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CONSUMER EVALUATION OF PACKAGE PREFERENCE AND COOKIE QUALITY

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Mary C. Zabik
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# CONSUMER EVALUATION OF PACKAGE PREFERENCE AND COOKIE QUALITY

By

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ABSTRACT

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OF
PACKAGE PREFERENCE AND COOKIE QUALITY

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Date Filled Oatmeal cookies, packaged in two different types of materials, were evaluated by consumers for preference of the cookies and package. Cookie quality characteristics were measured initially and four weeks later.

Consumers evaluated a Control product in cellophane versus a Test product in an oriented polystyrene tray in printed polypropylene film. Panelists had significant preferences for the Test package from a visual standpoint. Initial sensory evaluation of the cookies revealed preference for the Test cookie for most aspects except texture. The Control cookie was preferred at four weeks for all aspects except appearance.

Color measurements of cookie surfaces showed few differences between the products. Moisture analysis indicated significant differences in the interaction effect of storage and cookie position. Tenderness measurements, using the Allo Kramer Shear Press, indicated differences due to treatment, storage, and their interaction. Cookies required more force to shear after four weeks, regardless of package type; control cookies required the most force.

To my parents and Dave

for their love and support.

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# INTRODUCTION

Consumer choice is a very complex science which deals with many aspects of a person's behavior. A person's attitude is thought to help determine their behavior, regardless of what the situation is. The visual impression of a product must be pleasing for it to evoke a positive reaction. This positive reaction then leads to a preference or a choice. The design of a package is important for this initial visual impression of a product; then the product within must live up to the expectations that the package has provided. Some packaging films that are gaining widespread use have been found to be poor barriers to gases which can create quality defects in the products within.

The purpose of this research was to determine the acceptability of a new type of cookie package in a consumer preference test against an existing package. Quality measurements as well as sensory measurements of the product were performed to establish the effect of the packaging films on the keeping qualities of the cookies.

There has been very little recent research involving food packages as they relate to consumer attitude and choice. It is an ever growing area of concern as competition forces companies to spend more money and time on advertising and packaging design. Behavioral science is

becoming increasingly intertwined with other science disciplines. There is a need for these sciences to work closely together in the development of new ideas and products to meet consumer demand. It is the intent of this paper to interrelate the two sciences. This information will also be useful in determining packaging acceptability and will help in future packaging decisions.

# REVIEW OF LITERATURE

This review of literature is divided into two main areas. The first one is concerned with consumer behavior as it relates to perception and attitudes regarding preference and how it ultimately affects consumer choice. The second area concentrates on the role of packaging, the various types of packaging materials, and factors associated with packages that can affect the quality of baked products.

## Consumer Behavior

Consumer behavior can be attributed to internal states of mind such as attitude, perceptions and motivations, or to internal drives such as affiliation, achievement and aggression. These traits can not be observed so must be inferred from the observation of behavior. Behavior has also been attributed to goals, purposes or needs. The need for goods arises out of a consumer's existence. They fulfill their wants and needs through the seeking of goods; it is this seeking of goods that becomes a goal striving, problem solving and information processing activity for the consumer (Sheth, 1977).

## Attitude and Choice

The accomplishment of goals is one of the key reasons for a consumer to make a choice. A consumer uses previous knowledge and experience to interpret the information they process. (The capacity of a consumer to process information is limited, however, so they reduce potentially complex choice situations to ones which are more manageable. Sometimes they choose what they have chosen before, or other times they are so uninterested or uninvolved in choosing that they expend little effort (Bettman, 1979a).

Choice, according to Webster's (Anonymous, 1977), is "to select freely and after consideration; to have a preference for," while attitude is "a feeling or emotion toward a fact or state (a state of readiness to respond in a characteristic way to a stimulus - an object, concept or situation)." Attitude is generally thought of in terms of intervening mental or hypothetical concepts which determine behavior regardless of the situation (Foxall, 1983). Attitudes have recently been thought to have a major impact on consumer choice; earlier research, however, focused on the impact of demographic factors, studies of motivation, and personality impacts (Bettman, 1979a).

## Information Processing

The process of choice includes the functions of processing capacity, motivation, attention and perception,

acquisition and evaluation of information, memory, decision processes and learning. Information processing is one of the central components of choice behavior. There is a vast amount of information provided to the consumer and they react to it in many different ways.

Consumers are active, rather than passive participants in the choice process (Bettman, 1979a; Robertson, 1970) in the sense that they selectively perceive, retain and act upon information. Most people differ greatly in the way in which they acquire information, the strategies they imploy to acquire it, and their use of this information when making judgments. This may be due in part to their different abilities to process information. One emerging area of consumer behavior is that of visual information processing. Mental imagery especially is a strong facilitator of the type of learning that characterizes consumer information acquisition (Childers et al., 1985).

The environment influences people's behavior. Through interaction with their environment, they develop and interpret the meanings of certain parts of information they take in according to each particular situation. They process the information and make a selection from several alternatives. Akhter et al. (1987) suggested that consumer evaluation and choice is influenced by interactions between cognitive representation of an item and the cognitive representation of the environment where the evaluation is taking place.

## Mood

Mood also appears to have an effect on choice. Seigel and Risvik (1987) examined the effect of mood on food acceptance ratings and found that panelists who were given a questionnaire about their moods containing negative type responses to questions, responded with consistently lower acceptance to a product than did those who were given a questionnaire with positive sounding responses. They suggest that care in the treatment or environmental setting of consumer panels is necessary to get the most unbiased ratings possible. The panelists should be in a quiet, comfortable room with a minimum amount of distractions. Individual evaluations should be conducted in individual booths rather than in group format.

## Self Concept

Onkvisit and Shaw (1987) have theorized that self-concept plays a major role in the study of consumer behavior because many purchases consumers make are directly influenced by the image a person has of himself. A person's self-concept is a life long process that begins in childhood when they are influenced by other people's behavior and attitudes and how that person interacts with them. When a consumer evaluates a product he forms perceptions about it which he then compares to his own value system to decide whether or not the product will

satisfy his needs. Consumers tend to select products that correspond to their own self-concept. The image of a product must be desirable enough to enhance a consumer's self-concept. The consumer is seeking reputation and prestige among many other meaningful symbols. The nearer that the product comes to fitting the image of the consumer's self-concept, the more likely the consumer will buy the product.

## Perception

Perception is the mental impression a person has of the stimulus object as seen within their perceptual field. No two people perceive an object exactly alike because no two people have the same view of the world. A person's view of the world is formed over time and reflects their physiological characteristics, their psychological characteristics and the nature of their social environment and experiences. Robertson (1970) based an approach toward understanding perception on the principles that perception is selective and organized, that it depends on stimulii (cues) which encourage perception such as intensity, contrast, frequency and movement; and that this depends on and is influenced by personal factors such as one's needs, moods, memory, experiences and values. A vital factor in consumer perception and acceptance is the visual impression of a product since vision is one of the strongest of the

senses (Cheskin, 1957).

## Color/Package Influences

Tom et al. (1987) found that packaging and color are cues having a strong influence on consumer perception and the consumer buying decision. Color, especially, plays an important role in the consumer's perception of a product by producing favorable or unfavorable reactions. For example, color cues are indicators of temperature: red denotes warmth, and most reds have over an 80% acceptance level (Cheskin, 1957).

The acceptance or rejection of a product is often caused by the package. Changing the dominant color on a package may increase the consumer's acceptance of the package by a large percentage; on the other hand, a color change can also have a negative influence and cause consumer rejection.

Consumers consider all cues at the same time, so the interaction of cues with each other is important. Consumer choice is affected by memory; external memory is available without needing to be stored. Package information is a part of external memory (Bettman, 1979b).

The way a consumer is affected by packaging is called "packaging impact." Good packaging impact involves immediate attraction, recognition and visual recall (Prince and Silbert, 1982).

Cheskin (1957) implied that if a product is going to be successful it must be marketed successfully; therefore it should meet the criteria of what he defines as successful marketing: two of these criteria are product quality and package appeal. The quality of the product within the package is important (i.e. is the quality good to begin with?, does the product maintain its quality over time?). The major factors that control the purchase and consumption of most food products include availability, cost, hedonic preference and nutritional value (Cardello et al., 1985). The overall impression of quality that the whole product/ package unit conveys is yet another important factor. Package quality is affected by many variables including the materials used in making it, design, color, size, etc. The package visually characterizes the product to the consumer and this visual perception is important in the effect it has on consumer acceptance and on choice. Changing the design of the package can mean an increase in acceptance if the new design is psychologically more favorable than the old one.

People's ideas about what is beautiful or pleasing to the eye can vary. Some people like modern functional designs best, while others prefer complex sophisticated forms (Douglas and Dubois, 1977). Revision and improvements of packaging may mean changing shapes, angles, designs or colors. This may be done to freshen up a package and upgrade its image.

Research has shown that consumers often have more favorable opinions toward a revised package's aesthetics (Prince and Silbert, 1982). Consumers were shown several versions of a new instant breakfast drink package design, along with the old package. It was found that there were significant preferences for the new versions.

Marshall (1985), referenced the work of Yankelovich et al., who showed that consumers are becoming more aware of cost effectiveness, including searching for value in terms of money, time and effort rather than just seeking the cheapest or easiest solution. An invaluable aid in assuring the success of a package is to stay in touch with consumer desires and maintain an awareness of shifts in demographics (Anonymous, 1987a).

## The Role of Packaging

The role of packaging to product acceptability is well established from the standpoint of consumer behavior. The effect packaging has on the quality of the product is important in determining the best package from the standpoint of product quality.

Successful packages have to be physical containers; they have to protect and maintain the quality of the product as well as appeal to and attract the consumer. A product's success or failure depends on whether the package is able to sell the product. The package shape, graphics

and materials influence its success (Sacharow, 1986).

Eye appeal is a hard concept to imagine and consumers have a wide range of ideas about what they consider good eye appeal. Their psychological profiles (perceptions, opinions, attitudes and beliefs) which are very distinctly different from one another become important in how they see a package. The overall success of some food products may depend on how well the package exhibits the concepts of natural, fresh, homemade or wholesomeness. A package has to be tamper-proof and highly visable but should not reduce the eye-appeal of the product itself (Anthony, 1987).

Consumers ~~most~~ must easily perceive physical appearance and they usually evaluate it first. Color becomes important because it is the first thing the customer sees in the store. Packaging deals not only with the physical presence of the materials themselves but with advertising, printing, marketing, shelf-life and product protection. The package appearance is important initially to consumers but there must also be a concern for the performance of the package in the bakery, the store, and in the consumer's home. Some considerations include protection from light, insects, odors, temperature extremes and tampering (Lipka, 1987).

Consumers want convenience and quality; they also want a price/value relationship that provides adequate shelf-life, convenient storage, sturdiness, attractiveness/ informativeness, affordability, protection from external contaminants, ease of opening, resealability, flavor/aroma

protection, direct usage and tamper evidence (Anonymous, 1987b). Change is always evident in food product packaging. Packaging technologies are changing so fast that many systems become obsolete within a few months (Anonymous, 1987c).

## Product Protection

A package functions foremost as a means of protecting the product within from contamination and spoilage until it reaches the consumer. In the case of food products this becomes a critical factor. A package can include the tray within it, the plastic surrounding that tray and the inks on the package. The chemicals of packaging materials should not react with chemicals in the food. Package materials are legally considered to be food additives by the FDA (Schwartz, 1985) since they may be sources of chemicals that can migrate into a food.

## Criteria for Packaging Material Selection

Packaging materials must provide more utility than ever before - they not only serve to protect the product, they also need to be able to help sell the product. An important consideration when deciding on packaging materials is how the packaging material will affect the product (Anonymous, 1987b).

Materials used in packaging directly affect the shape

and structure of the package because they can be made into different configurations. Materials are also known to have an influence on the perception and preference of a product (Anthony, 1987).

Plastic packages have assumed a role of increasing importance in the manufacture and sale of foods and beverages. Recent developments are keyed toward foods with longer shelf-lives (Brown, 1986). Food companies use plastic packages more often for packaging bland, taste and odor sensitive foods. That trend, along with the longer expected shelf-life gives the plastic more time to affect the food (Anonymous, 1987d).

Plastics are defined as "any one of a large and varied group of man-made materials consisting wholly or in part of combinations of carbon with water, oxygen, hydrogen, nitrogen, and other organic and inorganic elements which, while solid in the finished state, is at some state of its manufacture made liquid, and is thus capable of being formed into various shapes, mostly through the application, either singly or in combination, of heat and pressure" (Sacharow, 1986).

## Films

A film is a flexible plastic. Packaging films used on food products have to have a special combination of qualities. Important to packaging films are the properties of clarity or transparency, physical/impact strength at

high and low temperatures, chemical resistance, thermoformability and high heat distortion temperatures (Anonymous, 1987c; Sun, 1987).

Many different films are available for use in packaging food products. Cost and machinability (or ease of use) must be taken into consideration along with product protection. Multi-layer films are probably seeing the most widespread use, since one can choose the characteristics most important for each individual type of food. There are many new films in use today with better functionality and improved barrier properties (O'Leary, 1986).

Cellophane. Cellophane was discovered in the early 20th century by the Swiss chemist Bradenberger, and it was commercialized in the late 1920's. The name comes from the combination of the words cellulose (the wood product which forms the basis of it) and diaphane (which means transparent). It is a very adaptable packaging film. Uncoated cellophane is flexible, strong, transparent and grease-proof. It is very hygroscopic, though, so it is highly permeable to water vapor. Cellophane is usually coated to improve barrier resistance. A nitrocellulose coating is used to make the sheet flexible while still maintaining a moisture vapor barrier. A coating of polyvinylidene chloride (PVDC) is added as an oxygen barrier. The PVDC coating gives superior product protection with resistance to grease and oil penetration (Sacharow, 1986).

Polypropylene. Polypropylene (PP) was invented in 1954 by Professor Guilio Natta in Milan by polymerizing propylene to high molecular weight solid polymers. These films have good resistance to acids and alkalis at room temperature and they are not affected by most solvents. Nevertheless at temperatures above 20°C solvents can attack polypropylene. PP films are quite stiff, clear, grease resistant, and have superior tensile strength. Orienting (stretching the polymeric chain of the plastic) can provide an improved film. PP films can also be coated to increase their different barrier and heat-sealing properties. Oriented polypropylene (OPP) film is sensitive to the application of solvents so it is usually coated with an aqueous system. The coating will either be heat-seal coating (polyvinyl acetate in an aqueous system) or Saran$^{R}$ (PVDC) coating. Using heat-seal coatings provides a broad heat-seal range and better film versatility but does not improve barrier properties. PVDC coating is an excellent barrier to gases (Sacharow, 1976). Cookies account for about 10% of the 350 MM pounds of OPP film used in flexible packaging in the United States (Marra, 1988).

Polystyrene. This widely used film was discovered by E. Simon in 1839 and first synthesized in 1866. It is a clear, stiff, transparent thermoplastic with moderate water barrier properties, good melt strength and rigidity (Brown, 1986; Miltz, 1986; Sacharow, 1976; Sun, 1987). It is often formed into trays to package food products in. Expanded

polystyrene is used extensively for the protection, storing and serving of a number of food products (Monte and Landau-West, 1982).

## Quality Considerations

A major function of a food package is to minimize any reactions that could effect the quality of the enclosed food product. Certain reactions can occur spontaneously without any external catalysts; in this case, the packaging only serves to contain the product. Many times, however, various environmental agents (gases, water vapor and oxygen) can alter the quality or shelf-life stability of food products under normal storage and distribution. The transport of these reactants across the partial barrier of the package can be the limiting factor in shelf-life (Gilbert, 1985).

Other factors that can affect shelf-life are damage in shipping (a physical cause) and seal failure (mechanical cause). Light can be a catalyst for oxidation of fats and flavor, functioning as an agent that deteriorates the food by fading colors, forming noxious products, and causing loss of nutrients. Clear packages with a good view of the product make it especially susceptable to the damaging rays of UV light (Anonymous, 1987e; Gilbert, 1985).

There are various aspects to consider about a package/food interaction at the contact point. Resin compounds can

cause off-tastes and odors, mask taste and odor components or absorb them from the food (Anonymous, 1987d). There are a number of different ways in which a plastic package can interact with food and affect aroma and flavor. Flavor and aroma give foods their distinct identity and form a basis on which consumers will make choices for buying. So it is important to have the food flavor and aroma degrade as little as possible before the consumer gets it. The type of package in which the food is contained can both directly and indirectly affect and contribute to deterioration of flavor (Anonymous, 1987e).

Barrier Problems and Migration Effects

A subject of growing concern in the packaging industry in the last few years is that of migration of low molecular weight species (such as residual monomers and solvents) from polymeric packaging materials. Migration, an undesirable package/product interaction, results from the mass transfer of material from the polymer of the package into the contained food product (Anonymous, 1987e; Miltz, 1986).

A lot of attention has been given to the potential toxic affects of food packaged in polymeric packages. The transfer process can cause off-flavors in the foods and sometimes it can also cause toxic compounds. Sensory detection of these types of compounds usually occurs at lower levels than those required to make the food toxic.

There is a major concern about the amount of compounds in a product from the packaging materials that may cause a decrease in quality but will not cause toxicity. Components causing toxicity are closely regulated, but smaller levels may cause losses in product quality and thus are of practical concern too. Especially evident are odor and flavor changes. The residues that cause these types of problems can come from solvents used in the package preparation such as those solvents which are found in many inks and adhesives (Gilbert, 1985).

Packaging materials, and their ability to perform effectively in the protection of products depends in part on diffusion of gases and vapors through the materials (Gray and Harte, 1986). Migration of some of these gases or other low molecular weight molecules from the packaging material to the product within may cause a change in the color or loss of flavor. Furthermore, it is possible that a packaging material that undergoes oxidation can accelerate the oxidation of products with which it is in contact. Substances having the capabilities of migrating into foods that are in contact with polymeric packaging materials are actually considered to be potential indirect food additives (Kashtock et al., 1980).

An older approach to migration was based on the assumption that when there is residue in the package it will migrate into the contents even if the concentrations are low. The Delaney Clause was based on this theory. The

new theory explains the residue as being composed of three different types: 1) the molecules at very low concentrations that are non-diffusible and bound tightly to active sites in the polymer, 2) partially bound molecules (also to active sites) but not as tightly bound so they can migrate under appropriate conditions, and 3) unbound molecules that can diffuse easily through the polymer (Miltz, 1986).

Kashtock et al. (1980) found that resins with limited active site binding potential were more likely to have more efficient reduction of residual monomers; thus the residual monomer remaining would likely be absorbed or bound within the matrix of the polymer and there would be a limited potential for it to migrate into the food product.

Certain foods have been found to be incompatible with polystyrene. Some of this incompatability is due in part to the dissolving of polystyrene into certain essential oils found in many flavor compounds (Monte and Landau-West, 1982). Biran et al. (1979) also found that certain polymeric monomers were absorbed by oils and even by casein particles to some extent. Although styrene is not a carcinogen, it is toxic at high concentrations; it has a very strong repellant odor and taste and it makes foods that contain it unacceptable. In tests designed to determine the sensory threshold of styrene in food products it was found that panelists could detect styrene in a fat-

based food product at concentrations as low as 5 parts per billion with a 95% confidence level (Miltz, 1986).

Hatzidimitriu et al. (1987) tested the odor barrier properties of several multi-layer packaging films. They found that laminations of nylon and polyethylene vinyl alcohol (EVOH) in high density PP films had superior gas and vapor barrier performance (especially to permeants of ethyl acetate and toluene) as compared to those films with laminations of PVDC and polyethylene terephthalate-glycol (PET-G) even at high relative humidities. It has been speculated that off-flavors in baked products may possibly occur as the result of migration of residual monomers from the package to the product. In one case, this migration occurred from an oriented polystyrene (OPS) tray to cookies (Clark, 1986). However, additional research on cookies by Hodges (1986) did not find enough residual styrene monomer to be detectable in a product by an expert panel. Other studies show a possible cause of off-flavors to be a combination of residual styrene from the tray itself and toluene, an ingredient often found in the ink of pre-printed films.

Conversely, plastics can absorb flavor and aroma compounds from foods which can lower the overall appeal of the product to consumers (Anonymous, 1987e). The loss of food components to plastic packages has just recently begun to receive consideration. Kwapong and Hotchkiss (1987) found that taste panelists were able to significantly

distinguish between control and test samples when they tested for sorption of aroma compounds in essential oils by certain plastics. Fat and pigments can also be absorbed but this affects the package (staining or stress cracking) rather than the quality of the food. Flavor components, absorbed from the products by the package, will result in a loss of flavor or odor intensity, a loss of character, and a reduced perception of quality by the consumer (Anonymous, 1987e; Gray and Harte, 1986). Smaller molecules are absorbed faster and in greater quantities than large ones; sorption is also higher at higher temperatures.

Gases and aroma compounds can be lost from a product through permeating plastic packages. Water vapor can enter a package and cause textural changes. Oxygen can enter a package and react with the unsaturated fats of the product by causing lipid oxidation and resultant rancid off-flavors (Anonymous, 1987e; Labuza, 1982). Limiting the exposure of foods to oxygen is one of the most important actions a packager can take to assure a high retention of quality and nutrient content and long shelf-life (Brown, 1986).

Package designers have a wide range of barriers that are available to satisfy almost all levels of protection that products need. Often, a combination of materials is needed to provide a foods complex requirements. A barrier is a material which limits the transfer of a substance into or out of a food (Brown, 1986).

A lot more importance is being given to the area of

flavor and odor barriers. Until recently, adhesives had been developed for moisture, air and food product barriers but now the adhesives must be functional components of the packaging material (O'Leary, 1986). Combining an OPP film and a high barrier PVDC adhesive can give a laminate with improved barrier properties (moisture, oxygen and flavor/aroma) and provide a longer shelf life (Anonymous, 1987f).

Adhesives were originally used for holding together layers of film to form flexible packaging laminates. Now they need to be able to withstand the extremes of temperatures and opposing forces. Dry bonding between the two layers of a plastic film help take advantage of each film's barrier properties as well as increasing the machinability and shelf-life of the film. The multi-layers give added benefits and better aesthetics to packages (O'Leary, 1986).

Storage Effect on Sensory/Texture Characteristics

Texture, in the food industry, is rarely acknowledged unless it is a key attribute of a food product. Most food companies spend more time and money on the evaluation of flavor (Munoz, 1986).

Food texture is the result of a micro-structure which is dependent on the influence physical forces have on chemical components. A food product's structural characteristics dictate mechanical properties and sensory

response. Foods are very complex heterogeneous conglomerates of water with protein, carbohydrate and lipid. They often have their form rearranged during processing and they may contain structure-altering enzymes (Stanley, 1986).

A growing area of food science research is the correlation of sensory ratings with instrumental measures. Integrative machines such as the Allo-Kramer Shear Press are destructive tests since the physical constitution of the product is changed during the course of measurement (Moskowitz, 1983). The destruction of a product by instrumental tests is different than the destruction caused by mastication in sensory tests. This difference can make correlation of the two tests difficult.

The perception of flavor and texture is a function of time (Lee and Pangborn, 1986). The sensations of aroma, taste and texture can show large changes in intensity over time. Sych et al. (1987) found that during the storage of cakes detrimental textural changes (staling) took place in the crumb. Cakes packaged in PP film had the greatest amount of moisture transfer through the film when stored at low relative humidities. Changes occur throughout the shelf-life of food products which may result in a decrease in consumer acceptance. These changes occur in crumb texture, moisture redistribution and moisture loss. Increased storage time also negatively affects the objective and subjective measurements of crumb softness in

bread (Stollman and Lundgren, 1987). The available literature with specific studies of packaging effects on cookie texture over time is limited.

## EXPERIMENTAL PROCEDURE

This study was initiated for the purpose of determining whether the material and type of container in which a cookie is packaged will make a difference in the acceptability of that product to the consumer. Cookies were presented to a panel of 62 consumers. In addition to gathering consumer response on visual aspects of the cookie package, certain quality characteristics of the cookies were also measured in order to evaluate the effect of different packaging materials on cookie quality over time. Consumer sensory panels were conducted when the product was fresh and when it was four weeks old.

### Sensory Panel Recruitment

Panelists were recruited from a file of consumers who participate regularly in panels for Archway Cookies, Inc. Panelists were required to evaluate the visual aspects of cookie packages and to evaluate (by characteristics of aroma, flavor and texture) the sensory quality of cookies that were produced commercially.

### UCRIHS Review/Approval

A request was made to the Michigan State University

Committee on Research Involving Human Subjects (UCRIHS) for an expedited review which was granted. The UCRIHS gave approval of the research project on March 18, 1987.

## Cookie Package Procurement

The product that was evaluated was one that is currently being produced commercially, marketed and sold retail nationwide. Therefore, cookies to be used for the research were obtained from a single batch run at an Archway Cookies, Inc. bakery in Ashland, Ohio. The product, marketed under the name of "Date Filled Oatmeal Cookies" is a soft, machine wire cut oatmeal base cookie which is folded over with a small portion of fruit (date) filling inside. For proprietary reasons, the actual cookie formulation will not be provided in this research paper. However, a similar formula can be found in Matz (1987) and is shown in Table 1. For the purpose of repeating the experiment, like samples could also be obtained from a large number of retail grocery stores if so desired.

At approximately midway through a 1487 pound batch run of product, 80 sample packages (each containing 12 one ounce cookies) were pulled off the line after the standard wrapping procedure. Forty of these samples were packaged by an Oliver #999 Standard Wrapping Machine, Oliver Machinery Company, Grand Rapids, Michigan. In this particular sample package, individual cookies were stacked

Table 1. Formula for Oatmeal Wire-cut Cookie dough.

| Ingredients | Per cent |
|---|---|
| Flour | 36.3 |
| Sugar, granulated | 19.9 |
| Shortening | 10.7 |
| Molasses | 7.3 |
| Monocalcium phosphate | 0.1 |
| Sodium bicarbonate | 0.4 |
| Salt | 0.4 |
| Vanilla, 7X | 0.2 |
| Cinnamon | 0.5 |
| Water or ice (variable) | 9.2 |
| Rolled Oats | 7.7 |
| Currants | 7.3 |

Reprinted with permission, from Matz (1987).

four high in three side-by-side stacks and placed on a flatboard made of solid bleached sulphate paperboard. This paperboard was coated with clay on the bottom (printed) side and an extrusion of polyethylene on the side in contact with the cookies (manufactured by Murnane Packaging Company). The cookies on the flatboard were over-wrapped with a film of cellophane which was folded at the ends of the package and heat sealed on the bottom and ends of the package with sealer plates. The cellophane (Flexel 140 V58 by Olin) was 140 Gauge (1.4 mil thickness), with a base sheet of cellulose, coated with PVDC, and coated on one side with release coating. A glue-on label depicting the product name, ingredient list, etc. was then applied to the top surface of the package. This package was the Control package.

An equal number of packages were quickly transferred to another packaging station where they were carefully unwrapped by hand, and then re-wrapped using a Fuji-Formost, FW-340 packaging machine, Formost Packaging Machines, Inc., Woodinville, WA. Twelve cookies were placed in three stacks in a compartmentalized tray made of OPS (manufactured by Detroit Forming, Inc., Southfield, MI). The tray proceeded through the Fuji wrapper which wrapped it in pre-printed OPP film (252 ASB by Mobil Chemical Company), (1.12 mil thickness; one side PVDC coated and the printed side acrylic coated), using heat again to seal the bottom and to crimp seal the ends of the

packages. This package was the Test package.

## Cookie Evaluation

Cookies were held for three days to allow for equilibration of moisture within the packages. The room temperature was 68°F and the relative humidity (r.h.) was 70%. The three day equilibration time would be the minimum time a product would be enroute from the bakery to the store after production and be available for purchase and consumption by a consumer. The cookies were stored under natural (window) lighting with overhead florescent lights during the day and in a naturally darkened room at night. On the fourth day after baking, the cookies were evaluated objectively then given to the consumer panel for subjective scoring. These objective and subjective measurements were repeated after four weeks of shelf-life.

### Objective Measurements

Objective measurements were used to evaluate the quality characteristics of the Date Filled Oatmeal Cookies both at 0 time (four days after baking) and four weeks later. The quality characteristics that were determined included color, moisture and tenderness.

Color: The color of the cookie surface was determined by using an Agtron Color Quality Meter, standardized first

with the 00 calibration disc and the 75 (97) calibration disc in the red mode. The top three cookies from each of two Control packages (a total of 6 cookies) were placed together side by side, slightly overlapping and face down on the sample area. The lid was put on and a reading taken. Cookie samples were rotated approximately 120°, another reading taken, rotated 120° more and a final reading taken. The three readings were averaged. This procedure was repeated for the Test packages in order to obtain a similar color reading. Like packages were held on the shelf and this procedure was repeated after four weeks.

Moisture: Moisture determinations were made on three samples from each of two packages for both types of packaging. Cookies from three specific positions within each package were taken. Figure 1 illustrates this specific positioning. The cookies were ground individually at high speed for ten seconds, the container was shaken twice by hand, then they were ground for another ten seconds in a Hamilton Beach Commercial Bar-Mixer type blender. Approximately 5 grams of cookie crumbs were placed on the tray of an LP-16 Mettler PE360 Moisture Meter (accuracy .01%). The meter lid was closed and the start button depressed. Approximately 5 minutes later the machine locked in on a reading and it was recorded. The moisture of the cookie was calculated by the formula:

$$\% \text{ Moisture} = 100 - \text{reading}$$

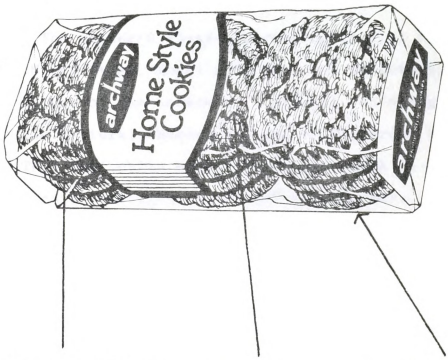


Figure 1. Cookie position within the stack and within the package

The six readings obtained were averaged for both the Control and the Test packages. Like samples were held on the shelf for four weeks and the moisture readings were repeated.

Tenderness: The standard shear-compression cell of the Allo-Kramer Shear Press, Model SP12 was used to determine tenderness values of the cookies. This unit was designed to measure the textural characteristics of different types of foods. This particular model is equipped with an electronic recorder, called the TR-5 Texturecorder. Whole cookies were weighed to the nearest .01 grams and then were positioned singly in the bottom of the standard shear-compression cell. A Force Transducer of 3,000 pounds with a range of 1/10 was used for each determination. Single determinations were made on each sample cookie with three measurements per package (again according to specific position within the package, illustrated in Figure 1) on two packages for a total of six determinations for the Control and six for the Test package. The tenderness value, expressed as pounds of force per gram was calculated according to the formula:

$$\text{Tenderness} = \frac{\text{Range x Transducer x Reading}}{\text{Sample Weight x 100}}$$

An average of six values was recorded for each type of package as tenderness. Like packages were held on the

shelf and this procedure was repeated after four weeks.

Subjective Measurements

Samples were evaluated by a panel of 62 subjects recruited from a file of consumers who regularly participated in consumer panels for the company. The desired population of this panel was one which would closely approximate that of the normal buying group of the company's products. This population should have consisted of approximately 75% females and 25% males; over 50% of the people should have been in the 25-54 age range.

Visual Preference Tests: The two cookie packages were assigned random numbers. The panelists were first asked to evaluate the two packages of cookies from a visual standpoint. A photograph of the two types of packages is shown in Figure 2. Panelists were shown the cookie sample packages individually in a room set up similar to a classroom. The room was quiet, had florescent lighting and was temperature controlled at 68°F. The panelists were allowed as much time as they needed and were also allowed to handle either or both of the packages. Prior to viewing the two samples, they were given a questionnaire which they took into the classroom with them. This first questionnaire had four questions on it which asked them to make choices regarding their preferences by marking the appropriate space under the sample number next to each


Figure 2. Photographic comparison of two different cookie packages.

question. A sample of the questionnaire appears in Appendix A.

Sensory Preference Test: Cookies were removed from similar Control and Test packages. They were re-packaged and sealed individually in clear cellophane packages the day prior to the panel evaluation and were assigned new random numbers. Consumers were asked to evaluate these products from a sensory standpoint in an enclosed taste panel room. The room was divided into six individual evaluation areas. Colored lights were used (red, blue and green) to simulate daylight conditions. The panelists had to open each individual cookie packet, taste the cookie and evaluate it according to the instructions and questions on a questionnaire they were given. The questions were simple preference type and had to do with cookie appearance, aroma, texture, flavor and overall acceptance. Panelists did not know from which package the products originally came. The sensory tests were repeated by the same panelists four weeks later on samples of products from similar Control and Test packages which were held on the shelf for four weeks. The questionnaire used for sensory evaluation is in Appendix B.

## Statistical Analyses of Data

The data on the objective measurements of color, moisture and tenderness values for Date Filled Oatmeal

cookies were analyzed for variance using Mstat (Michigan State University, 1982). A split-plot design for factorial analysis was chosen for the measurements of texture and moisture to determine if any significant differences existed in the mean values for the effects of treatment, storage, position of cookie within the package, and for several interaction effects among these variables (Gill, 1988). When significant differences were found among any of the means, Duncan's Multiple Range Test of the ranking subprogram of Mstat was used to compare and rank them.

Chi-Square (Steel and Torrie, 1980), was used to analyze consumer panel data for preference of the cookie package from a visual standpoint and preference for the cookie itself, both at 0 time and after four weeks of storage. Cross-tabulations between consumer preferences for cookies and selected demographic data for the panelists were used to form the basis for the discussion about the panel.

# RESULTS AND DISCUSSION

This study was designed to determine the effects of alternative materials of packaging on the quality characteristics of Date Filled Oatmeal cookies. Consumer acceptability and/or preference for these two different packages, as well as preference of the product itself both initially and after four weeks of shelf-life was also included in the information gathered.

## Cookie Objective Measurements

Date Filled Oatmeal cookies were chosen for this research because they are a representative product of Archway Cookies, Inc. and because they contribute to approximately 15% of overall sales for the company. They are not only considered representative but are considered vital to the existing product line of the company. Analyses of variance tables as well as tables of replicate means and standard deviations accompany this section of the discussion.

### Color

The analysis of variance for the lightness (L) values of the cookie surfaces and the means and standard deviations for these data are shown in Tables 2 and 3,

Table 2. Analysis of variance for L values (color) of Date Filled Oatmeal cookies stored in two different types of packages, measured at 0 time and four weeks.

| Source | df | Sum of Squares | Mean Squares (color value) | F Value |
|---|---|---|---|---|
| Total | 11 | | | |
| Treatment | 3 | 17.61 | 5.87 | 3.32* |
| Error | 8 | 14.16 | 1.77 | |

* significant value of F at a probability of .10

Table 3. Means and standard deviations[1] for L values of Date Filled Oatmeal cookies stored in two types of packages and measured at 0 time and four weeks.

| Package Type | Storage Time | Color Values L |
|---|---|---|
| Control | 0 time | 27.90 ± .78 ab |
| | 4 weeks | 29.90 ± .66 a |
| Test | 0 time | 26.90 ± .81 b |
| | 4 weeks | 29.50 ± .81 ab |

1 Based on 3 replications

Values with the same letters are not significantly different from each other at a probability of .05 (Duncan).

respectively. The analysis of variance revealed a significant difference among lightness values for treatment means, but only at a probability of .10 (Table 2).

Duncan's Multiple Range Test was used to separate the means. These results are shown in Table 3. This test did not reveal differences between the means for the Test package and the Control package. Both the Control and the Test packages had an increasing degree of lightness associated with increased time on the shelf. This increase in lightness (fading) would be a normal and expected reaction when a product has been exposed to artificial florescent-type lighting. There seemed to be less fading in the cookies from the Test package. Individual differences in the manually selected off-the-line packages could account for the slight differences between initial measurements of both types of packages; however, these differences were not enough to be significant. Presumably, the effects would be greater with more extended time on the shelf.

The product in the Control package, measured for lightness at 4 weeks, had a larger L value (lighter, more fading) than did the Test product at 4 weeks. Although these two measurements were not significantly different from each other, the Control product at 4 weeks, as mentioned before, was significantly different from the Test product's 0 time measurement. The two products ideally should have had the same 0 time L values. This indicates

that the degree of fading was very close to being significant and perhaps with a longer exposure to light it would have been. Furuya and Warthesen (1984) found, when measuring the effect of various light intensities on pasta products, that a single layer of a macaroni product exposed to the light was useful in the determination but that the packaging considerations may cause differing effects. Color measurement devices are for completely transmitting or reflecting materials (Francis, 1977), which unfortunately most foods are not. So there will be some variability in the accuracy of measurements due to this.

The printed surface of the PP film Test package allows light to be diffused in a different manner than does the surface of the cellophane Control package. It would appear that the materials do not cause enough of a difference after four weeks exposure to light to be significant.

## Moisture

The analysis of variance of the percentage moisture data is presented in Table 4; replicate means and standard deviations of percentage moisture values in the cookies are presented in Table 5.

A split-plot analysis of variance was performed in order to test for all possible variations and interactions among storage, position and treatment. There were no significant differences found among means for treatment or

Table 4. Analysis of variance for moisture values of Date Filled Oatmeal cookies in two types of packages, measured at 0 time and after four weeks.[1]

| Source of Variation | Degrees of Freedom | Sum of Squares | Mean Square | F Value |
|---|---|---|---|---|
| Total | 23 | | | |
| T | 1 | .108 | .108 | 1.029 |
| S | 1 | .027 | .027 | .257 |
| T x S | 1 | .044 | .044 | .419 |
| Error[1] | 4 | .419 | .105 | |
| P | 2 | .254 | .127 | .520 |
| T x P | 2 | .334 | .167 | .684 |
| S x P | 2 | 1.642 | .821 | 3.365* |
| T x S x P | 2 | .096 | .048 | .197 |
| Error[2] | 8 | 1.950 | .244 | |

[1] T = Treatment type, S = Storage, P = Position of cookies within the package (i.e. middle, top, bottom).

Error[1] = possible error due to differences among packages from the treatment/storage interaction.

Error[2] = possible error due to package difference from the package/cookie position interaction.

* significant value of F at a probability of .10

Table 5. Means and standard deviations[1] for the moisture percentages of Date Filled Oatmeal cookies in three different positions within cookie packages, measured at 0 time and four weeks.

| Storage Time | Cookie Position (within stack) | Moisture Percentage |
|---|---|---|
| 0 time | middle | 12.98 ± .36 ab |
| | top | 13.40 ± .11 ab |
| | bottom | 13.65 ± .19 a |
| 4 weeks | middle | 13.45 ± .18 ab |
| | top | 13.51 ± .09 ab |
| | bottom | 12.87 ± .17 b |

1 Based on 4 replications

Moisture percentages with the same letters are not significantly different from each other at a probability of .10 (Duncan).

means for storage. There was also no significant difference found among means for the interaction of treatment and storage.

Again, as shown in the second half of the split-plot analysis, there was no significant difference found among means for the position of the cookie within the package; there were also no significant differences found among the means for the interaction of treatment and cookie position or for the interaction of treatment, storage and cookie position. There was, however, a significant difference found for the interaction effect of storage and position of the cookie within the package. This difference was significant at a probability of .10.

Table 5 contains the means and standard deviations for moisture percentages of the different cookie positions within the package. This analysis does not separate the two types of packaging since no differences were found due to treatment type. According to manufacturer specifications, the Test cookie package film (PP) has superior moisture barrier properties to that of the Control package film (cellophane). A treatment difference was anticipated since the water vapor transmission rate of the PP film is .33 gm/100 sq. in. in 24 hours and that of the cellophane is .45 gm/100 sq. in. in 24 hours. The superior properties of polypropylene were not reflected in the data here, since no significant differences were found in moisture due to treatment type. Perhaps a longer storage

period would have reflected this difference in barrier properties; it appears that this difference does not affect cookie properties for at least up to 4 weeks storage time.

Significant differences were not found for the cookies in the middle or top positions within the stack, either at 0 time or upon measurement at 4 weeks shelf life. However, a significant difference was found, at a probability of .10 (Duncan) for the cookie positioned on the bottom of the stack from the 0 time measurement to the measurement after 4 weeks, regardless of treatment type. Cookies in the middle or at the top of the stack showed a slight increase in moisture percentages over time, while the cookies at the bottom of the stack showed a significant decrease in moisture readings. Normally, one would expect to see an equilibration of moisture within the package over time, but in this instance, it would appear that the moisture in either type of package migrated upward in the stack, causing the cookie on the bottom to lose the most moisture over time. In a similar six week study conducted for another Archway cookie bakery, package material did have an effect on moisture loss. Packages wrapped in the Test material showed virtually no moisture loss when compared to those wrapped in cellophane (Anonymous, 1987h).

Texture (shear compression)

An analysis of variance on the shear compression data

is shown in Table 6. A split-plot analysis was performed for texture as it was for moisture in order to test for all the possible variations and interactions.

Significant differences were found among means for treatment type, for storage type, and for the interaction of treatment and storage. The variances for treatment type and for the treatment/storage interaction were significant at the .05 level of probability (Duncan's); the variance of the means for the effect of storage was significant even at the .005 level of probability, indicating that the 4 week storage period had a great effect on the shear compression (tenderness/texture) of the cookies.

Duncan's Multiple Range Test was used to sort the means for shear compression values of the cookies in the two types of packages for the two different storage times. Table 7 gives the means and standard deviations for these values. More force was required to shear both the Test cookie and the Control cookie after 4 weeks of storage as compared to the force required to shear either one of them at 0 time. While initial measurements of shear compression values of the Control and Test packages were not significantly different from one another, measurements at 4 weeks were significantly different for each type of treatment (package material) from each other and from the measurement of each type at 0 time. These values were significant at the .01 level of probability. Cookies from both treatment types required significantly greater force

Table 6. Analysis of variance for shear compression values of Date Filled Oatmeal cookies in two types of packages, measured at 0 time and after four weeks.[1]

| Source of Variation | Degrees of Freedom | Sum of Squares | Mean Square | F Value |
|---|---|---|---|---|
| Total | 23 | | | |
| T | 1 | .310 | .310 | 19.375* |
| S | 1 | 2.704 | 2.704 | 169.000** |
| T x S | 1 | .338 | .338 | 21.125* |
| Error[1] | 4 | .064 | .016 | |
| P | 2 | .108 | .054 | .080 |
| T x P | 2 | .444 | .222 | .329 |
| S x P | 2 | 1.168 | .584 | .866 |
| T x S x P | 2 | .016 | .008 | .012 |
| Error[2] | 8 | 5.388 | .674 | |

1 T = Treatment type, S = Storage, P = Position of cookie within the package (i.e. middle, top, bottom).

Error [1] = possible error due to differences among packages from the treatment/storage interaction.

Error [2] = possible error due to package differences from the package/cookie position interaction.

* significant value of F at a probability of .05

** significant value of F at a probability of .005

Table 7. Means and standard deviations[1] for shear compression values of Date Filled Oatmeal cookies in two types of packages, measured at 0 time and four weeks.

| Package Type | Storage Time | Shear Compression lb/g | |
|---|---|---|---|
| Control | 0 time | 5.44 ± .27 | c |
| | 4 weeks | 6.34 ± .23 | a |
| Test | 0 time | 5.45 ± .25 | c |
| | 4 weeks | 5.88 ± .23 | b |

[1] Based on 6 replications.

Values with the same letters are not significantly different from each other at a probability of .01 (Duncan).

to shear after 4 weeks of shelf-life than they did on initial measurement. The Control product at 4 weeks required the greatest force for shearing. The literature supports these results because PP film has better moisture barrier properties (i.e. moisture loss can cause staling and firmer products). Cellophane, with an oxygen transmission rate of only 0.6 cc/100 sq. in. in 24 hours, compared to 4.0 cc/100 sq. in. in 24 hours for the PP film would appear to have the advantage against products drying out due to oxygen transfer. However, both films were coated with PVDC - an excellent oxygen barrier (Anonymous, 1987g; Sacharow, 1986).

## Cookie Subjective Measurements

Sensory data was obtained from panelists in the form of preference tests as indicated by use of the questionnaires which appear in Appendix A and Appendix B, respectively.

Appendix C gives the demographic characteristics of the consumer panel used for the study which was found to be fairly close to the desired one. The majority (92%) of the panelists were female, and although it was deemed desirable to have closer to 25% males involved in the research, this number was close to the actual buying group profile for the product, as shown in Appendix D. Over half of the males in the study considered themselves to be the major purchasers

for their household which made their responses that much more useful and meaningful. The goal was to have at least 50% of the respondents in the 25-54 age range; the actual panel consisted of over 60% fitting that criteria. The target population are those to whom the product was intended to be sold; the assumption was that the information obtained from this consumer test would approximate the behavior of the target population (Sidel and Stone, 1979).

## Visual Preference

Panelists were first asked to evaluate and give a preference for one of the two packages, using the Panelist Questionnaire in Appendix A. Table 8 gives this data, which when analyzed using Chi-Square Tests (Steel and Torrie, 1980), corrected for continuity, showed a significant preference for the Test package over the Control package for each of the four questions asked. Panelists rated the Test package as the one they most preferred for the aspects of appeal, product protection, value, and purchase intent.

Color psychologically affects what we deem as eye-appealing and gives us the connotation of product image. Primary package color seems to have an influence on consumer choice. Baked products are more often packaged in bright, bold colors, such as reds, which have an extremely

Table 8. Chi-Square values [1] for visual panel data of test for preference between two different packages of cookies.

| Question Subject | Package Preferred | Chi-Square Values |
|---|---|---|
| Appeal | Test | 24.932* |
| Protection | Test | 41.950* |
| Value | Test | 21.875* |
| Purchase Intent | Test | 24.932* |

[1] Based on responses from 62 consumers.

* Significant values of Chi-Square at .005 probability.

high rate of acceptance (Lipka, 1987; Cheskin, 1957). The literature in this area seems to correspond to the results obtained here (Sacharow, 1976; Anthony, 1987).

Douglas and Dubois (1977) found that better educated people are often more apt to be innovators and are more receptive to new ideas. In fact, these people are considered to be more sensitive to information and are very rational in their purchase behavior. The demographic data in Appendix C shows that 87% of the panelists in this study had graduated from high school, almost 70% had attended at least some college, while 37% of those people had graduated from college or had even more education than 4 years of college. It appears that education level could very well have an influence on how perceptive a person is to new ideas. A cross check of data showed that the majority of the respondents who selected the Control package over the Test package as their preference were in the portion of the group with the least amount of education.

## Sensory Preference

Initial evaluation for preference of the cookie itself, again using Chi-Square Tests (Table 9), revealed a preference for the Test product for appearance, aroma, flavor and overall acceptance. Preference for flavor and aroma of the Test cookie had significant values of Chi-Square. The Control product was preferred, although not

Table 9. Chi-Square values[1] for sensory panel data of test for preference between two differently packaged products, measured at 0 time and four weeks.

| Storage Time | Question Subject | Product Preferred | Chi-Square Values |
|---|---|---|---|
| 0 time | Appearance | Test | .271 |
| | Aroma | Test | 2.016* |
| | Texture | Control | .266 |
| | Flavor | Test | .804** |
| | Overall | Test | .424 |
| 4 Weeks | Appearance | Test | .378 |
| | Aroma | Control | .980** |
| | Texture | Control | .080 |
| | Flavor | Control | 2.040* |
| | Overall | Control | .327 |

1 Based on responses from 62 consumers.

* Significant values of Chi-Square (at .25 probability).

** Significant values of Chi-Square (at .50 probability).

significantly, for the single attribute of texture. Specific literature on studies involving foods stored in these types of materials is not readily available. These particular materials are used primarily in packaging bakery products; cakes do not have long shelf-lives, and most other cookie products have very extended shelf-lives (beyond 6 months) and are thus normally packaged in foil or laminated paper products.

Brady and Mayer (1985) found, in their studies of bread texture, that the effects of moisture and temperature in the mouth and the physical changes that occur during chewing, cause these samples to change constantly. However, a sample tested with a compression instrument is subjected to steady, constant forces. So although samples in their study were the same at the beginning of the test, they weren't comparable throughout the test. Peleg and Normand (1982) demonstrated that the mechanical stimulus involved in mastication is different in both its form and intensity from the output of mechanical instrumental tests. While our sensory systems can glean information unavailable to even the most sensitive machines, there are certain subtle rheological characteristics of foods that we ignore.

The table of means and standard deviations for shear compression (texture) of the cookie samples, measured at 0 time and at 4 weeks (Table 7) indicated that there were no significant differences between means for the Control product on initial evaluation and the Test product

on initial evaluation; in fact, the means were almost identical. The differences found by Brady and Mayer between the two types of tests (instrumental vs. sensory), could help explain these results.

Studies by Kim and Setser (1980) indicated a presentation order bias with cakes. If panelists were not allowed to retaste samples or if they were not given a warm-up sample, they could have difficulty making reliable preference judgments. They found a bias for the second sample presented. In this study, consumers picked up samples out of boxes and carried them into another room to evaluate them. The order would be assumed to be random, with a 50% chance of one particular sample being tasted first. The evaluation forms, pre-marked with sample numbers, did present one item first for half of the panelists and the other item first for the other half of the panelists, in an effort to try and eliminate or reduce the order bias.

Evaluation of the product by the same panelists using the same questions four weeks later, showed a preference for the Test cookie for the attribute of appearance only. Referring back to Table 3, the Test product did exhibit slightly less color loss, but this was not a significant amount and could not directly explain the preference for appearance of this cookie at 4 weeks. There are many individual factors which add to the overall perception of the appearance of a food product. Hutchings (1977) found

that optical properties, physical form and the method of presentation are all of importance. Studies by Cardello and Maller (1982) showed that a person's preference for a food is not a good predictor of the acceptability of that food to the individual. They found that people who liked a food item more, were more likely to differentiate between two samples of the food. Preferences for the other attributes - aroma, texture, flavor, and overall acceptance, were for the Control product at the 4 week evaluation. Again, preferences for flavor and aroma, were significant. Since these two attributes are subjective in nature, one can assume that the reversal in preference may be able to be attributed to something that is causing a change in the flavor and aroma of the product, i.e. the type of packaging material. The Test package material is supposed to have superior flavor/aroma barrier properties (Anonymous, 1987g), but this literature made no reference to the effect on products from pre-printed film (ink of the film could cause flavor and aroma problems). Comments on panelist scorecards regarding the aroma and flavor of the Test product at 4 weeks, centered mainly on the noticeability of a heavy or strong taste (and a dry, coarse, crumbly, texture). The Control product at 4 weeks, on the other hand, was perceived as having a moist texture and a mild, sweet flavor. Several panelists could not detect much of a difference. It appears that those who did notice a difference were not able to identify the exact

nature of the flavor or aroma they were noticing.

Storage usually does have a negative effect on quality of products; stored products are expected to be less preferred than the original product (Labuza and Schmidl, 1988). But since both products were stored under equal conditions for the same amount of time, the effect of the storage should be similar for both products. A characteristic of storage that consumers find objectionable is the drying or loss of moisture of bakery items (Lagrange and Payne, 1988).

Moskowitz et al. (1980) noted that a recurrent problem in preference testing is that people commonly change preferences: they state A one time and B the next. A procedure to try and eliminate this type of problem would be to train the panel, and select only those who were able to discriminate very well. That, however, would not constitute a consumer panel, but rather a trained laboratory panel. This would detract from the original purpose and intent of having a consumer panel judge the products. Preference/acceptance panels which evaluate opinions of the consuming public should be conducted using consumers (Abbott, 1973). Cardello et al. (1982) described affective (preference) panels as those normally consisting of naive and untrained consumers of the product. Morrison (1981) implied that triangle discrimination tests should often be used in conjuntion with preference tests.

The data for texture of the product at four weeks

revealed that more force was required to shear the Control cookie than was required to shear the Test cookie, indicating a "tougher" product as far as the instrumental measurements were concerned. This did not correlate with the sensory data which showed a preference for the texture of the Control product; from an instrumental measurement point of view, this should have been a tougher product. It is possible that the panelists preferred a firmer texture, or perhaps the poorer impression left by the flavor and aroma of the Test cookie at 4 weeks of age was enough to offset a choice for preference of the texture of that product. Experiments conducted on panel perception of the texture of food products by Cardello et al.(1982), showed that with training, a consumer panel improved their ability to discriminate along textural dimensions.

Consumer comments in response to taste and aroma revealed that a large number of panelists were commenting on a different off-flavor and odor in the cookies from the Test package at the 4 week evaluation. Separate tests with cookies by Clark (1986) and Hodges (1986) revealed the possible effects of migration of toluene or styrene monomers to the product in the package from the packaging materials. This might be a possible cause of the negative attitude toward the flavor and aroma of the product. Panelists noticed a difference in flavor and aroma between the two products, but could not seem to identify the nature of it. Most panelists only indicated that they perceived a

strong, almost burnt or heavily-spiced flavor from the Test product at the the four week evaluation.

# SUMMARY AND CONCLUSIONS

Comparison of cookies packaged in two different types of packaging material revealed few significant differences on initial objective measurements. Measurements taken after four weeks of shelf-life, however, revealed differences among the treatment means for lightness values. A difference was found between the 0 time L value of the Test package (printed PP with an OPS tray) and the four week measurement of the cookies from the Control package (cellophane). Measurements at 0 time should have been the same. This difference was probably due to differences in the product as picked off the line (degree of bake, perhaps), and would not be relevant to this study. Both products had increasing lightness values (associated with fading) over time.

Moisture data analysis showed that there was a significant difference for the interaction effect of storage and the position of the cookie within the package. Further analysis found that the differences were for the cookies that were at the bottom position within the stack. Moisture in these cookies decreased significantly over time. Treatment type made no difference in this interaction effect.

Analysis of the texture (shear compression) data found

significant differences among means for treatment type, length of storage, and for the interaction of the two. The greatest effect was found with the 4 week storage time. The amount of force required to shear the products increased with time. The Control product at four weeks required the most force of all to shear.

Visual preference data showed that a significant number of panelists preferred the Test package over the Control package for the aspects of appeal, product protection, value, and purchase intent. Education level appeared to have some effect on this preference.

Sensory panels, upon initial evaluation, preferred the cookie from the Test package over the cookie from the Control package for appearance, aroma, flavor and overall acceptance. Preference for aroma and flavor was significant. Evaluations were repeated by the same panelists four weeks later and their preference was for the cookie from the Control package for every aspect except appearance. Preference for aroma and flavor was again significant.

The packaging materials used seemed to have varying effects on the products within. While the cellophane overwrapped Control cookie had the worst texture measurement after four weeks of shelf-life, it was the most preferred for flavor and aroma. It appears that the Test package materials had a negative effect on the perception of flavor and aroma, perhaps indicating that there is a

transfer mechanism involved.

Further studies need to be conducted to determine the exact nature of the aroma/flavor problem. The positive aspects of the Test package from a visual standpoint, as well as textural measurement standpoint, are enough to warrant further exploration of these packaging materials.

## RECOMMENDATIONS

1. A more extended study would be desirable, perhaps measuring the cookies for moisture, color and texture initially, at 3 weeks, and again at 6 weeks (maximum shelf-life for the product).

2. Additional studies, subjecting the cookies to different levels of humidity would also be desirable since actual products are subjected to extremes of heat/humidity during the summer months.

3. Water activity is an important criteria as well as the moisture level; a study incorporating this information would be beneficial.

4. Actual testing of the products for the level of toluene or styrene monomers present would be appropriate and helpful.

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# APPENDICES

APPENDIX A

DATE PANELIST QUESTIONNAIRE PANELIST NO.

_____ _____

INSTRUCTIONS:

Please examine both packages of cookies. Assume the products inside the packages are identical and that they are priced the same. Take your time and look at the entire package (shape, design, color, packaging material, label, etc.). Packages are numbered on the card beside the package. Please answer the following questions by placing an X in the space under the number of the package that is your choice. Feel free to write comments explaining the reasons for your responses.

| | # | # |
|---|---|---|
| 1. Which package do you find the most appealing? | _____ | _____ |
| 2. Which package do you feel offers the most protection for the product inside? | _____ | _____ |
| 3. Which package do you feel gives you the most value for your money? | _____ | _____ |
| 4. Which package of cookies would you be the most apt to pick up and purchase, based on your responses above? | _____ | _____ |

APPENDIX B

DATE SENSORY EVALUATION PANELIST NO.

_____ _____

INSTRUCTIONS:

Please open each individual packet of cookies. Each packet is numbered on the outside. Taste the cookies and answer the following questions by placing an X in the space under the number of the cookie sample that is your choice.

| | # | # |
|---|---|---|
| 1. Which cookie has the best appearance? | _____ | _____ |
| 2. Which cookie has the best aroma/smell? | _____ | _____ |
| 3. Which cookie has the best texture? | _____ | _____ |
| 4. Which cookie has the best flavor? | _____ | _____ |
| 5. Overall, which cookie would you rate as being the most acceptable to you? | _____ | _____ |

Please feel free to write any comments below:

APPENDIX C

## DEMOGRAPHIC CHARACTERISTICS OF CONSUMER PANEL (N=62)

| Age of Panelist | % |
|---|---|
| under 25 | 5 |
| 25-54 years | 63 |
| 55 and over | 32 |
| | 100 |

| Gender of Panelist | % |
|---|---|
| male | 8 |
| female | 92 |
| | 100 |

| Major Purchaser of Household | % |
|---|---|
| Panelist | 81 |
| Other | 19 |
| | 100 |

| Education Level of Panelist | % |
|---|---|
| 8th grade | 2 |
| some high school | 11 |
| completed high school | 19 |
| some college/bus. school | 31 |
| completed college or more | 37 |
| | 100 |

APPENDIX D

DEMOGRAPHIC CHARACTERISTICS OF

ARCHWAY COOKIE USERS*

| Age of User | % |
|---|---|
| under 25 | 4 |
| 25-54 years | 57 |
| 55 and over | 39 |
| | 100 |

| Gender of Purchaser | % |
|---|---|
| male | 25 |
| female | 75 |
| | 100 |

| Education Level of User | % |
|---|---|
| some high school | 26 |
| completed high school | 48 |
| some college or business school | 16 |
| graduated college | 11 |
| | 100 |

* Anonymous, 1985