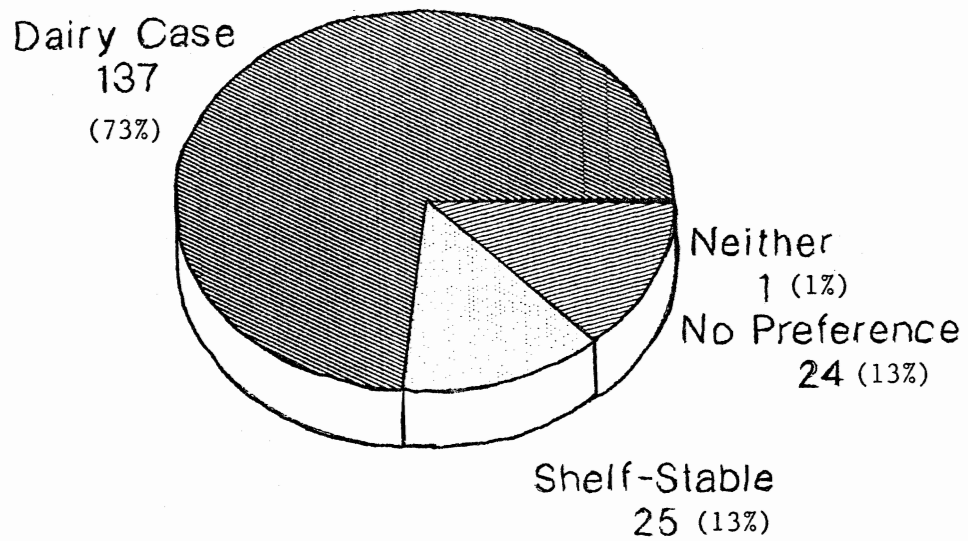
The overall acceptability of the shelf-stable milk may have been influenced by the appearance of the milk. Because the color of the two milks was noticeably different, this

difference may have influenced judgment even prior to tasting. Presumably, consumers perceive pasteurized milk to be snowy white in appearance. In this case, the dairy case milk was snowy white but the shelf-stable milk was more creamy white.

Overall acceptability of the shelf-stable milk may also have been influenced by flavor. Nelson, Trout and Strobel (cited in Deane, Chelesvig, and Thoams, 1967) stated that heated flavors in milk are not objectionable to most consumers, once they have become accustomed to it, but that a cooked flavor was objectionable. Thus, if the heat treatment used in processing the shelf-stable milk resulted in a cooked flavor, consumers may have found the flavor objectionable.

The second objective of the study was to determine which milk the participants would prefer to purchase, dairy case milk, shelf-stable milk, or both. Frequency distribution of responses for preferred purchase are illustrated in Figure 1. A substantial percentage (73%) of the participants said they would prefer to purchase dairy case milk. One respondent did not care for either of the milk samples. Her response was that neither of the milks tasted as good as her "Prairie Farms" milk. A small proportion of the respondents who indicated that they would purchase both of the milks stated that "price" would determine which product they would actually purchase.

Figure 1. Participants' milk preference.



Data indicated that the majority of these participants preferred the dairy case milk over the shelf-stable milk. It should be noted, however, that under the conditions of this study, sensory quality was the only attribute participants used to determine which milk they would prefer to purchase. Price, brand, nutritional quality, packaging and convenience are additional factors which may influence purchase. Arnold and Roberts (1982) stated there is a slight taste difference between UHT milk and pasteurized milk. However, price and convenience incentives may convince consumers to accept the flavor. Nelson (1987) noted that UHT milk introduced as a machine-vended item on a college campus was accepted.

A few participants actually rated shelf-stable milk higher on the hedonic scale than they did the dairy case milk but said they would prefer to purchase dairy case milk. This apparent contradiction may be due to the flavor and color of the dairy case milk being more familiar.

The third objective of this study was to determine if there was a difference in the acceptability of the 2% shelf-stable and the 2% dairy case milks by participants who regularly drink 2% dairy case milk. To identify these individuals, respondents were asked to indicate the frequency of their milk consumption and the type of milk they consume most often (Table 3).

Possible responses to the frequency question were never, several times a year, monthly, weekly, or daily. The

Table 3

Frequency of Milk Consumption and Type Consumed Most Often

	N	%
<u>Frequency</u>		
Daily	137	73
Weekly	31	16
Several times a year	13	7
Monthly	5	3
Never	1	1
Total	187	100%
<u>Type</u>		
2%	115	62
Skim	37	20
Whole	25	13
1%	10	5
Total	187	100%

majority (73%) of the participants in this sample said they consume at least one glass of milk a day. Participants were also asked, "What kind of milk do you drink most often?" and five response choices were given: whole, 2%, 1%, skim or other. The kind of milk consumed most often by these consumers was 2% milk (62%) followed by skim (20%), whole (13%), and 1% (5%). Thus, the majority (87%) of these respondents drink some type of lowfat milk most often. These results were consistent with Cohn (1988) who studied consumer expenditures of dairy products and found that lowfat milk and dairy products are purchased most often by today's consumers.

Eighty-seven (47%) of the participants indicated they consume 2% dairy case milk daily (Table 4). For these consumers, mean acceptability of dairy case milk (6.23) was significantly higher ($p=.0001$) than that for shelf-stable milk (4.10). Substantially more of the 2% daily consumers (40%) disliked (response ≤ 3) the shelf-stable milk than disliked the dairy case milk (3%).

The participants who drink 2% milk daily reported they could taste a difference between the two milks. Several stated that the shelf-stable milk was creamier and richer than the 2% dairy case milk. Thomas (1981) stated that consumers of lowfat milk have adapted to and prefer the less "rich" taste of lowfat milk. Though the shelf-stable was 2%, the UHT process may have increased the perceived richness of the milk.

Table 4

Acceptance of Dairy Case and Shelf-Stable Milks by
Participants Who Consumed 2% Dairy Case Milk Daily

	Shelf-Stable N	% ¹	Dairy Case N	%
Like Very Much				
7	17	20	48	55
6	11	13	22	25
5	10	12	10	12
4	13	15	4	5
3	13	15	2	2
2	8	9	1	1
1	15	17	-	-
Dislike Very Much				
Total	87	101	87	100
Mean \pm S.D.	4.10	\pm 2.12	6.23*	\pm 1.10

*Significantly higher, $p=.0001$

¹Percent does not always equal 100% due to rounding.

Objective four was to determine whether there was a relationship between participants' sex and their liking of dairy case and shelf-stable milk. The individuals' sex and the acceptability of shelf-stable milk and dairy case milk are illustrated in Figures 2 and 3. The females in this sample rated dairy case milk (mean= 6.21 \pm 1.21) significantly higher ($p=.02$) than did males (mean=5.79 \pm 1.14), but there was no significant difference in female and male ratings of shelf-stable milk.

The comparison of participants' sex and which milk they would prefer to purchase is illustrated in Figure 4. The majority of participants (58 males and 70 females) indicated they would prefer to purchase dairy case milk rather than shelf-stable milk. No relationship was found between participants' sex and the type of milk they would prefer to purchase.

Objective six was to ascertain whether there was a relationship between the participants' age and the acceptability of dairy case and shelf-stable milk (Table 5). Deane, Chelesvig, and Thomas (1967) reported that as the age of subjects in their study increased, they were more inclined to detect a flavor difference in milk processed at higher temperatures. Children under 13 years old were least likely to detect a cooked flavor. Correlational analyses in this study, however, indicated a negative relationship between age and the liking of both dairy case milk ($r= -.14$, $p=.05$) and

Figure 2. Acceptability of shelf-stable milk.

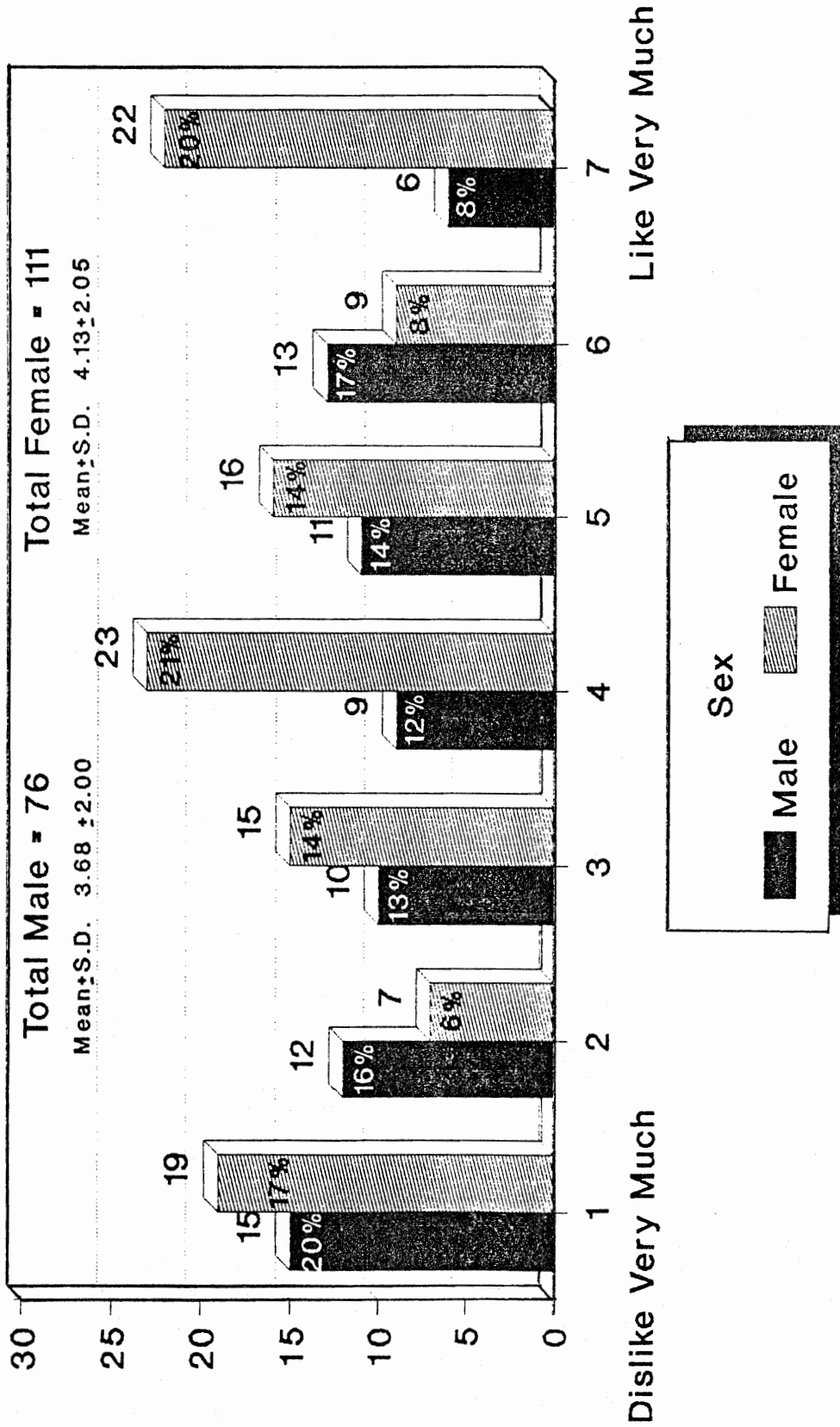
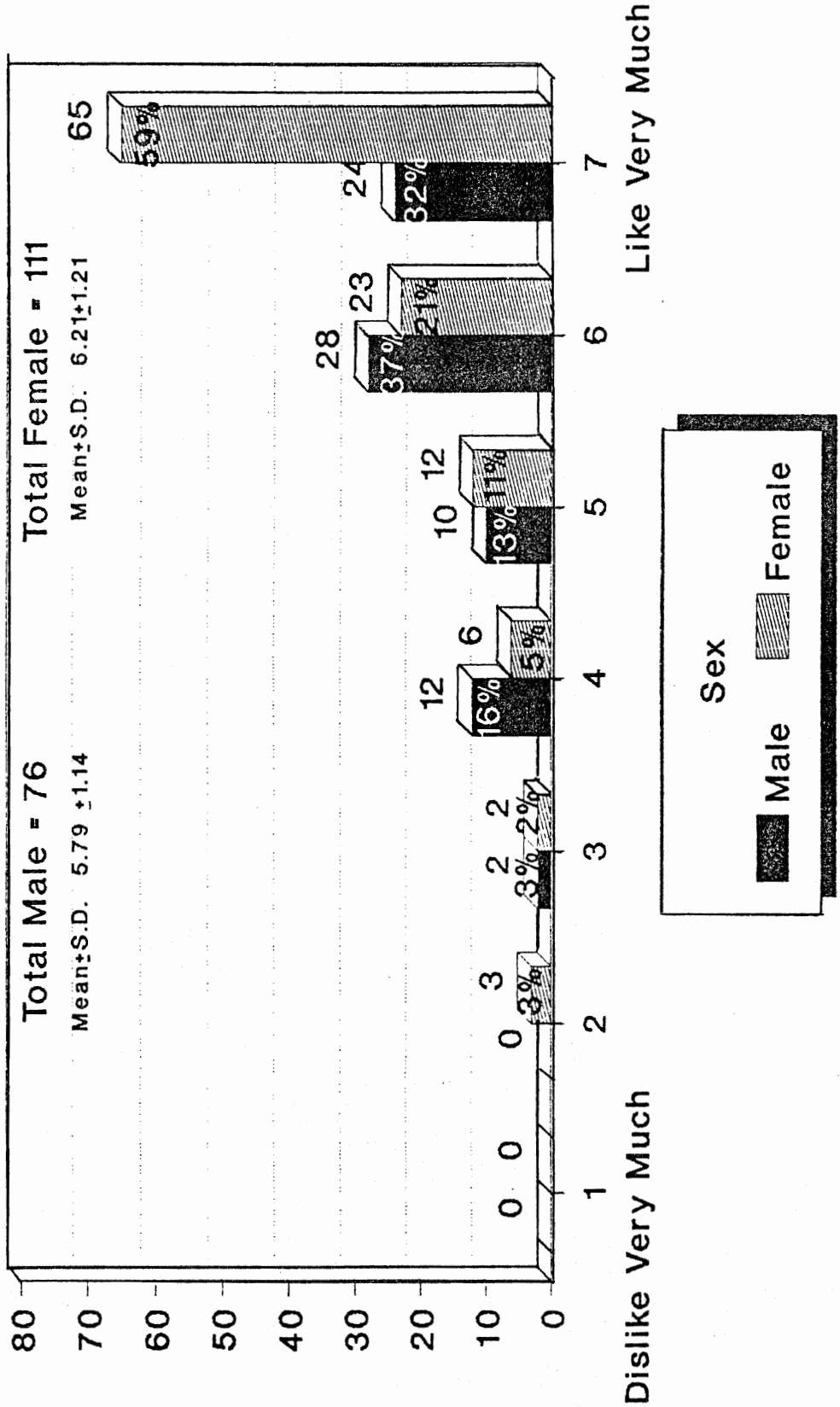


Figure 3. Acceptability of dairy case milk.



Percent does not always equal 100% due to rounding.

Figure 4. Milk preference by sex.

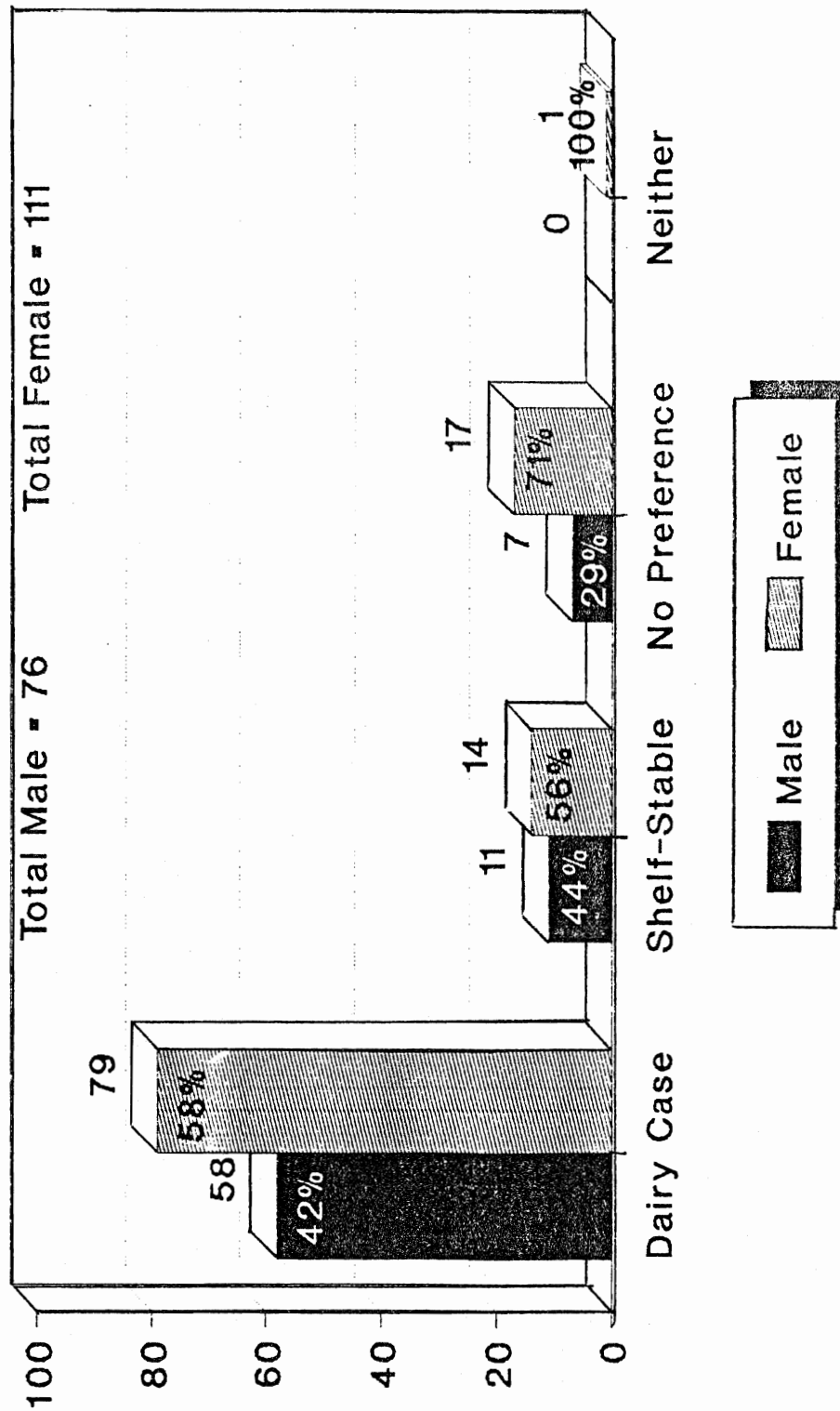


Table 5

Comparison of Age and Acceptance of 2% Shelf-Stable and Dairy Case Milk

	Like Very Much					Dislike Very Much			N	%
	7	6	5	4	3	2	1			
<u>Shelf-Stable Milk</u>										
Age (years)										
7-15	10	5	3	2	4	1	5	30	16	
16-20	3	2	2	3	1	1	1	13	7	
21-30	-	5	4	5	6	5	6	31	17	
31-40	2	4	3	6	5	5	4	29	16	
41-50	5	1	5	8	3	2	5	29	16	
51-64	4	3	4	6	5	2	6	30	16	
65+	4	2	6	2	1	3	7	25	13	
Total	28	22	27	32	25	19	34	187		
% ¹	15	12	14	17	13	10	18			
<u>Dairy Case Milk</u>										
Age (years)										
7-15	18	7	3	2	-	-	-	30	16	
16-20	8	4	1	-	-	-	-	13	7	
21-30	12	10	6	2	-	1	-	31	17	
31-40	13	10	2	2	1	1	-	29	16	
41-50	12	10	-	6	-	1	-	29	16	
51-64	14	5	5	4	2	-	-	30	16	
65+	12	5	5	2	1	-	-	25	13	
Total	89	51	22	18	4	3	-	187		
% ¹	48	27	12	10	2	2	-			

¹Percent does not always equal 100% due to rounding.

the shelf-stable milk ($r = -.12$, $p = .05$). This suggests that as the age of the participants in this sample increased, the acceptability of both shelf-stable and dairy case milk declined. The very small size of each correlation coefficient, however, indicates that the magnitude of the relationship is small.

Chi-square analysis revealed no relationship between participants age and which milk they would prefer to purchase (Table 6). The majority (73%) of all the consumers indicated they would purchase dairy case over the shelf-stable milk. The seven to 15 year old age group was the only age category which did not reflect a considerable difference in preference.

The questionnaires were administered in two Illinois counties, Coles and Cook, thus acceptability scores for shelf-stable milk in the two counties were compared. There seemed to be no relationship between location and participants' acceptance of shelf-stable milk (Figure 5). The mean acceptability score in Coles county (3.90 ± 2.14) was very similar to the mean score in Cook county (4.10 ± 1.80). The majority of participants in both counties disliked the shelf-stable milk.

Acceptability scores for shelf-stable milk in the two different Coles county stores were also compared. The subjects in store one (mean = 3.46 ± 1.95) rated the milk significantly lower ($p = .05$) than did the participants in store two (mean = 4.24 ± 2.23). Since the stores were located

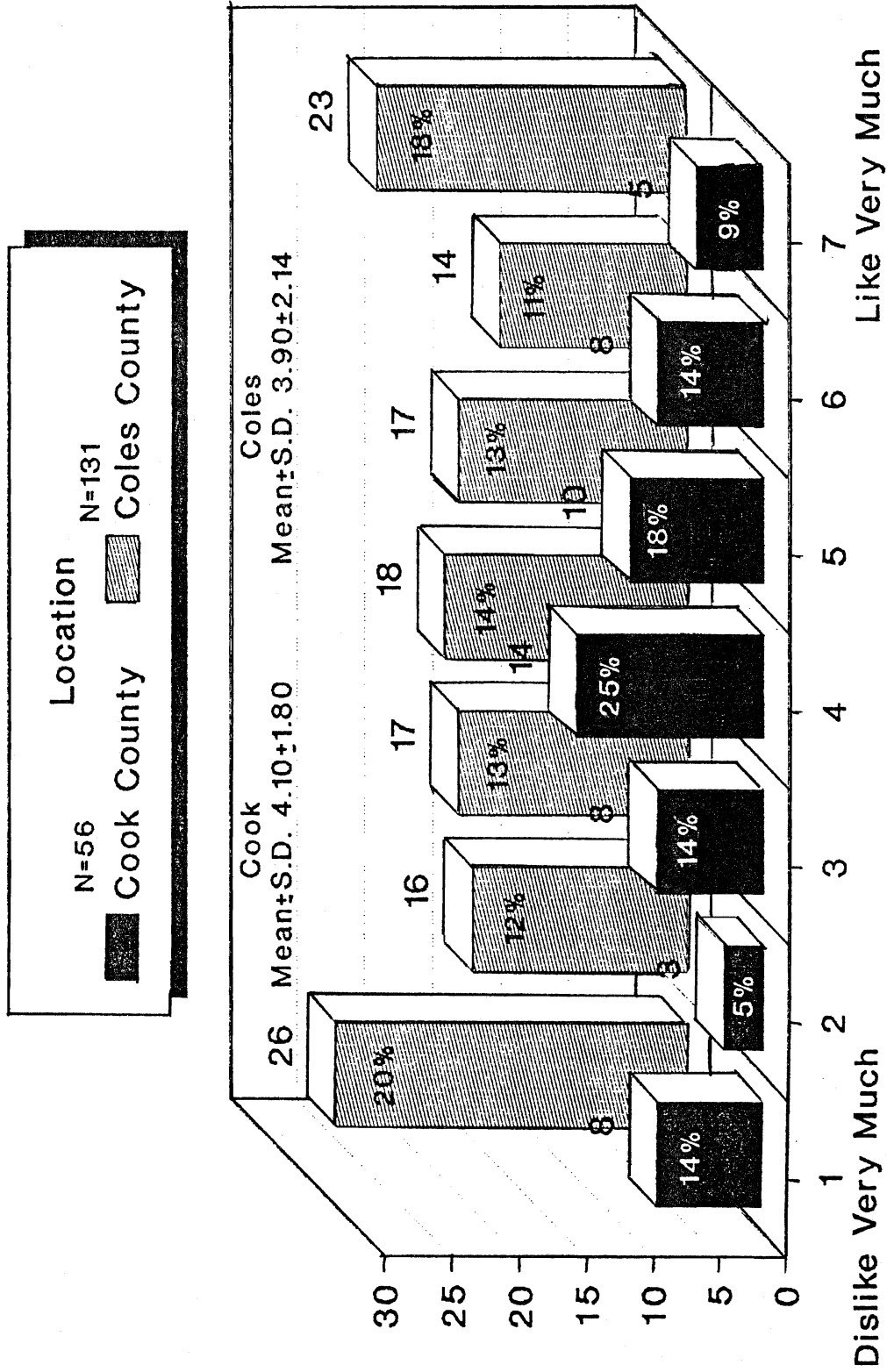
Table 6

Comparison of Participants' Age to Milk Preferred for Purchase

Age (years)	N	Dairy Case		Shelf-Stable		No Preference		Neither	
		N	% ¹	N	% ¹	N	% ¹	N	% ¹
7-15	30	15	50	6	20	9	30	-	-
16-20	13	10	77	2	15	1	8	-	-
21-30	31	25	81	4	13	2	7	-	-
31-40	29	23	79	3	10	3	10	-	-
41-50	29	19	66	6	21	4	14	-	-
51-64	30	23	77	2	7	4	13	1	3
65+	25	22	88	2	8	1	4	-	-
Total	187	137		25		24		1	

¹Percent does not always equal 100% due to rounding in each age category.

Figure 5. Acceptance of shelf-stable milk by location.



in two different communities, differences in consumers not identified in this study may help explain this finding.

Since the difference in acceptability is less than one point on the seven point hedonic scale, however, the difference has little practical significance.

Chapter V

Summary, Conclusion, and Recommendations

Summary

The purpose of this study was to provide additional information on the acceptability of shelf-stable milk. Data were collected from 187 consumers in Illinois. Three grocery stores, two in Coles county and one in Cook county were used to achieve this population. Seventy-seven males and 111 females, ranging in age from seven years to over 65 years old took part in this study.

Using a self-administered questionnaire, participants were asked to indicate how well they liked 2% shelf-stable and dairy case milk, which was provided at the time of administering the questionnaire. They were also asked to indicate which milk they would prefer to purchase. Milks were not identified until the questionnaire was completed. In addition to the blind taste test, subjects were asked to indicate their frequency of consumption and the kind of milk they used most often.

Statistical analysis of the data included means and frequency distributions as well as t-tests of independent samples, paired-comparison t-tests, Pearson product-moment correlation, and Chi-square tests of independence.

Acceptability of 2% dairy case milk was significantly higher than that of 2% shelf-stable milk, shelf-stable milk was generally viewed as unacceptable and most consumers said they would prefer to purchase dairy case milk. No practical relationships were found between acceptance of shelf-stable milk and consumer age, sex, frequency of milk consumption or store location.

Limitations

The sample size in this study was limited due to the inability of administering a taste test in certain stores. The inclement weather may also have had an effect upon the sample size. Because of the weather, the majority of the stores' regular customers may have been unable to shop at the time the questionnaire was administered.

Another limitation was the design of the research. Tasting the two milks during the same session probably caused consumers to compare the two milks instead of judging acceptability of each milk independently. Although this possibility was recognized by the researcher, because the shelf-stable milk tested in the pilot study was very similar in appearance to the dairy case milk and because time constraints prevented twice as many data collection sessions, the decision was made to test the milks together. Unfortunately, the color of the UHT milk provided for the actual study was much darker, thus making the research design less appropriate.

Conclusions

Within these limitations, several conclusions about the acceptability of shelf-stable milk have been drawn based on the findings from this study:

1. When sampling both milks in the same session, the participants' like the 2% dairy case milk much better than the shelf-stable milk. In fact, participants tend to dislike the shelf-stable milk.
2. Based on sensory characteristics only, participants would prefer to purchase dairy case milk as compared to shelf-stable milk.
3. Participants who indicated they drink 2% milk daily also like the dairy case milk much better than the shelf-stable milk.
4. There appears to be no relationship between the frequency of milk consumption and the acceptance of shelf-stable milk.
5. Acceptability of shelf-stable milk is not related to an individual's sex.
6. The participant's sex does not seem to influence purchase preference.
7. A negative relationship exists between age and the acceptability of both shelf-stable milk and dairy case milk. As the age of participants increased, the acceptability of both milks decreased.

8. The participant's age does not seem to influence purchase preference.

Recommendations

One recommendation for further study of consumer acceptability of shelf-stable milk is to examine other acceptability attributes besides sensory characteristics. Price, nutritional quality, convenience and availability are all important potentially influential factors that should be investigated.

Research on price comparisons could be conducted in regard to shelf-stable milk and pasteurized milk. Very little literature was found comparing the price of shelf-stable milk to dairy case milk.

Future study could also be conducted with the same variables used in this study only in a different location where milk is not always available. A comparison could be made with the Coles and Cook counties and the area that is selected.

A second recommendation would be to investigate the acceptability of shelf-stable milk without a comparison to any other type of milk. This study could possibly avoid the influence one milk may have on the acceptability of the other.

The results of this study on the acceptability of the shelf-stable milk as a beverage were obtained to the

researcher's degree of expectancy. The results suggest that sensory characteristics are only part of consumer acceptance and purchase of food products. As technology advancements increase the milk availability throughout the world, manufacturers need to be aware of consumers' acceptance patterns.

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APPENDIX A

Questionnaire

CONSUMER'S PREFERENCE OF TWO 2% FLUID MILKS

Please take a few minutes to answer the following questions.
Your response is greatly appreciated.

1. How well do you like the first 2% fluid milk?

LIKE ; 7 / 6 / 5 / 4 / 3 / 2 / 1 ; DISLIKE
 VERY MUCH VERY MUCH

Reason(s) for your response? _____

2. How well do you like the second 2% fluid milk?

LIKE ; 7 / 6 / 5 / 4 / 3 / 2 / 1 ; DISLIKE
 VERY MUCH VERY MUCH

Reason(s) for your response? _____

3. Which of these milk samples would you prefer to purchase?

Blue
 Red
 No preference

4. How often do you drink milk?

Never
 Several times a year
 Monthly
 Weekly
 Daily: 1-2 glasses 3-4 glasses 5+

5. What kind of milk do you drink most often?

Whole
 2%
 1%
 Skim
 Other (specify) _____

6. Did you regularly drink milk during:
(check the ones that apply)

Childhood (6-11)
 Adolescence (12-18)
 Young adulthood (19-34)
 Middle adulthood and older

7. Age: 10-15 16-20 21-30 31-40 41-50 51-64 65+

Thank you for your time and cooperation!

APPENDIX B

Letter of Appreciation and Individual
Taste Test Results

Thank you very much for participating in the study of milk.

The milks being sampled were 2% dairy case milk and 2% shelf-stable milk. The only difference between the two milks is the process and the packaging. Shelf-stable milk does not require refrigeration until after it has been opened.

The milk you liked the most was: Shelf-Stable
 Dairy Case

Your feedback was greatly appreciated!

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