A DISCUSSION OF THE HISTORY AND DEVELOPMENT OF THE IN-STORE MERCHANDISING AND PACKAGING OF FRESH RED MEAT WITH EMPHASIS ON THE EFFECT OF POLYVINYL CHLORIDE FILM ON A TRADITIONAL CELLOPHANE MARKET

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An Abstract
by
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In this thesis the author traces the historical development of the in-store packaging and merchandising of fresh red meat. The first meat departments were of the service type, in which the butcher both sold and wrapped the cuts of meat purchased by the shopper. The inherent advantages offered by self-service meat departments enabled self-service merchandising of meats to "come of age". This merchandising concept placed responsibility for sales ultimately upon the fresh meat package.

The basic problems of in-store meat packaging are also outlined and enumerated in this paper. For the most part these problems can be traced directly to the packaging material or to weaknesses in the complete package.

For the past three decades coated cellophane has been the preferred packaging film for fresh red meats. In the past few years polyvinyl chloride has presented a supreme challenge to this dominance of cellophane. Through a comparative evaluation of the advantages offered by these two films the superiority of polyvinyl chloride over cellophane as a packaging film for fresh meats is clearly shown.

The author concludes with a discussion of projections for the future with respect to the in-store packaging of fresh

meat. The effect of consumer demand, technological innovations, and future growth potential of polyvinyl chloride are analyzed.

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INTRODUCTION

A basic question in the meat and livestock industry today is, "To what degree is polyvinyl chloride replacing cellophane as a packaging film for fresh red meat?" In this paper the author should like to answer this question through the analysis of several topics including the marketing of livestock and meat, the growth and development of self-service retail outlets for meat, the in-store packaging of fresh red meat, and future projections with respect to the in-store packaging of fresh red meat.* Let us now look at some historical trends in the production of livestock and meat in the United States.

Meat is basic to the modern diet and meat animals are the mainstay of a modern agricultural technology. The abundance of meat and meat animals has become a distinguishing indicator of advanced society throughout history. The United States is certainly no exception to this general axiom. In the last forty years, production of all meats in the United States has increased nearly seventy-five percent from 17.7 billion pounds in 1923 to over 30.5 billion pounds

*Beef is considered by many people in the United States to be the preferred food in the diet because of its traditionally high "status" value and its high nutritional content. Therefore, the brunt of this discussion will center around fresh red beef.

in 1963. Production of beef alone has more than doubled in the past forty years--from 6.7 billion pounds in 1923 to 16.4 billion pounds in 1963.[1] In fact, cattle numbers have increased at the rate of more than one million head per year since before the turn of the century and most of the cattle raised since 1900 has been beef cattle.[2] Not only has the quantity of livestock raised and marketed for ultimate consumption increased significantly, but the quality of this livestock has also been greatly improved. The Federal Government has played a predominant role in the upgrading of standards concerning the condition of pre-slaughter livestock, slaughtering and processing operations and facilities, and post-slaughter handling of meat and meat products. Let us now investigate the history and chronological development of these Federal regulatory standards and analyze their implications on the livestock-meat industry.

In pioneer America the only outlet for the disposal of meat animals was through home slaughter. Home-slaughtered meat was dried, smoked and cured for future consumption or was bartered with neighbors for other needed goods and

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[1] Radiation Preservation of Food. United States Department of Commerce - Business and Defense Services Administration, January, 1965, p. 19.

[2] Stout, Thomas T. and Willard F. Williams, Economics of the Livestock-Meat Industry, The MacMillan Company, New York (1964), p. 54.

services. As the frontier expanded through the growth of towns, the farmer's market for the livestock he raised greatly expanded. Producers of livestock at this time had basically two available marketing channels for the distribution of their livestock. Farmers could sell their livestock to professional drovers--these men collected a sizable drove at as small a cost as possible and made deliveries to distant markets--or they could sell livestock direct to local butchers. Local butchers did not slaughter in any appreciable volume, so livestock producers were forced to seek out drovers as their only practical market channel. In these days production centers and marketing centers were separated by great distances. Time was of the essence in all early livestock drives and the journey between ranch and market was long, hot, dusty, and arduous. As a result of these livestock drives much of the meat consumed in urban areas of the United States before the Industrial Revolution came from scrawny, battered and bruised, diseased animals.

The meat packing industry was caught up in the great Industrial Revolution that occurred throughout all phases of American business after the end of the Civil War. The Union Army's enormous demand for packed meat gave large-scale industrial meat packing its real economic start. What happened to meat packing parallels the development of industrial capitalism into monopoly capitalism throughout

the United States. As we have seen, frontier meat slaughter and packing was done primarily by small-scale, independent butchers, who were located close to production sources. These butchers constituted a free-competitive market--each held no direct control over the total industry and there was "free play" of prices, profits and wages.[3] The Industrial Revolution changed this picture considerably. Technical innovations, notably the advent and rapid growth of railroads and the development of the refrigerated railroad car, helped to "reduce" the distance between production and slaughter and to foster the growth of large slaughter houses which could take advantage of basic economies of scale. The subsequent unionization of meat-packing employees helped to increase the output of these centralized slaughtering plants. Still, however, there were no provisions made to insure the quality of slaughtered livestock.

Federal meat inspection was established in the United States in 1890. Strangely enough, it began primarily from foreign rather than domestic appeals. European purchasers were skeptical of meat exports from the United States because these products bore no official evidence that the meat had come from healthy animals.[4]

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[3]Corey, Lewis, Meat and Man, The Viking Press, New York (1950), p. 41.

[4]Association of Food and Drug Officials Quarterly Bulletin, "Federal Meat Inspection Labeling Program", Vol.29, No.1, January, 1965, p. 3.

This first legislation provided for the inspection of meat after slaughter and before export, but made no provisions for the determination of whether the meat had come from diseased animals. The formal Meat Inspection Act was passed in 1891. The principal justification for this legislation was the economic goal of increased exports rather than the protection of domestic and foreign consumers from disease. This legislation in itself held no specifications regarding acceptable standards of sanitation for the slaughter and processing of livestock. Numerous protests concerning sanitation, labor conditions, and, in general, the meat that was being slaughtered and processed, developed throughout the United States in the late nineteenth and early twentieth centuries. The most famous protest was that of Upton Sinclair whose book, The Jungle, which described the abominable conditions existing in the meat-packing industry, became an immediate best-seller. This book aroused considerable public interest in meat packing and directly led to the passage of the Meat Inspection Act of 1906. The Meat Inspection Act of 1906 is the basis for all Federal meat inspection today. This Act:

1. Established a permanent inspection service-the Meat Inspection Division, Agricultural Research Service, United States Department of Agriculture.

2. Specified not only before-and-after slaughter inspection but also inspection at successive stages in the cutting, handling, and processing of meat.

3. Regulates the transportation of meat in interstate and foreign commerce.

4. Prohibits the use of harmful ingredients or misleading labels.[5]

The law is mandatory for all meat-packing plants operating in interstate or foreign commerce or that sell meat directly to the Federal Government. Today, less than twenty percent of the total number of slaughtering plants in the United States are Federally inspected, but these plants do a very high percentage (83 percent) of the total slaughtering in the United States.[6] These two Meat Inspection Acts have combined to produce great advances in the quality of meat slaughtered for human consumption. Unfortunately, public awareness and subsequent action toward the removal of poor working conditions and lack of employee benefits lagged far behind the upgrading of quality standards toward the meat that was being processed. The public was appalled by the fact that the meat it consumed could be potentially diseased, but seemed to take in stride the fact that members of society were dying in the filth and stench of the packing plants. Sinclair later remarked that his book was "aimed at the public's heart, but hit its stomach instead."[7] Social reforms were slow in coming

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[5]Fowler, Stewart, The Marketing of Livestock and Meat, Interstate Printers and Publishers, Inc., Danville, Illinois (1957), p. 492.

[6]Economics of the Livestock-Meat Industry, op.cit., p. 625.

[7]Ibid., p. 624

to the meat-packing industry, but today employees enjoy wages, benefits and conditions comparable to other American industries.

Aside from the provisions and regulations of the Meat Inspection Acts, several additional factors are specifically responsible for improvements in the quality of beef produced and marketed. First, better breeding and improved management have reduced death losses of all the varieties of beef cattle. Secondly, sharp and continued increases are evident in the numbers of cattle fed to higher grades. Thirdly, official grading of meat and increased consumer demand for better quality in beef have undoubtedly contributed to the trend toward better and more uniform beef quality.[8] Thus far some of the reasons for increased quality of meat offered for consumption have been discussed. The significance of these factors is further heightened because farm population decreased one-third during the twenty-year period between 1940 and 1960.[9] Nevertheless, at the same time the number of units of livestock on farms raised for ultimate consumption has greatly increased. Today two-thirds of the farmers produce more livestock than all farmers did two decades ago--and this livestock is of a greatly increased quality!

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[8] Ibid., p. 549.

[9] Ibid., p. 428

THE GROWTH OF SELF-SERVICE MEAT DEPARTMENTS

Concurrent with the development of significant innovations and government regulations which in combination helped to increase the quality of livestock slaughtered and marketed was the growth of self-service retail outlets.

As the American frontier moved westward we have seen that home production of meat was popular in most local areas. General stores sprung up in frontier towns to serve the needs of the people for variety in the goods they used and consumed. These stores tended to enjoy small economic monopolies in the communities they served because they offered liberal credit, in-store clerk service, and order-filling and delivery functions. Early grocery stores stocked and merchandised only grocery items; meat was sold by small-scale, independent butchers or by small-volume meat markets. Because of the numerous advantages they offered to the shopper, grocery stores began to grow and develop early in the twentieth century. The originator of the supermarket is generally considered to be Clarence Saunders, who founded the Piggly Wiggly Stores in 1915. The supermarket concept was the result of a combination of ideas put together by pioneers in the

grocery field. Among these men were Michael Cullen of the King Kullen Stores and Robert Matis and Ray Dawson of the Alpha Beta Stores.[10]

As early grocery stores continued to grow a few operators combined grocery and meat stores, featuring either a leased meat department or having the grocery and meat sections operate separately but share costs. Gradually the meat department operation was absorbed by the grocer and the combined food store emerged.

Let us now survey the historical development of the meat department in these early retail outlets. The first supermarket meat departments were the service type, consisting of one or two regrigerated display cases. In these departments merchandising was very limited and impulse buying was negligible due to the lack of variety in cuts of meat available for consumers. The customer told the butcher the type of meat she wished to purchase and he sold her a particular cut--often explaining the best cooking method for the cut. In these service-type meat departments the personality of the butcher played an important role in the total success of the department. His sales efforts were aimed primarily toward selling additional meat items to complete the shopper's weekly menu plans. The direct customer contact in the early meat

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[10] Avisco Cellophane, Meat Packaging Manual; American Viscose Division, FMC Corporation, Philadelphia, Pennsylvania, p.2.

departments gave the butcher an opportunity to move slow-selling items, high-margin items and less desirable cuts of meat.[11] Success and consumer acceptance of these service meat departments led some stores to consider the concept of the self-service meat department. As early as 1920 meat department operators had begun to experiment with the self-service merchandising of meat. In-store cutting and pricing of meat presented no important problems, but wrapping did! Customers would not accept "blind-wrapped" meat, and no transparent film was available at this time that was sufficiently durable to be satisfactory. (Later in this discussion we shall study the development of transparent films for packaging fresh red meat and analyze the profound influence these films have had on modern meat-merchandising procedures and techniques.) Therefore, pre-cut meat, selected by the customer, had to then be wrapped by a clerk. This operation proved more costly--in terms of both time and money--than had the traditional meat department. As stores grew in size it became more and more difficult to provide sufficient skilled meat personnel to handle peak buying hours. Meat departments became "bottlenecks", seriously interfering with the smooth

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[11] Brand, Dr. Edward, Assistant Dean-College of Business and Public Service-Michigan State University, Modern Supermarket Operation, Fairchild Publications, Inc., New York (1963), p. 32.

flow of store traffic.[12] Another major problem which faced self-service meat merchandisers was the displaying of pre-cut meat. These stores generally utilized dairy cases with ice cooling to display their pre-cut meat. Unfortunately, these "meat" cases did not maintain low enough temperatures, resulting in excessive product spoilage. For lack of satisfactory refrigerated display cases and adequate wrapping materials, the advent of self-service meat operations was considerably delayed.

Throughout the 1930's the same conditions prevailed. Many operators experimented with and subsequently abandoned their self-service meat operations. It remained for the Great Atlantic and Pacific Tea Company to pioneer the development of the self-service meat case. A & P engineers converted a fish and delicatessen case into a usable meat case, and placed these cases in selected stores. This breakthrough in self-service meat display increased meat sales in the experimental stores by about thirty percent without adding increases in labor costs to these stores.[13] The improvised case was modified by refrigeration equipment manufacturers, and the first practical refrigerated self-service meat display equipment was put into production for distribution to retail outlets.

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[12] "Packaged Meats...Their Background and Their Future", Modern Packaging, Vol. 18, No. 6, February, 1945, p. 77.

[13] Modern Supermarket Operation, op. cit., p. 32.

The rationing of supplies brought about by America's entry into World War II produced material shortages and temporarily curtailed the manufacture of refrigerated display cases. It was not until after the war ended in 1946 that self-service meat cases were again manufactured. Retailers, trying to find methods for reducing costs in the meat department, turned enthusiastically to self-service as rapidly as the necessary equipment became available. The self-service concept in meat merchandising grew tremendously. Numbers of retail stores without fresh meat and specialized meat markets dropped sharply by 1949, while the number of stores which featured fresh meat had increased and the average size of these stores had increased greatly. The three decades between 1920 and 1950 were the foundations of the "chain store age".[14] Chains grew and spread rapidly through fantastic construction programs, consolidations and mergers. Some of the nation's larger retail food chains became firmly established during the 1930's. In order to function more efficiently, chain stores introduced several revolutionary operating procedures which later became standardized practices for the developing chain stores. Among these practices were the

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[14]Technically, any group of two or more stores might be considered a chain, but the Bureau of Census now considers groups of eleven (11) or more stores as constituting a chain.
McCarthy, E. Jerome, Basic Marketing: A Managerial Approach, Richard D. Irwin, Inc., Homewood, Illinois, (1964), p. 514.

"cash and carry" concept of merchandising with its elimination of many traditional retailer services, the stocking of only popular, quick-moving items, the standardization of store layout, and the establishment of uniform accounting procedures. These chain stores featured centralized purchasing of goods and low-cost selling methods for these goods--this was reflected in lower prices for the consumer and helped the chain stores gain tremendous public acceptance.[15]

The growth of one hundred percent self-service meat departments has been indeed spectacular. In 1948 there were 178 completely self-service meat departments located in stores throughout the United States. By 1949, over 1,000 food stores operated self-service meat departments. This number increased to 2,800 stores by 1951 and to 20,000 stores in 1958![16] The number of stores featuring complete self-service merchandising of fresh meat has continued to increase since 1958, but not at such a startling rate.

Certainly no one today can deny that the meat department of any modern retail outlet exerts considerable

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[15] Economics of the Livestock-Meat Industry, op. cit., p. 403.

[16] Statistics taken from:
Avisco Cellophane Meat Packaging Manual, op. cit., p. 4. Modern Supermarket Operation, op cit, p. 34. "Flow Sheets of Prepackaged Fresh Meats", Food Technology, Vol. 7, No. 9, September, 1963, p. 350.

influence over the ultimate success or failure of that outlet. A store's reputation and its comparative status among competitors for customers is often totally dependent upon the quality of meat it offers for sale. Thus, the meat department acts as a "drawing card"--it draws customers into one store and away from competing stores. Surveys conducted by Burgoyne Index and A. C. Nielsen indicated that the number one reason for shopper selection of a store was the quality and freshness of its meats.[17] The 7th duPont Consumer Buying Habits Study, which was conducted in 1965, affords another statistic which helps to substantiate the importance of the retail meat department. The method of data collection in the survey was as follows:

> A. As shoppers entered the store they were asked by specially trained interviewers what they intended to buy. All items were recorded by the interviewer on a checklist. For each item the shopper planned to buy she was asked what brand or kind she had in mind. To reduce bias and avoid influencing behavior shoppers were not told their purchases would be checked as they left the store.
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> B. After shoppers had completed their buying interviewers approached them a second time and, on the samechecklist, entered the actual purchases made.[18]

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[17] Technical Sales Bulletin, Reynolds Metals Company, January 27, 1966, p. 1.

[18] The 7th duPont Consumer Buying Habits Study, 1965, E.I. duPont deNemours and Company, Inc., Wilmington, Delaware, p. 1.

Shoppers were asked the question, "Do you confine your buying of food to one store alone?" Results of the survey indicate that sixty-one percent (61%) of the total number of shoppers interviewed (over 7,000) normally buy at least one product at another store, and that twenty-eight percent (28%) normally buy fresh meat at a different store than the store where they buy the remainder of their groceries.[19]

The meat department also acts as a "focal point" with regard to the ultimate marketing mix which is presented by the retail outlet. Although selling meat is not the sole object or principal aim of the retailer, the meat industry depends heavily upon him, because the retailer occupies a strategic position in the distribution channel. He can closely observe the preferences and desires of consumers, then influence the meat industry by his interpretation and transmittal of these preferences--effecting resultant changes in industry production and marketing patterns, and,finally, influence the consumer with respect to his purchased product mix.

Sales volume figures also point out the importance of the retail meat department. There are five basic reasons why meat retailing is a prime candidate for top management direction. First, meat retailing is a major

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[19]Ibid, p. 3.

commitment for the retail outlet. Meat department operations typically account for approximately one-fourth of a store's total sales volume--fresh red meat sales represent nearly fourteen percent (14%) of total store sales, and for a substantial portion of its invested capital requirements.[20] Second, sales of fresh meats constitute a serious profit impact for the retail outlet. Therefore, key changes in retailing strategy affect not only the profitability of the individual meat departments, but also the total profit picture for the entire store. Third, meat sales have an effect on the sales of other departments in the store. Fourth, meat quality and ultimate sales have an influence upon the reputation and public image of a store. Lastly, meat department operations offer a substantial opportunity for significant profit improvement.[21]

The meat industry has traditionally been an industry in which the processing, distribution and retailing of its main product provide very little profit to those who supply the services. At the retail level the meat department turns out to be the least profitable area in the store.

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[20] Cryovac Meat Study, W. R. Grace Company, Cryovac Division, Duncan, South Carolina. Material compiled during the summer of 1965 by Douglas Novakoski, Graduate Research Assistant--MSU School of Packaging, p. 6.

[21] A Top Management Approach to Meat Merchandising, McKinsey and Co., Inc., Management Consultants; New York, New York, October 26, 1964, p. 7.

This is because meat is substantially changed in form within the store, which requires cutting and processing labor. Prices of these services, like all other prices, have been affected by inflationary trends in the general economy. In addition, the steadily increasing number and quality of services rendered all along the meat marketing channel have tended to increase total marketing costs and to decrease profits. Many retail meat managers feel that beef takes an inordinate amount of labor to prepare it for retail packaging. "It usually takes more cutting time for beef (expressed as a percentage of total cutting time) than the percentage of fresh meat tonnage accounted for by beef" is the common reply of these managers.[22] Specific statistics concerning the costs of these added services will be presented later in this paper.

The price-merchandising strategy of retail meat departments has also been responsible for the low level of profitability achieved by these departments. These departments operate under a policy of variable-price merchandising. This involves the simultaneous manipulation of selected prices upward and downward in order to draw attention to the market offerings of the firm and to

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[22] Improving Profits in Marketing and Distribution of Meat, McKinsey and Company, Inc., Management Consultants; Chicago, Illinois, June 15, 1964, p. 30.

differentiate them from those of its competitors. This practice is different from simple price cutting because it involves the simultaneous raising and lowering of prices and does not require that price increases and decreases on individual items always be of the same amounts or follow each other chronologically.[23] This strategy is manifested in the popular "weekend special" features of virtually all retail outlets. Again, beef plays a major role in depressing meat department profits. Being the most popular consumer meat, fresh beef is feature-priced more often than any other type of meat. This alone establishes a grave dichotomy in the meat department. Here we have beef, the most popular and leading seller among fresh red meat, being priced low to draw customers into the store, but requiring a great amount of additional labor in order to stimulate sales to these customers! Little wonder profits in the meat department are low relative to those of other departments within the store!

On the basis of the preceding discussion, there are two obvious needs for retail meat departments at the present time. First, the amount of in-store labor necessary to prepare meat for sale must be reduced; and second, it is essential that meat merchandising practices and policies

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[23] Nelson, Paul E., and Lee E. Preston, Price Merchandising in Food Retailing: A Case Study, Institute of Business and Economic Research; University of California, Berkeley, California (1966), pp. 4-5.

be redefined and revamped. A look at the in-store packaging process for fresh meat will result in a primary framework from which fundamental recommendations may be made.

A package for any food product must perform three basic functions. First, and fundamentally, the package must physically contain the food product. Second, the package must maintain the optimum quality of the food product over time. Third, the package must be appealing to a customer so that resultant sales are made--in other words, the package must be a "silent salesman" for the product at the point of purchase.[24] In addition to these three primary factors, Dr. C. Olin Ball states that fresh red meat should be packaged for four other reasons.[25] These reasons are as follows:

1. Meat is packaged to protect it from contamination induced by bacteria and filth.

2. Meat is packaged to retard or prevent the loss of moisture from its exposed surface areas.

3. Meat is packaged to shield it from the deleterious effects of light waves.

4. Meat is packaged to facilitate handling, both in the cutting and packaging rooms and in the display case in the retail outlet.

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[24] Charlton, F. S., and R. F. DeLong, "Foods and Permeability", Modern Packaging, Vol. 29, No. 7, March, 1956, p. 227

[25] Ball, Dr. C. Olin--Department of Food Science--Rutgers University, "Here Are Facts On Color Changes In Packaging of Fresh Meat Cuts", The National Provisioner, Vol. 143, No. 27, December 31, 1960, p. 10.

SELF-SERVICE VERSES SERVICE TYPE RETAIL MEAT DEPARTMENTS; ADVANTAGES AND DISADVANTAGES

As we have previously seen, the growth of self-service meat departments, in terms of the total number of stores which have made the conversion from service-type to self-service departments, is indeed startling. In these self-service meat departments virtually all of the fresh meat is cut, trimmed, and packaged within the department itself. Despite the lack of basic economies of scale associated with the in-store packaging of meat--these non-economies of scale are reflected in the low profit levels of meat departments--retail outlets still prefer to pre-package meats on their own premises. Two questions which should immediately arise are "Why is the in-store pre-packaging of fresh meats so popular,? and What advantages are offered by this process both to stores and to customers of stores that cannot be offered by service-type meat departments?"

It has been found through numerous surveys that meat department sales increase as a result of conversion by that department from service to self-service, with resultant pre-packaging of fresh meats. Potential sales volume increases are the biggest advantage that meat pre-packaging can offer the retail outlet. Well-stocked display cases help to stimulate impulse purchases, resulting in more units

purchased per customer and more total units purchased per store. Some operators claim sales gains of twenty to sixty percent over the service method of meat merchandising.[26]

The in-store pre-packaging of meat also affords better control by the store over the freshness of the merchandise it stocks. Consumers demand fresh meat--they tend to observe, inspect and determine the resiliency of a particular meat cut before eventually purchasing it. Studies of consumer attitudes toward quality in pre-packaged meats have established the following factors as determinants of freshness: Color; Amount and Distribution of Fat; Amount of Bone; Shape and Contour of Meat Cut; and Marbling. While this list is by no means comprehensive, it does point out the importance of freshness to the consumer. Observation, inspection and handling are the methods by which consumers determine freshness in the retail outlet.[27] Meat which is not fresh (and the consumer determines the nature of this desired freshness) simply will not sell! By pre-packaging the meat it displays the meat department is in a better position with respect to always having an adequate supply

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[26] Modern Supermarket Operation, op cit, p. 34.

[27] A. Beef For Tomorrow, Publication 751, National Academy of Sciences, National Research Council, Washington, D.C. (1960); Material from the article "Evaluation of Consumer Acceptance Studies on Beef", Emil Mrak and George Stewart, p. 12.
B. Economics of the Livestock-Meat Industry, op.cit, p. 522.

of fresh meat on hand for sale. Regular rotation of display stock and additional packaging of fast-moving cuts to meet peak hours of demand insure the meat department that its merchandise is fresh ever time.

In addition, pre-packaging of meats and their self-service display definitely helps to reduce the number of "shopper waits and bottlenecks" in the meat department. Wrapping of purchased meat cuts by a clerk has been eliminated; pre-packaging makes shopping for meat easier and stimulates the smooth flow of shopper traffic throughout the store.

In-store pre-packaging of meats enables the meat department to realize increases both in total production output and also in efficiency during production. When skilled meat personnel can utilize all their time in cutting and trimming operations--without having to also act as clerks --greater standardization of processing and packaging is the result. This standardization reduces costs and increases sales.

In-store pre-packaging makes possible the wide display of a variety of meats at all times. This enables the store to enjoy increased sales on lower-priced cuts, seasonal and specialty items, and slow moving items when any of these products are purchased on impulse to complement a menu plan.[28]

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[28] "Meat Packager's Report", Modern Packaging, July, 1948, p. 126.

Counterbalancing these basic advantages of in-store meat packaging are the following disadvantages. Proponents of service-type meat departments would consider these factors to be advantages associated with this merchandising method. First, in-store packaging and self-service displaying of meats greatly reduces or virtually eliminates customer contact with meat department personnel. Suggestive selling or promotion of particular meat cuts by the butcher has all but been eliminated. The package must "sell itself" to the customer in today's meat department. This places ultimate sales responsibility upon an intangible object which may or may not be constructed in the most efficient possible manner. Mass displays are difficult to keep orderly over time--this tends to further reduce the effectiveness of the package as a salesman.

Second, there exists the acute problem of working out production schedules to coincide with peak hours of sales. This problem is magnified when consumer demand is anticipated incorrectly or when employee time is utilized inefficiently.

Third, strict shelf-life control is an absolute must. In-store pre-packaged meat is highly perishable because of its relatively short shelf-life (approximately three to four days if the meat is displayed at a temperature of

32 - 34 degrees Fahrenheit.)[29] This makes stringent control essential.

Fourth, failure to stock optimum numbers and adequate varieties of packaged meats can lead to much reprocessing and repackaging of meat cuts which have become unsaleable due either to poor appearance of the meat, the package, or both.[30] Rewrapping and reworking meat from display cases should be eliminated where possible. From the presentation of these comparative advantages and disadvantages of the in-store packaging process, and remembering the dynamic growth and consumer acceptance of in-store pre-packaged meats, it is readily apparent that the advantages of in-store packaging and self-service merchandising far out weigh their disadvantages and make this method preferable to service-type meat retailing.

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[29] Ball, Dr. C. Olin-Rutgers University, "Emerging Packaging Science Through Research: A Case History In Meat Packaging", Papers Presented At The 24th Annual National Packaging Forum, The Packaging Institute, New York, New York (1962), p. 60.

[30] Rewrapping costs money! Data from a survey of 57 companies controlling 1,071 individual retail outlets indicate that rewrapping a particular package of meat costs approximately 1.5-2% of the selling price of that package. "What's Happening In Meat Packaging", Supermarket Merchandising, April, 1959, p. 65.

THE IN-STORE PACKAGING OF FRESH RED MEATS
COLOR RETENTION: A BASIS PROBLEM

Two additional problems are of concern to those persons who are interested in the packaging of fresh red meats. One problem is inherent in the phrase "fresh red meat" itself --this is the maintainence of the bright red color associated with acceptable meat for consumption. The second problem concerns the generation and growth of bacteria on the surfaces of packaged meat cuts. Let us now analyze these two problems in detail.

Probably the most important single factor in the sales appeal of pre-packaged meats, particularly beef, is color.[31] Presence of desirable color is one of the important factors which determines whether a particular meat cut will be ultimately accepted by a customer. Since color has long been identified with freshness, the consumer relies on this criterion of quality to provide him with a product which he considers satisfactory for consumption.

There are five basic factors which influence the final color of meats which are packaged in the retail outlet. These are the breed of the animal, the type of feeding used to raise the animal, the pre-slaughtering operations

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[31] "Discoloration of Fresh Red Meat and Its Relationship to Film Oxygen Permeability", Food Technology, Vol. 9, No. 4, April, 1955, p. 194.

undergone by the animal, the efficiency of resulting slaughtering procedures and techniques, and, finally, the length of time which the meat cut is exposed to air after cutting and before packaging in the meat department.[32]

The color of packaged meat is in a dynamic state over time and continually changes due to fluctuations in the condition of its environment, particularly oxygen tension and temperature.[33] The extent of these changes in meat color differs between particular cuts of meat although usually, under any given cycle of environmental conditions, a typical color pattern develops for each meat species and may be readily predicted.

The color of fresh meat is due principally to the concentration and chemical state of the muscle pigment myoglobin and to some extent the hemoglobin which remains in the tissues as residual blood after the animal has been slaughtered and processed.[34] Myoglobin is closely related to blood hemoglobin. Hemoglobin serves to transport oxygen from the lungs to the tissues of the living animal; in the

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[32]Hookman, R.O., "Problems In Packaging Meat Products", The National Provisioner, Vol. 114, No. 16, April 20, 1946, p. 76A.

[33]Fellers, David A., "'Pair Testing' Compares How Films Maintain Color of Fresh Meat", Package Engineering, June, 1965, p. 92.

[34]Fellers, David A., loc. cit.

tissues, this hemoglobin is released to myoglobin.[35] The myoglobin, being a part of the muscle tissue itself, stores oxygen and makes it available for the life processes of the muscle. Myoglobin is an extremely complex purple-red protein which has a molecular weight of 17,500 and is composed of approximately 150 different amino acids which are linked together. The iron in this compound is chemically in the ferrous state and the pigment normally exists in meat which has not been cut.[36]

Landrock and Wallace have made extensive studies concerning the degeneration of color over time in fresh red meat which is packaged for sale in retail outlets. These researchers have presented a Color Cycle for fresh meat which explains why meat cuts which are packaged for retail self-service undergo a gradual brown discoloration during storage in the display case. In more technical terms, this Color Cycle involves the change of oxymyoglobin to reduced myoglobin which then changes to metmyoglobin.[37]

When meat is first cut the surface is purple, indicating the presence of the muscle pigment myglobin which

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[35] "Discoloration of Fresh Red Meat and Its Relationship to Film Oxygen Permeability", op.cit, p. 194.

[36] Ibid, p. 194. Also, "Emerging Packaging Science Through Research: A Case History In Meat Packaging", op.cit, p. 60.

[37] Lavers, G.C., "Discoloration of Packaged Red Meat", Modern Packaging, January, 1948, p. 127.

is in a reduced form.[38] The meat cut is then left exposed to the air for a period of time, enabling the meat to "bloom" or acquire the bright red surface color which consumers ordinarily accept as indicating good quality. This oxygenation or "blooming" of the meat occurs very rapidly within thirty minutes after cutting and is accelerated because the process is carried out in the temperature-controlled cutting room of the meat department. The bright red color of the meat surface after oxygenation is known as the oxymyoglobin stage in the development of the Color Cycle.[39]

The amount of oxymyoglobin in the meat determines the color of the meat itself, which ranges from a bright red for beef to a delicate pink for veal and pork. Even after the "death" of the animal, the muscle tissues retain a certain amount of respiratory activity. This activity results in the continuous consumption of oxygen within the meat. Inside the piece of meat the oxygen present while the animal lived is rapidly consumed and without the blood circulation necessary to provide new oxygen this oxygen deficiency prevails. The interior of the meat cut, therefore,

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[38] "Oxygen Control Key to Fresh Meat Color", The National Provisioner, Vol. 133, No. 7, February 12, 1955, p. 21.

[39] "Facts About Meat Color. Oxygen Is Key to Color in Meat", op. cit, p. 144

remains purple in color, while the meat surface during the oxymyoglobin stage is red. The meat cut is then packaged and subsequently placed in the display case. The functional components of the package for fresh meats and their peculiar prerequisities and requirements will be discussed later in this presentation.

The remaining stages in the Color Cycle take place after packaging and during display of the meat. When the packaged meat is placed in the display case its surface is bright red. This condition has resulted from the oxygenation of the surface of the meat. The Color Cycle is produced because metmyoglobin and reduced myoglobin form a reversible oxidation-reduction system of the ferrous-ferric type. In the reduced myoglobin or purple stage the iron of the meat is in the ferrous state; in the metmyoglobin or brown stage the iron of the meat is in the ferric state.[40]

In review, the Color Cycle in packaged meats manifests itself through a series of color changes in the meat surface--the surface of the meat changes from bright red to purple to brown over time. As has been previously stated, the length of time involved is approximately three to four days.

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[40]Discoloration of Packaged Red Meat", loc.cit.

The physical variable which in all probability exerts the greatest influence over the rate of color changes of packaged meats is the temperature of the self-service display case. Strict temperature parameters are required for display of fresh meats because the color changes associated with the Color Cycle increase rapidly as the temperature increases.

There are two basic reasons why temperature increases cause greatly increased color changes in fresh meat. First, increased temperature acts as a catalyst which speeds up the conversion of oxymyoglobin (red pigment) to metmyoglobin (brown pigment). The higher temperature effects the basic oxidation reaction by helping to remove free oxygen from the system, thereby speeding the process along. Second is the normal effect of an increase in temperature upon the velocity constants of the color change reactions themselves, due to the increase in the supply of energy available to implement these reactions. With more energy available the color change processes naturally proceed at a faster rate.[41]

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[41] "Emerging Packaging Science Through Research: A Case History In Meat Packaging", op. cit., p. 61.

BACTERIAL GROWTH: A RELATED PROBLEM

A second factor which is inherent in the in-store packaging of fresh red meats is the growth and development of bacteria on the surface of the meat cut and within the meat itself. The effect of bacterial action and its relationship to color deterioration in packaged meats has been well documented. Jensen has stated that microorganisms, both living and dead, and their enzymes on the surface of meat tend to increase the rate of oxidation of fresh meat pigments to the dark brown metmyoglobin.[42] Extensive studies have been conducted by Bratzler, Butler, and Mallman concerning the effect of bacterial action upon the effective shelf-life of pre-packaged beef cuts.

In all cases these researchers observed that bacterial growth reduced the salable shelf-life of packaged beef steaks. Changes which were caused or speeded up by bacterial growth included discoloration of the cut through the increased rate of metmyeglobin formation, production of off-odors, and slime formation.[43]

While the majority of research studies concerning bacteria and pre-packaged meat have been performed on cuts

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[42] Butler, O.D., L.J. Bratzler, and W.L. Mallman, "The Effect of Bacteria on the Color of Pre-packaged Retail Beef Cuts", Food Technology, Vol. 7, No. 10, October, 1953, p. 397.

[43] Ibid, p. 399.

of beef, the mechanisms of bacteria growth, development and resultant deleterious effects of bacteria are similar over time for all species of meat. For all types of meat displayed the first two days display time may be considered the lag time or initial growth phase for bacteria. During this time period the number of organisms present on the meat remains nearly constant. At the end of this time the bacteria enter a positive growth acceleration phase during which the average rate of increase in numbers increases sharply with time. It is during this positive growth phase for bacteria that the discoloration rate of pre-packaged meat is at its greatest.

Correlations of the rate of metmyoglobin formation with the number of bacteria present on meat have shown that microbial action does indeed exert a great influence over meat color. This undoubtedly occurs through the reduction of the amount of oxygen present and available for the meat due to the abnormally high oxygen demand of the aerobes on and in the meat during their phase of rapid growth.[44]

Strict controls on both refrigeration and sanitation are essential in order to retard the growth and development of bacteria in pre-packaged fresh meats. It is extremely important to maintain low temperatures at every point in the distribution channel for meat--in all holding, shipping

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[44] "Flow Sheets of Pre-packaged Fresh Meats", op. cit., p. 352

and processing rooms, and especially in the display case. Generally, assuming the same level of contamination to exist, a packaged meat cut will keep twice as long at 32° Fahrenheit than it will at 40°Fahrenheit, and four times as long as it will at 50°Fahrenheit.[45]

With respect to sanitation, many studies have been undertaken for the purposes of sampling numerous meat department surfaces for bacterial counts and correlating these counts with the numbers of bacteria present on retail meat cuts. These studies have shown that virtually all surfaces in the meat department, except those dealing directly with the meat cutting operation, were low in the number of organisms present. Cutting tools and cutting surfaces were found to offer the greatest sources of contamination to pre-packaged fresh meat.

Both temperature control policies and sanitation practices must be regularly evaluated and rigidly enforced. Successful meat department operators know that once product life is lost it cannot be brought back through special additives or by expensive packaging operations. The areas of color deterioration and bacterial development are two areas which will continue to be of great interest to those persons concerned with the in-store packaging of fresh meat. In the future, these problems are certain to warrant increased

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[45]"Better Meat Packaging", The National Provisioner, Vol. 136, No. 25, June 22, 1957, p. 31.

researeh and teehnieal innovatiens whieh will eombine to produce better meat department understandingand resultant problem-solving proeedures. With respeet to in-store packaging there remain still other developments whieh the author feels should be enumerated and elarified.

THE PACKAGING PROCESS ITSELF

Machinery For In-store Packaging of Fresh Meats

The development of modern refrigeration methods played an important part in the establishment of in-store packaging and self-service merchandising. Another important advance in in-store meat packaging was the production of machinery designed to reduce the inefficiencies inherent in the cutting and packaging processes. The design of an automatic scale which calculates the retail price dependent upon tare weight of the cut, prints the label with the name of the cut, weight, and price, and heat seals the label to the package was basic to the trend toward increased automation in the meat department.

Today meat departments utilize three basic categories of packaging machinery for the production of finished packages. Each separate category may be used alone or in combination, depending upon the particular use requirement and sales volume of individual meat departments. First, automatic machinery that completely accomplishes the wrapping and heat sealing operations may be used to package fresh red meat. Second, semi-automatic machines that finish the wrapping and sealing after an operator has made the initial wrap and heat seal may be chosen. Third, manual wrapping aids that simply hold a roll of meat-wrapping film and contain hot wires for cutting this film are available. Clearly, the

trend over the past few years is toward increased use of semi-automatic and automatic machinery for in-store packaging; nevertheless, only twenty-five percent (25%) of the fresh meat being presently pre-packaged is packaged by these two categories of machinery; seventy-five percent (75%) of the total pre-packaged meat is still being packaged manually.[46]

This is indeed a vital area of promising growth potential for the relatively near future. Weekly sales volume appears to be the primary determinant of whether conversion by a retail meat department from manual to semi, or completely automatic machinery is feasible. The Supermarket Merchandising survey of 1959 yields valuable information concerning the attitudes of retailers toward meat department automation and the prerequisites that retailers hold before conversion to some type of automation is possible. Of the 1,071 retail outlets which participated intthis survey, nearly seventy-one percent (71%) were using either semi, or completely automatic meat-wrapping machines; these outlets wrapped approximately seventy-three percent (73%) of their total fresh red meat by machine.[47] Today that twenty-seven percent (27%) of the total fresh meat which demanded

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[46]Reynolds Metals Company Bulletin, January 27, 1966, op.cit, p. 2.

[47]"What's Happening In Meat Packaging?", op.cit, p. 61.

manual wrapping in 1959 has been reduced through increased wrapping efficiency and improved packaging material technology to fifteen percent (15%).[48]

The average minimum weekly meat department sales volume warranted before the stores in this survey would require installation of a meat wrapping machine was $10,000. Among individual outlets this figure ranged from a minimum of $7,000 to a maximum of $25,000 per week. Based on average weekly meat sales of $8,500 for all stores in the survey, this figure gives us a better understanding as to why the trend toward wrapping automation has been relatively slow.[49]

There were many other significant questions asked in this survey; two of these questions and the data generated from them are as follows:

A. What savings or other advantages do you get from meat wrapping machines?

Answers Given	Percent of Stores Giving This Answer (N=1,071)
1. Reduced labor costs	51.4
2. Faster production for peak sales	62.1
3. Cuts down wrapping material expense	1.1
4. Gives fresher merchandise	3.0

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[48] Reynolds Metals Company Bulletin, January 27,1966, loc. cit.

[49] "What's Happening In Meat Packaging?, loc. cit.

B. Have you been able to reduce costs in the meat department in any way during the past two years?

Answer Given	Percent of Total Stores Using Machines
Yes	86.0
No	2.1
No Answer	11.9

Data From Stores Not Using Wrapping Machines

Answer Given	Percent of Total Stores Not Using Machines
Yes	51.9
No	30.9
No Answer	17.2

Data From Total Stores Surveyed

Answer Given	Percent of Total Stores
Yes	76.0
No	10.6
No Answer	13.4

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The significant fact to be gleaned from these data is that meat departments with wrapping machines have been almost over whelmingly able to enjoy some reductions in costs and at the same time have been able to increase production rates in the process. Present day data have tended to substantiate the findings of the 1959 report. As more and more retailers turn enthusiastically toward automation further increases in production efficiency and corresponding decreases in costs can be expected.

Cost and Profit Structures

Traditionally, meat department costs have been relatively high. This has been caused principally for four basic reasons:

A. Inefficient utilization of labor.

B. Slow processing methods.

C. Relatively low sales volumes which have prevented the use of higher speed equipment. Retailers themselves have set very high minimum weekly sales volumes as prerequisites for the justification and introduction of wrapping machines.

D. High capital investment in facilities which are used only a portion of the work week.[51]

Also, the additional work steps which are necessary for pre-packaging--such as the removal of bone dust, traying and holding the meat for sufficient color development have raised costs associated with the meat department. Today cutting and wrapping of fresh meat accounts for two-thirds of the total man-hours expended in the meat department and for 58.4 percent of the total meat department expenses.[52]

McKinsey and Company, Management Consultants, have segmented the total in-store meat department costs as follows:[53]

Activity	Percent of Total Costs
Cutting	38
Packaging	29
Stocking of Display Cases	13
Customer Service	9
Cleaning of Equipment	4
Receiving of Orders	3
Ordering	2
Supervision	2

[51] Dreyfus, R.L, Supplement to the Cryovac Meat Study, Technical Report, November, 1961, p. 1.

[52] "Improving Profits in Marketing and Distribution of Meat", op. cit., p. 29.

[53] Preliminary report to "Improving Profits in Marketing and Distribution of Meat", McKinsey and Co., Inc., Chicago (July, 1964), p. 3.

The areas of cutting and packaging are prime areas for significant cost reductions in the future. Automation should prove to be the best method by which meat departments reduce total costs. The real necessity for meat departments is the ability to undertake an integrated approach to the analysis of their total costs.[54] Too often the purchase price of a certain material or the expense of a particular service is singled out and receives major emphasis. This practice, while reducing immediate costs, often results in increases in long-range costs somewhere else in the structure of the department. Meat departments must learn to abide by the "total system of action" concept, where individual costs are minor compared to the total costs of the entire department. They must realize that the whole is sometimes much greater than the sum of its parts!

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[54] Beardsell, A. C., "Meat Packaging", Paper presented to the Meat Science Institute at Rutgers University, August, 1959, p. 2.

ADDITIONAL RETAIL PACKAGING PROBLEMS

The Supermarket Merchandising[55] survey also asked the participating retailers to list the meat packaging problems that caused them the most trouble with respect to disturbances in the smooth functioning of departmental operations. The most common answers to this question were as follows:

A. Fading and shrinking of packages.

B. Bloody packages.

C. Broken film.

D. Discoloration of the meat cut.

E. Using the incorrect side of the film for wrapping.

F. Poor product visibility--failure to see both sides of the meat cut.

G. Getting a tighter package.

Clearly in 1959 there were many retail operators who were greatly dissatisfied with the basic package for fresh red meat. The author should now like to present a historical development of the components of this package and then analyze some of the some of the reasons for its disfavor among retailers and consumers.

55"What's Happening in Meat Packaging?", op. cit., p. 65.

CHARACTERISTICS OF THE PACKAGE FOR FRESH RED MEAT

Basically the package for a fresh meat cut must exhibit numerous functional characteristics. Most important, the outer wrapper must permit the free passage of oxygen to the surface of the meat in order to prolong its red color over time. In addition, this wrapper must provide controlled water vapor passage, odorproofness, flaverproofness, greaseproofness, inertness to wet products, machinability, and be relatively inexpensive. The tray or card component must adequately absorb meat fluids yet must remain durable when wet. The total fresh meat package must have strong heat seals for package protection throughout the shelf-life of the meat. It must exhibit resistance to puncture, tear, fracture, and stretch while in the display case. The total package must perform these two protective functions yet be transparent and clear in order to promote impulse sales.[56] These stringent requirements place a great deal of the responsibility for the ultimate sales of packaged meat upon non-human parts of the packaging-merchandising system - the components of the "silent salesman", the package!

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[56] Cryovac Meat Study, op. cit., p. 6.

CELLOPHANE AS A FRESH MEAT FILM

Traditionally, fresh meat has been placed in a molded pulpboard tray, wrapped with a suitable coated-cellophane film, heat sealed and then placed in a self-service display case. It can be said that the pre-packaging of fresh red meat in cellophane has been responsible for the fostering of modern self-service meat operations.

Cellophane is regenerated cellulose, a material derived from wood pulp and cotton. These natural materials, after being boiled and purified, are converted to white sheets. These sheets are then placed in a mixer and a solution of caustic soda is added to form a slurry. The caustic soda is removed by pressure squeezing and the sheets are shredded to form crumbs. Next, the crumbs are mixed with carbon disulfide to form a material which looks like heavy sawdust. These particles are again dissolved in caustic soda; the dissolved crumb is filtered to remove impurities and is known as viscose--it is now a thick orange solution resembling honey in appearance. The viscose solution is pumped through a narrow slit into a bath of dilute sulfuric acid where it is converted back to a solid in the form of a sheet of cellophane. The raw cellophane then travels on rollers through various chemical baths where it becomes transparent. Later it is softened and passed around heated rollers; when

dry it is wound on a metal core and is ready for further processing or coating operations.[57]

Cellophane, unlike most other flexible packaging films, is not a single product but a complex family of films engineered to meet a wide range of packaging needs. The basis for this wide adaptability of cellophane is the numerous and varied coatings that are applied to the cellophane base sheet. Cellophane is the only packaging film that is not thermoplastic. The non-thermoplastic cellulose substrate has provided the ideal base for coatings that have made cellophane heat sealable and have given this film a complete range of barrier, slip, wetability and sealability parameters.[58] Also, being a cellulose and not a plastic material cellophane is much like paper and shares many of the advantages of paper such as stiffness and dimensional stability over time.

Jacques Brandenberger, a Swiss chemist who was working for a French textile manufacturer, discovered cellophane in 1923 while experimenting with a variety of coatings designed to make cloth resistant to spills and easily cleanable. The tablecloth idea eventually failed, but the newly discovered material was called cellophane--"cello" came from the word Cellulose, and "phane " from the French word diaphane, which means transparent.[59]

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[57] How Cellophane Is Made, Film Operations Department, American Viscose Division--FMC Corporation, Philadelphia, Penna., p. 1.

[58] Perino, Dom A., "The Future For Cellophane", Paper, Film, and Foil Converter, Vol. 40, No. 1, January, 1966, p. 64.

[59] "At Avisco the Emphasis is Empathy", Paper, Film, and Foil Converter, Vol. 38, No. 3, March, 1964, p. 67.

Cellophane was brought to the United States when duPont bought the American rights to the manufacturing process in 1923, and the first American-made cellophane was produced a year later. This first cellophane was of the plain, transparent, non-moistureproof, non-heat sealing variety. It was sealed with adhesives and was used for ornamental and sanitary protective packaging. Cost of the basic cellophane, however, was so high that the material was used as a wrapper for luxury items only--mass produced and mass displayed items were not packaged in cellophane at this time.

The first attempt to use cellophane as a wrapper for meat occurred about 1925 when a plain, transparent cellophane package for sliced bacon was introduced. The package did not meet the functional requirements with regard to the shelf-life of the meat, and the package concept soon was disregarded.[60]

The single most important milestone in the history of cellophane as a packaging film was the development in 1927 of a process to manufacture moistureproof film. This process was designed and carried out by Dr. Hale Charch, a research chemist for duPont.[61] The uses of cellophane were now greatly widened, particularly for the packaging of food products.

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[60] Cryovac Meat Study, op. cit., p. 4.

[61] The Story of Cellophane, E. I. duPont de Nemours and Company, Inc., Wilmington, Delaware (1952), p. 7.

The author has previously outlined the historical development in retailing policies and meat department merchandising practices which were taking place concurrently with these innovations in cellophane research and technology. Again, retailers who could foresee the great growth potential in self-service merchandising made numerous attempts to use cellophane as a packaging material for fresh red meats. Unfortunately, this moistureproof cellophane available for meat packaging became brittle and nondurable at the low temperatures which were required in the meat display cases. Meat packages required a second overwrap when the customer made her selection for purchase. Also, the number of rewraps which were necessary on original packages of meat was very high, resulting in greatly increased costs. These developments, coupled with the poor refrigeration methods and the inefficient utilization of meat department labor that were prevalent during the period, placed great restraints on the visions of the more progressive retailers. Cellophane was not yet ready to emerge as the preferred film for meat packaging applications. Because of this, self-service meat departments were forced to remain dormant, waiting patiently for some significant breakthrough in basic cellophane research.

This long-awaited breakthrough manifested itself in 1946 when a nitrocellulose-coated cellophane designed specifically for fresh meat packaging was marketed. The

film also featured a water retardant--the coating was advertised as an anchored type of coating.[62] The special coating was applied on one side of the film only. During the in-store packaging operation the uncoated side of the cellophane sheet was placed next to the meat surface. It was the function of this uncoated side to supply oxygen to the surface of the meat. It was absolutely essential that the uncoated side of the cellophane touch the meat because dry cellophane itself has a low oxygen permeability rate. High oxygen transmission through the film required the formation of a moisture layer on the film. This layer formed evenly on the inside of the package only, that is, on the uncoated, wettable side of the film. The coated side of the film permitted oxygen to enter the package and reach the meat surface only after the uncoated side had become wet with moisture. Therefore, because oxygen could reach the meat, "bloom" was retained and the shelf-life of this meat could be prolonged.

In addition, this special fresh meat cellophane offered meat department operators other advantages such as ease of handling, clarity, adaptability to various sizes of meat cuts and relatively low cost. The controlled moistureproofness and high oxygen transmission rate of this red meat

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[62] Cluman, A. B., "The Cellophane Story", Flexible Packaging Branch-Containers and Packaging Division, United States Department of Commerce, Business and Defense Services Administration (July, 1960), p. 4.

cellophane now provided retailers with an effective packaging material for their pre-packaged meat cuts. Retailers turned again to cellophane, and the self-service race was on. The development of this effective packaging material was almost totally responsible for the rebirth and subsequent dynamic growth of the in-store packaging and self-service merchandising of fresh meat.

Polyethylene-coated cellophane for fresh meat packaging was developed in 1957.[63] This film utilizes the same principles for "bloom" retention as did the original nitrocellulose coated cellophane and both films are being used presently for the in-store packaging of fresh meats.

As far back as 1959, as shown in the Supermarket Merchandising survey, numerous meat department operators were beginning to question the effectiveness of the coated cellophane package for fresh meats. Virtually every problem area that caused extra work steps or trouble for these retailers centered around the package or some other factor that could be traced back to the package. Fresh meat cellophanes had been effective in developing the in-store packaging concept, but now both retailers and film producers had begun to question their total superiority. Film producers began to seriously investigate the abilities of numerous

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[63] Sineath, H. H., "Cellophane", Modern Packaging Encyclopedia 1966, Vol. 39, No. 4A, McGraw-Hill, New York (1965), p. 155.

thermoplastic films to more effectively package fresh meat, both from a protective and from a merchandising standpoint.

Film packaging of red meats was born and had grown because of cellophane, and until 1959 reasons for changing to another film were not sufficiently conclusive to warrant such a change. The time was ripe, however, for other packaging films to enter the fresh meat packaging market--a market which had for so long been totally dominated by the coated cellophanes. In the years since 1959, many plastic films have attempted to dislodge coated cellophane from its position as the preferred fresh meat packaging film. In the opinion of the author only one of these films has enough inherent advantages to perform this feat. In the future, the coated cellophanes should receive their strongest challenge from polyvinyl chloride.

POLYVINYL CHLORIDE AS A FRESH MEAT FILM

Polyvinyl chloride itself is a synthetic resin which is produced from the by-products of coal and petroleum processing. Acetylene gas is liberated from both these basic natural products during this processing. The monomer vinyl chloride may be made in several different ways--the most common method is by the addition of hydrochloric acid to the acetylene gas. Polyvinyl chloride resin at this stage in the manufacturing process is a low-boiling liquid which is in the gaseous state at normal room conditions. To produce the polymer, this liquid vinyl chloride is emulsified in water and subjected to a polymerization catalyst--usually some type of peroxide--under slightly elevated temperature and pressure.[64] After further processing and drying operations, the polyvinyl chloride resin takes the form of a fine, white powder and is now ready to be converted into plastic film.

Most of the polyvinyl chloride film designed for the in-store packaging of fresh meats is manufactured by the "blown tube extrusion" method. In this process the extruded material emerges from a bowl-shaped die in the form of a tube and is literally "blown" into a bubble by compressed

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[64] Technical Sales Manual, Ethyl Corporation - Visqueen Division, Terre Haute, Indiana (1963), Section IV, p. 401.

air. This bubble of film is subsequently cooled, collapsed and wound onto rolls. In the first stage of manufacture, raw materials such as polyvinyl chloride resins, plasticizers, stabilizers, lubricants and color toners are dry blended and fed into the conical hopper of the extruder. The plasticizer, by far the most important of the additives to the basic resin, is compounded with the resin in specified amounts to control the degree of softness in the finished film. In red meat polyvinyl chloride film additional plasticizer is added to insure that the manufactured film will exhibit the desired softness. Next in importance, the stabilizer is utilized to minimize decomposition and degradation which might take place within the film during storage and use.

Lubricants, in the form of waxes, are added to the dry mix in very small amounts to reduce friction within the raw materials and to increase their rate of flow during the processing operations. Color toners, also added in minute amounts, aid in producing maximum clarity in the finished films. Transformation of the raw materials to plastic form by the extruder results from their passage through a series of stages which produces fusion of the particles due to increased temperature and pressure. In the final mixing step, complete fusion of the plastic occurs and it is fed into the die. In the die the plastic is formed into a tube of uniform wall thickness. As this tube emerges from the die

it is cooled so that its molecular structure will lend itself to orientation, or molecular alignment. At this point air pressure is interjected into the tube and forms it into a thin bubble which is approximately twenty feet high. This air pressure gives the film its lateral molecular orientation, or its orientation in the cross direction of the finished roll. At the top of the bubble the film is collapsed by a set of rollers; the speed at which the film is pulled over these rollers determines the amount of longitudinal alignment of the film, or its amount of orientation in the machine direction. After collapse and two-directional molecular alignment, the film passes over chilled rollers which "lock" its molecular structure into place. It is then wound on cores and stored in an air conditioned environment until further finishing operations are required, such as slitting and packing.[65]

In this extrusion process biaxially oriented polyvinyl chloride film which shrinks in both the machine and cross directions, upon the application of heat can be produced during one single operational cycle. The molecules of the biaxially oriented polyvinyl chloride film are said to possess an "elastic memory" or to exhibit "shrink energy". A familiar analogy should clearly illustrate these concepts. First, a number of rubber bands are stretched in two perpendicular directions and then frozen. Next the bands are

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[65] "Reynolon PVC Film Fabrication", Reynolds Metals Company Richmond, Virginia, pp. 4-4 to 4-8.

thawed until they snap back together. Like the rubber bands, the molecules of the thermoplastic polyvinyl chloride film can be stretched in two directions to produce new and different alignments. The molecules "freeze" in these new positions as the film is rapidly cooled. Then reheated, as in a packaging operation, these molecules attempt to return to their original positions. As a result of this mass molecular action the film tries to attain its initial size by shrinking.[66]

As previously mentioned, the amount of this "shrink energy" can be controlled by changes in the basic extrusion process. Therefore, the manufacturer can design films with widely differing shrink characteristics in order to meet varying packaging applications or situations. Also, biaxial orientation of the polyvinyl chloride simultaneously and substantially upgrades the physical properties of the film itself. The stretching operation produces a thinner, stronger and less expensive film based on price per unit area quotations. In addition, extrusion and the orientation process for polyvinyl chloride enable this film to offer the following general advantages for meat department operators.

First, polyvinyl chloride offers extreme clarity, especially for finished packages which must sell themselves. This clarity of the package provides for easy product and

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[66] "Shrink: A New Dimension in Films", Modern Packaging, Vol. 34, No. 12, August, 1961, p. 116.

brand identification in the display case; also, compounds which eliminate fogging of the finished package are added to the red meat film during the manufacturing process. This insures that effective product identification will be maintained throughout the shelf-life of the meat cut.

Second, polyvinyl chloride exhibits excellent impact or puncture strength. This makes for a tough, durable, highly abrasion resistant film for meat packaging applications. The biaxial orientation process functions to increase the impact resistance of the oriented film seven to twenty times as much as that of the unoriented film.[67] Also, if an initial puncture has been made in a package wrapped with polyvinyl chloride this puncture will not run or spread furtherthroughout the shelf-life of the fresh meat. that is, even though the basic impact resistance of polyvinyl chloride is very high the resistance of this film to a continued tear is substantially greater.

Third, polyvinyl chloride enables meat departments to display neater, tighter finished packages. Because it shrinks to conform perfectly to the package shape yet retains its dimensional stability over time, polyvinyl chloride can facilitate cost reductions due to decreases in the number of rewraps made over a period of time. Polyvinyl

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[67] Galvaneni, Aldo B., "Oriented Polyvinyl Chloride Films", Reynolds Metals Company, Papers Presented at the 23rd Annual National Packaging Forum, The Packaging Institute, New York (1961), p. 291.

chloride overwraps also reduce the number of package "leakers"--packages that have failed in the display case. The orientation process and resultant "elastic memory" of the film enable polyvinyl chloride to retain its excellent cling properties throughout the life of the product.

Fourth, polyvinyl chloride packages are non-sticking, allowing finished packages to be stacked immediately after heat sealing. The nature of this sealing operation itself for fresh meat enables polyvinyl chloride to provide a more protective package than competitive films. Polyvinyl chloride packages for fresh meat are produced on an L-sealer. This type of sealer bonds by welding two film surfaces together, producing a package seal that is non-stripable, compared with competitive films which are coated and can be easily stripped apart. Moreover, polyvinyl chloride packages how no affinity for collecting dust while in mass displays. Therefore, meat cases look better, individual packages look better, and increased sales result from in-store meat packaging with this film.

Fifth, and most important, the controlled water vapor transmission rate and the high oxygen permeability of red meat polyvinyl chloride film enable packaged meats to breathe, resulting in prolonged shelf-life and maintenance of desired red meat "bloom" for extended time periods.

Polyvinyl chloride offers these basic advantages to meat department operators; nevertheless, it is competitively

priced with all other fresh meat films, and, in fact, is priced lower than its primary competition for the in-store packaging market! Both fresh meat cellophane and polyvinyl chloride offer numerous advantages to the modern retail meat department operation. The author should now like to present a comparative evaluation of the relative advantages offered by these two competing films with respect to the prerequisites necessitated for effective in-store meat packaging.

A COMPARATIVE EVALUATION OF CELLOPHANE AND POLYVINYL CHLORIDE AS FRESH MEAT FILMS

The Color Cycle for fresh meats, as previously explained, is a natural chemical phenomenon which proceeds over time irregardless of the packaging material utilized. That is, no packaging medium known can totally eliminate the oxidation of myoglobin to metmyoglobin which occurs despite stringently controlled temperature conditions in the display case. At best, all that can be expected from a package for fresh red meat is the assurance of optimal shelf-life of the meat. With respect to this factor, both fresh meat cellophane and polyvinyl chloride are very effective in prolonging the time required for metmyoglobin formation and resultant removal of the package from the display case. Because of the high oxygen transmission rates and the controlled water vapor transmission rates featured by both cellophane and polyvinyl chloride, packages made from both these films react essentially alike over time as packages for fresh meat except as the individual meat cut is affected by variations in moisture loss. Therefore, comparisons of the abilities of cellophane and polyvinyl chloride to retain the red "bloom" of packaged meat cuts do not reveal a clear competitive advantage for either packaging film. Both films perform effectively within the natural limits imposed by the degradation process itself. Color retention although extremely important in fresh

meat packaging should not be made the sole indicator of efficiency displayed by the packaging film. Merchandising characteristics of the individual package also cannot be overlooked.

Polyvinyl chloride does greatly surpass cellophane, however, with regard to finished package quality and appearance. The softness and shrinkability of polyvinyl chloride enables it to stretch and cling tightly to the meat cut, resulting in a smooth package without bulges or excessive wrinkling, no matter how oddly-shaped the item. Also, polyvinyl chloride retains its cling properties throughout the shelf-life of the meat, thus assuring that the package will retain its excellent appearance. Unlike the loose cellophane package which reflects light and makes it difficult for consumers to see the meat cut, the excellent conformity of the polyvinyl chloride insures that optimum product visibility will be maintained at all times.

The biaxial orientation of polyvinyl chloride film during the manufacturing process substantially increases its impact strength and its resistance to tearing after an initial puncture has occurred. The red meat cellophane sheet lacks this molecular alignment and, therefore, does not exhibit as great an impact strength as does polyvinyl chloride. Impact resistance is very important to a package that must sell itself in a self-service department. Meat packages constructed from polyvinyl chloride show more

resistance to puncture from repeated handling by customers during display, thereby reducing the labor costs associated with rewrapping and redisplaying the same package. The orientation process also improves the low temperature flexing quality of polyvinyl chloride. Again, cellophane does not undergo this process and is inherently more brittle than polyvinyl chloride, even at room temperatures. This difference in brittleness is even more pronounced at meat-case temperatures--another reason for the fewer number of rewraps necessitated when the initial wrap is made with polyvinyl chloride.

Polyvinyl chloride definitely shows much better anti-fogging properties than does cellophane. The red meat polyvinyl chloride film packages will not fog under normal in-store display conditions, while cellophane packages will tend to fog under these same conditions. Studies have proven that various constituents of fresh meats tend to degrade conventional cellophane films, reducing their clarity and ultimately leading to package wrinkling and reduced strength.[68]

Literature from manufacturers of both cellophane and polyvinyl chloride concerning the in-store packaging process itself shows basically dichotomous findings. Manufacturers of both films claim that faster wrapping speeds are attainable with their own particular film. The post-packaging

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[68] "Special Films For Fresh Meats", Modern Packaging, Vol. 31, No. 10, June, 1958, p. 107.

requirements for cellophane packages, however, again give a competitive edge to polyvinyl chloride when the total packaging-displaying time is considered. Polyvinyl chloride packages can be heat-sealed at much lower temperatures than can cellophane packages. Because of this fact fresh meat can be displayed almost immediately after packaging with polyvinyl chloride, without packages sticking together after sealing, inter-package scorching, or early meat discoloration from contact with still-hot film.

When packaging with cellophane, valuable time is lost because fresh meat packages must be cooled somewhat before they are merchandised. Also, molded pulp trays are not required when fresh meat is packaged in polyvinyl chloride meat film. These trays are necessary for cellophane packaging because the high heat-sealing temperature of the film would burn the meat were it not for the protection afforded by the pulpboard tray. In combination the factors listed above give polyvinyl chloride an overwhelming advantage over cellophane when the fresh meat package, including both its functional and merchandising characteristics, is considered as a total entity.

Efficiencies in both production operations and marketing channels in the four decades since its introduction have enabled cellophane prices to decrease considerably. Today fresh meat cellophane is priced from sixty-two to seventy-nine cents per pound, compared with a base price for

polyvinyl chloride of from ninety-four cents to one dollar per pound.[69] These base-price quotations can be very misleading, however, in view of the film requirements for fresh meat packaging. Since individual packaging operations involve not pounds but square inches of film, a cost per thousand square inch figure for these two films would be much more significant.

Assuming the average yield of three-quarter mil polyvinyl chloride to be 32,000 square inches per pound and the average price of this film to be ninety-seven cents per pound, polyvinyl chloride costs the meat department retailer just .030 cents per thousand square inches.[70]

In a similar manner, assuming the average yield of one mil coated cellophane to be 19,500 square inches per pound and the average price of this film to be seventy cents per pound, coated cellophane costs the meat department operator .036 cents per thousand square inches.[71]

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[69] Prices quoted for cellophane are from Price Lists--Eastern United States--as of January 1, 1966.
1) E. I. duPont de Nemours, Inc.
2) American Viscose Division-FMC Corporation
3) Olin-Mathieson Chemical Corporation
Prices quoted for polyvinyl chloride are from:
Boskirt, R.L., "The Plastiscope", Modern Plastics, Vol. 43, No. 5, January, 1966, p. 41.

[70] "The Plastiscope", loc. cit., The average price figure is simply the mid-point of the price range previously quoted.

[71] "Cellophane", Plastics World, Vol. 23, No. 2, February, 1965, p. 114. The average price figure is simply the mid-point of the price range previously quoted.

This method of cost comparisons is a much more practical and realistic approach to the problem of packaging material cost allocation. Since the films are used on an area basis, costs per unit area are much more valuable to the retailer. Using these cost per area data which are based on averages alone, polyvinyl chloride red meat film is much less expensive--in this case seventeen percent (17%) less expensive--than the coated cellophanes! The extreme strength characteristics of polyvinyl chloride enable meat packagers to use this film in thinner gauges than they would normally use cellophane. This accounts for the much higher yield values for polyvinyl chloride than for cellophane, with the resultant savings in material costs being accrued to the retailer and subsequently to the consumer in the form of lower retail prices. Polyvinyl chloride has shown still another advantage over coated cellophane for the in-store packaging of fresh meats--its price per unit area of film used is lower.

To summarize this section, the author should like to briefly present some typical attitudes of meat department personnel in chain stores which have recently switched meat packaging films from cellophane to polyvinyl chloride. Meat department managers in retail outlets which were using polyvinyl chloride film felt that its advantages over cellophane were:

A. Better overall appearance.
B. Better overall performance.

C. Better heat sealing.
D. Better resistance to tearing.
E. Enabled faster manual wrapping.
F. Required less rewrapping.
G. Better bloom retention.
H. New wrapping personnel could be taught quicker.

Meat wrapping personnel said they preferred polyvinyl chloride to cellophane because:

A. They could wrap faster.
B. There were less rewraps.
C. Packages looked better--these people actually took more pride in their work because of a change in packaging films![72]

In 1954, John M. Ramsbottom of Swift and Company stated that "there is need for shrinkability in films for fresh meats to assure a package which is free from voids between film and meat."[73]

Today this much desired characteristic is being dramatically offered to retailers by polyvinyl chloride fresh meat film. The inherent advantages of this film over cellophane plus the enthusiasm of retail meat packagers who have switched from cellophane to polyvinyl chloride are sure to stimulate a great growth potential for this relative newcomer to the meat-packaging industry. Polyvinyl chloride has and will continue to exert tremendous pressure on cellophane in this vast market area.

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[72] Reynolds Metals Company, Technical Sales Bulletin, op. cit., p. 4.

[73] Ramsbottom, John M., "Meat Packaging Criteria", Modern Packaging, Vol. 27, No. 6, February, 1954, p. 132.

FUTURE PROJECTIONS

Consumer Demand For Fresh Meat

Historical trends concerning the consumption of fresh meat in the united States, combined with significant consumer characteristics and attitudes about fresh meat and some basic economics of meat consumption, will yield valuable information which can be utilized to make predictions about future consumption patterns for fresh meat.

Since the turn of the century the long-run trend in American meat consumption has been up. Nevertheless, the percentage of consumer disposable income spent for fresh meat has not increased even though consumers have increased the amount of services purchased with this meat. Immediately after World War II when supplies of some consumer goods were relatively short compared with supplies of meat, a somewhat higher percentage of disposable income was spent on meat. Since amounts of meat had also been rationed during the war, the post-war lifting of restrictions resulted in a natural increase in consumer spending for fresh meat. In the two decades after World War II, however, the retail value of red meat--expressed as a percentage of consumer disposable income--has moved downward. There are two basic reasons for the decline in the retail value of fresh meat.

First, consumption readjustments to more normal levels after the high post-World War II consumption levels have

functioned to depress the retail value of fresh meats. Second, meat prices over the past twenty years have not risen as fast as the prices of other commodities. Consumers, therefore, could buy the same or greater quantities of fresh meats with a smaller percentage of the food dollar.[74] Let us now consider the income-elasticity of demand for fresh red meats.

Based upon the physical quantity of meat consumed, the income elasticity of demand for all species of fresh meat has been calculated to be approximately .35.[75] This figure means that a one percent (1%) increase in real consumer income--the true income of the consumer after all relevant price changes are taken into account--would be expected to produce a .35 percent increase in the total quantity of all fresh meat consumed. These data indicate that the total demand function for fresh meats is inelastic. When supplies of meat are scarce retail prices are higher and consumers receive fewer pounds of meat for their additional expenditures; when supplies are plentiful the opposite adjustment occurs.[76] Large percentage changes in the prices of fresh meats are associated with relatively small percentage changes in consumption of these meats. There are definite limitations to the capacity of the human stomach, and,

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[74] Butz, Dale E. and George L. Baker, Jr., The Changing Structure of the Meat Economy, The Harvard Press, Boston, Mass. (1960), p. 12.

[75] Ibid., p. 10.

[76] Economics of the Livestock - Meat Industry, op. cit., p. 550.

therefore, increases in the total volume of food purchases can be made only at the expense of severe decreases in retail meat prices.

Based upon consumer expenditures for meat consumed, the income elasticity of demand for all fresh meat has been calculated to be .45.[77] This figure means that a one percent increase in real consumer income will produce a .45 percent increase in the amount of money spent for meat. As real income increases consumers do not simply consume more of the same meat cuts that they have consumed in the past, but tend to purchase higher priced cuts of meat, better quality meat, or kinds of meat that include more meat department service costs. The income elasticity for meat calculated on the basis of quantity purchased is declining and should tend to decline in the future. Therefore, most of the change in total red meat consumption in the future will be the result of increases in population, not from significant increases in per capita consumption rates. As incomes rise the basic wants of consumers with respect to quantity of meat consumed are more nearly satisfied. Also, income elasticities for fresh meats based on expenditures for meat cuts are likely to remain high in the future as consumers continue to purchase higher-priced cuts and more built-in services.

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[77] The Changing Structure of the Meat Economy, op. cit., p. 11.

The Importance of the Package as A Sales Man for Fresh Meats

These economic data indicate that future consumption patterns for fresh meats, with respect to both quantity and quality of meat purchased, will tend to place even more of the direct responsibility for the ultimate sale of pre-packaged meats upon the package itself. More effective packages will be required for all meat cuts because, as the real incomes of consumers tend to rise, these consumers will demand and purchase better quality meats. The physical and chemical quality of the meat will tend to remain excellent, and will not necessitate substantial upgrading --the package of the future will become increasingly important in the conveyance of improved psychological quality of the meat cut to the potential customer. In connection with this, self-service meat studies have shown that shoppers are more critical of meats purchased in pre-packaged form. Again, self-service meat department operators must stress quality in the packaging of all types of fresh meats sold in order to insure complete customer satisfaction.

The 7th duPont Consumer Buying Habits Study of 1965 yields an important statistic which will function to substantiate the importance of the fresh meat package of tomorrow. Purchases of individual shoppers were classified into four categories:

A. Specifically planned - a specific brand or item purchased as planned.

B. Generally planned - a general classification of items to be purchased, such as a loaf of bread, without reference to some particular brand.

C. Substitute - a change from a specifically or generally planned purchase.

D. Unplanned - an item bought which the shopper did not have in mind when entering the store; this category represents the "impulse purchases" made by the shopper.

The last three purchase classifications of this list require that some type of comparative evaluation between packages or between brands of a particular item be made by the shopper before an ultimate purchase decision takes place. For these three decision areas the package has the opportunity to exert tremendous influence over the shopper. With respect to fresh meat purchases this study found that fifty-eight percent (58%) of the purchase decisions of participating consumers were made within the store.[78] The individual package for fresh meat does indeed play an important part in total sales, and this significant influence by the package should increase in the future.

The future importance of the package for fresh meats is also reflected by the general axiom that the consumer always sells herself more satisfactorily than any clerk can.[79] Studies have shown that the shopper tends to over-buy when she has the opportunity to look over a full case of prepackaged meat and pick out what appeals to her. Again, the

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[78] The 7th duPont Consumer Buying Habits Study-1965, op. cit., pp. 2-3.

[79] "Packaged Meats...Their Background and Their Future", op. cit., p. 80.

importance of the meat package to the total sales generated by the meat department has been shown.

Thus far the author has shown that increases in future consumption of fresh red meat will depend primarily upon increases in total population rather than increases in per capita consumption. Changing consumption patterns and increases in disposable income will be reflected in more discriminating attitudes by consumers concerning their tastes and preferences for fresh meat. Demand for quality and uniformity among retail meat cuts over time and demand for increased meat department services may beexpected to rise in the future. These factors will combine to further increase the importance of the fresh meat package as a marketing tool.

Technological Innovation and Change-- The Role of Centralized Pre-Packaging

With respect to technological innovation and change for the meat industry as a whole, there is little evidence to indicate that any major innovations will occur in the meat industry in the near future. Historically, the meat industry has been relatively slow in developing and implementing new processes and techniques and this trend should continue in the future. However, the evolution of one particular packaging concept should prove to be of extreme importance to every person who has contact with fresh meats, whether this contact be in processing, packaging and merchandising, or purchasing.

All who have an interest in fresh meat are watching the development of the concept of centralized fresh meat pre-packaging. Ideally, from an economic standpoint, all packaging of fresh meats should be done within the slaughtering plant. From the standpoint of the meat packer, centralized packaging would allow the packer brand control over the product. Centralized pre-packaging would also give the retailer complete selectivity as to the types of meat cuts he would receive and display.

Among members of the meat industry there is at present a strong divergence of opinion concerning centralized pre-packaging. Some individuals feel that centralized pre-packaging is inevitable, while others think that it still has too many unsolved problems. Before centralized pre-packaging becomes a reality the following problems must be eliminated. First and foremost, consumer aversion to the purchase of frozen meats must be overcome. Frozen meats have never sold well, in spite of the fact that most consumers freeze a major share of their meat in home-freezers or refrigerators before it is ultimately consumed. Proponents of centralized pre-packaging will have to develop extensive consumer-education campaigns before this concept will be truly successful. Second, packaging materials and systems will have to be greatly improved before centralized pre-packaging can be put into effect. Shelf-life requirements for centrally packaged fresh meats will necessitate approximately a doubling of the protective characteristics

exhibited by the packaging material. New films possessing entirely different characteristics may have to be developed. Third, labor unions are and will continue to be a definite deterrent to the progress of centralized pre-packaging. At present labor unions regard this trend as a threat to the job security of their members and will oppose this concept until adequate compromises can be worked out.

Because of these problems associated with centralized pre-packaging of fresh meats, transition from in-store to centrally-located packaging facilities can come about only when a higher level of understanding and agreement between packer, retailer, union member and consumer is achieved. At the present time the author feels that this required level of agreement between participating parties will not be achieved within the near future. In other words, the in-store packaging of fresh meats should continue to grow and prosper.

The Effect of Polyvinyl Chloride on A Traditional Cellophane Market

In conclusion, the author should like to make several evaluations concerning the future of cellophane as the preferred packaging film for red meats. In 1965 approximately sixty-nine million pounds ofcoated cellophane were utilized in the packaging of fresh meats.[80] In the few short years since its introduction, however, polyvinyl chloride has

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[80] "Cellophane", Modern Packaging Encyclopedia-1966, Vol. 39, No. 4A, McGraw-Hill, Inc., New York (1965), p. 26.

made serious inroads into the dominance of cellophane for fresh meat packaging. It has been estimated that polyvinyl chloride has already replaced twenty percent (20%) of the cellophane market for in-store meat packaging.[81] In a speech prepared for the 1963 meeting of the American Meat Institute, Roland Welborn of Swift and Company, stated that "the real hope for the meat industry lies with those who develop a 'product' marketing approach and who tend more and more away from a 'commodity' marketing approach."[82] Basic to this "product" marketing approach is a meat package which stimulates impulse sales while protecting its contained product. Because of its inherent advantages over cellophane, polyvinyl chloride will continue to rapidly displace cellophane as the preferred packaging film for fresh red meats. In the future, further innovations in and advantages of in-store meat packaging which previously could be attributed to cellophane will be directly traceable to the emergence of polyvinyl chloride film. Today, because of the rapid growth and enthusiastic acceptance of polyvinyl chloride as a packaging material for fresh meats, manufacturers of cellophane have been forced to take a second look at this film which for so long has dominated fresh-meat packaging. In fact, one major manufacturer of cellophane recently began to produce and market

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[81] "Packaging Films", Modern Plastics, Vol. 43, No. 5, January, 1966, p. 98.

[82] Cryovac Meat Study, op. cit., p. 12.

polyvinyl chloride for meats! The effect of this new and dynamic packaging material--polyvinyl chloride--on traditional meat-packaging principles, materials, and operations has been startling. The entire meat-packaging industry is sure to benefit from this effect for many years to come.

BIBLIOGRAPHY

BOOKS

Baker, George L. and Butz, Dale E. The Changing Structure of the Meat Economy, Boston: The Harvard Press, 1960.

Brand, Edward. Modern Supermarket Operation. New York: Fairchild Publications, Inc., 1963.

Corey, Lewis. Meat and Man. New York: The Viking Press, 1950.

Fowler, Stewart. The Marketing of Livestock and Meat. Danville, Illinois: Interstate Printers and Publishers, Inc., 1957.

McCarthy, E. Jerome. Basic Marketing: A Managerial Approach. Homewood, Illinois: Richard D. Irwin, Inc., 1964.

Nelson, Paul E. and Preston, Lee E. Price Merchandising in Food Retailing: A Case Study. Berkeley, California: Institute of Business and Economic Research - University of California, 1966.

Radiation Preservation of Food. United States Department of Commerce - Business and Defense Services Administration, January, 1965.

Sineath, H.H. "Cellophane," Modern Packaging Encyclopedia -1966, XXXIX, No. 4A. New York: McGraw-Hill, 1965.

Stout, Thomas T. and Williams, Willard F. Economics of the Livestock-Meat Industry. New York: Macmillan Co., 1964.

BIBLIOGRAPHY

PERIODICALS

"At Avisco the Emphasis is Empathy", Paper, Film and Foil Converter, XXXVIII, No. 3 (March, 1964), p. 67.

Ball, C. Olin. "Here Are Facts On Color Changes In Packaging of Fresh Meat Cuts", The National Provisioner, CXXXXIII, No. 27 (December 31, 1960), p. 10.

"Better Meat Packaging", The National Provisioner, CXXXVI, No. 25 (June 22, 1957), P. 31.

Boskirk, R. L. "The Plastiscope", Modern Plastics, XXXXIII, No. 5 (January, 1966), p. 41.

Bratzler, L. J., Butler, O. D., and Mallman, W.L. "The Effect of Bacteria on the Color of Prepackaged Retail Beef Cuts", Food Technology, VII, No. 10 (October, 1953), pp. 397-400.

"Cellophane", Plastics World, XXIII, No. 2 (February, 1965), p. 114.

Charlton, F. S. and DeLong, R. F. "Foods and Permeability", Modern Packaging, XXIX, No. 7 (March, 1956), p. 227.

"Discoloration of Fresh Red Meat and Its Relationship to Film Oxygen Permeability", Food Technology, IX, No. 4 (April, 1955), p. 194.

"Federal Meat Inspection Labeling Program", Association of Food and Drug Officials Quarterly Bulletin, XXIX, No. 1 (January, 1965), p. 3.

Fellers, David A. "'Pair Testing' Compares How Films Maintain Color of Fresh Meat", Package Engineering, X, No. 6 (June, 1965), p. 92.

"Flow Sheets of Prepackaged Fresh Meats", Food Technology, VII, No. 9 (September, 1953), pp. 350-352.

Hookman, R. O. "Problems In Packaging Meat Products", The National Provisioner, CLIV, No. 16 (April 20, 1946), p. 76A.

Lavers, G. C. "Discoloration of Packaged Red Meat", Modern Packaging, XXI, No. 5 (January, 1948), p. 127

"Meat Packagers Report", Modern Packaging, XXI, No. 11 (July, 1948), p. 126.

"Oxygen Control Key to Fresh Meat Color", The National Provisioner, CXXXIII, No. 7 (February 12, 1955), p. 21.

"Packaged Meats...Their Background and Their Future", Modern Packaging, XVIII, No. 6 (February, 1945), p. 77.

"Packaging Films", Modern Plastics XXXXIII, No. 5 (January, 1966), p. 98.

Perino, Dom A. "The Future For Cellophane", Paper, Film and Foil Converter, XXXX, No. 1 (January, 1966), p. 64.

Ramsbottom, John M. "Meat Packaging Criteria", Modern Packaging, XXVII, No. 6 (February, 1954), p. 132.

"Shrink: A New Dimension in Films", Modern Packaging, XXXIV, No. 12 (August, 1961), p. 116.

"Seoial Films For Fresh Meats", Modern Packaging, XXXI, No. 10, (June, 1958), p. 107.

"What's Happening in Meat Packaging?", Supermarket Merchandising, XXIV, No. 4 (April, 1959), pp. 62-65.

BIBLIOGRAPHY

REPORTS

American Viscose Division, FMC Corporation. How Cellophane Is Made. Philadelphia.

American Viscose Division, FMC Corporation. Avisco Cellophane Meat Packaging Manual. Philadelphia.

Cryovac Division. W. R. Grace Company. Cryovac Meat Study. Duncan, South Carolina: Compilation 1965.

Cryovac Division, W. R. Grace Company. Technical Report, Dreyfus, R.L., Duncan, South Carolina: November, 1961.

E.I. duPont de Nemours and Company, Inc. The 7th duPont Consumer Buying Habits Study 1965. Wilmington, Delaware: 1965.

E.I. duPont de Nemours and Company, Inc. The Story of Cellophane. Wilmington, Delaware: 1952.

Ethyl Corporation, Visqueen Division. Technical Sales Manual, Terre Haute, Indiana: 1963.

McKinsey and Co., Inc. A Top Management Approach to Meat Merchandising. New York: 1964.

McKinsey and Co., Inc. Improving Profits in Marketing and Distribution of Meat. Chicago: 1964.

National Academy of Sciences, National Research Council. Beef For Tomorrow. Washington, D.C.: 1960.

The Packaging Institute. Papers Presented at the 23rd Annual National Packaging Forum, Galvanoni, Aldo. B. "Oriented Polyvinyl Chloride Films", New York: 1961.

The Packaging Institute. Papers Presented at the 24th Annual National Packaging Forum, Ball, C. Olin. "Emerging Packaging Science Through Research: A Case History in Meat Packaging." New York: 1962.

Reynolds Metals Company. "Reynolon PVC Film Fabrication", Richmond, Virginia.

Reynolds Metals Company, Technical Sales Bulletin. Richmond, Virginia: January 27, 1966.

U.S. Department of Commerce. Business and Defense Services Administration. Cluman, A. B. "The Cellophane Story", Washington, D.C.: July, 1960.

BIBLIOGRAPHY

UNPUBLISHED MATERIAL

Beardsell, A. C. "Meat Packaging". Paper presented to the Meat Science Institute at Rutgers University, August, 1959.