

Marketing Fresh Meat in the Deoxymyoglobin State

Lyle J. Ernst*

In discussing the subject of meat (particularly beef) color, it is necessary to consider the entire distribution system from cattle to slaughter to the final product in the retail case. For our discussion today, we will confine our considerations to beef cut fabricating, packaging and merchandising. The primary focus will be geared toward the impact of these various factors on consumer reaction or acceptance.

Traditionally, red meats, especially retail beef cuts, have been marketed in the oxygenated or oxymyoglobin state. Typical consumers pride themselves in being able to select beef cuts with the most desirable color.

Recent dietary awareness has led to special lean beef cuts being offered in many supermarkets. This change, plus changes in the USDA grading system, has resulted in better trimmed, less marbled product taking over the typical pre-packaged fresh meat case. Generally, the best choice or prime steaks are sold only at the deli counter or by special cutting at the meat counter.

You may ask, how does all this relate to the topic of this paper? It sets the background picture for the changes that are taking place in today's beef products as they are fabricated and marketed. Add to these product changes the need to reduce labor costs in fabrication and distribution and the time for major packaging changes may be now.

Over the past 30 years, we have seen the change from butchers cutting to order while the customer watched, to about 90% prepackaged product. Initially, typical packaging involved a paperboard or pulp tray with cellophane overwrap and today is a foam or clear plastic tray with PVC stretch film.

In September 1978, American Can Company began a pilot test to evaluate central fabricating, vacuum packaging and marketing beef cuts in the deoxymyoglobin state. While most meat scientists are familiar with the effect of vacuum on the color of meat pigment, most consumers are not aware that vacuum packaging results in a purple-red color. Our study dealt with carcass beef being fabricated directly into retail cuts.

Figure 1 shows the myoglobin changes that relate to color changes in fresh meat. The beef carcass as it comes from the cooler to the fabricating area is then cut into retail cuts. As the individual cuts are made they typically exhibit pigment in the

myoglobin (purple-red color) state. For typical tray/overwrap packages, the cut surface is allowed to oxygenate to the oxymyoglobin state before wrapping. This process is also known as "blooming" the product. The film overwrap oxygen permeability is designed to maximize the bloom duration after packaging.

When the product is vacuum packaged after cutting, the exposure time to oxygenation must be minimized to maintain a maximum myoglobin condition. In this paper, we will refer to this condition as the deoxymyoglobin state. If excessive exposure to oxygen occurs before vacuum packaging, certain muscles have a tendency to develop some metmyoglobin, which causes the brownish red color. If only deoxymyoglobin pigment is present in the vacuum packaged beef, complete oxygenation ("bloom") will occur when the package is opened. However, if metmyoglobin has developed only partial oxygenation will occur.

Figure 2 shows the effect of vacuum and/or partial pressures of oxygen on meat pigment color. As you can see, it is desirable to have the maximum vacuum level obtainable in the packaging system to maintain a deoxymyoglobin pigment even with high oxygen barrier packaging films.

Prior to conducting the vacuum packaged beef pilot test at Erdman's Supermarkets, four Super Value stores in Rochester, Minn., a survey of the consumers dislikes for fresh beef sold in the supermarkets was made. Table 1 shows that 90% of the consumers disliked something about the current product and package. The key concerns with the package were lack of visibility and leakproofness. Major product concerns were waste (fat, bone, etc.) and lack of selection (size of cut, number of packages). While color is always a concern, only 10% of the respondents referred to color in the negative sense based on tray/overwrapped product.

In order to acquaint customers with deoxymyoglobin color, point of purchase brochures were distributed and questions answered by store meat department personnel to help shoppers acquire this knowledge. Extensive radio and newspaper advertising were used to introduce the vacuum packaged beef products.

While a significant number of consumers that purchased the vacuum packaged beef products noticed a color difference, they did not exhibit an adverse reaction. While twice (10 vs. 20+%) as many consumers commented on the dark meat color of the vacuum packaged beef versus the controls, after the color phenomena was understood, it was not reported as a negative. The positive package aspects of total visibility and leakproofness overshadowed the color concerns. However, it should be remembered that vacuum packaged and tray/overwrap product were not displayed side by

*L. J. Ernst, Manager, Commercial Development, Meat Packaging Department, American Can Company, American Lane - 3C1, Greenwich, CT 06830

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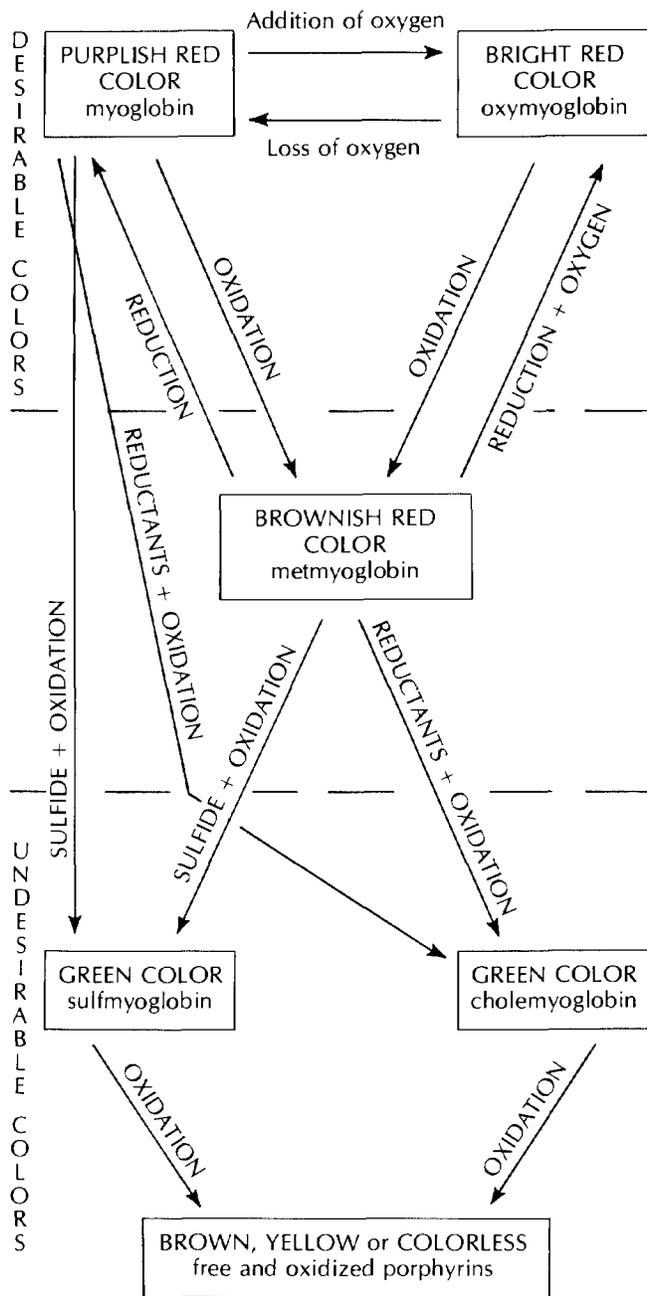


Figure 1. Color changes in fresh meat.

side. There was no good way of determining how many consumers refused to purchase the product due to the myoglobin (purple-red) color. However, consumers that purchased the vacuum packaged beef cuts were more concerned with the attributes of product visibility, leakproofness, freezer ready packaging and meat palatability.

There was a definite indication that the color at the meat case (decision point) was the most critical. This color can be greatly altered by the effects of display case lighting. The best lighting combination tested involved fluorescent deluxe warm white supplemented by incandescent spots. While the color

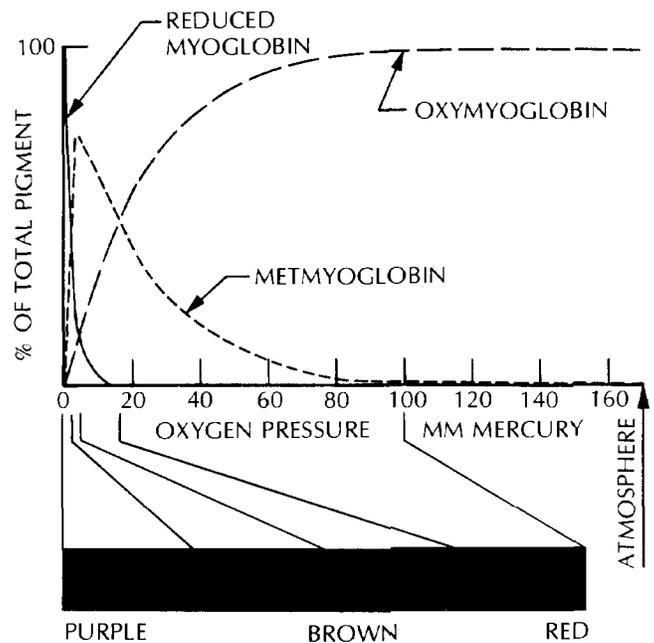


Figure 2. Oxygen pressure/pigment state/color.

Table 1. Things Disliked About Fresh Beef Sold in Supermarkets

	Women	Men
	(329)	(149)
	%	%
Dislike Nothing	10%	11%
Dislike Something	90	89
	(100%)	(100%)
Packaging (Net)	57%	43%
Visibility/Want to See Both Sides	37	24
Dislike Leaking/Dripping Packages	11	2
Holes in Package/Torn Wrapping	5	2
Waste/Excess Fat, Bone (Net)	34	20
Selection/Availability (Net)	33	27
Color Negatives (Net)	10	11
Not Fresh/Fresh Enough	9	10
Not Tender/Too Tough	8	11

looks different at the checkout counter or in the home, the decision has already been made and does not significantly impact the consumer at these points. In Europe, retailers have been successful in obtaining government approvals to use NAFA lights in the retail display cases. However, this bright pink fluorescent light is not used in the U.S.A. The cost of \$25 per tube versus \$2.50 for conventional fluorescent tubes appears to be another major deterrent.

The phenomena of "bloom" once the package is opened in the home and permitted to oxygenate for 10 to 15 minutes was not well understood initially. With continued use of this

Table 2. What Was the First Thing Consumers Noticed About the Fresh Beef Samples?

	Standard Beef Sample	Vac-Pack No Concept	Vac-Pack With Concept
Base: Total Respondents	(168)	(154)	(156)
	%	%	%
Waste/Excess (Net)	72	52	25
Too Much Fat/Lot of Fat	39	32	15
Color	36	34	37
Good Color/Like Color	11	3	4
Dark Color	10	25	19
Packaging	12	34	42
Clear Package/Wrap	*	13	23
Miscellaneous	30	18	9
Looks Fresh	11	1	6
Not Fresh	4	6	6

Table 3. What Did Consumers Like About the Fresh Beef Samples?

	Likes		
	Standard Beef Sample	Vac-Pack No Concept	Vac-Pack With Concept
Base: Total Respondents	(168)	(154)	(156)
	%	%	%
Leanness (Net)	40%	38%	30%
Not Too Much Fat	23	18	19
Good/Well Marbled	11	15	17
Color (Net)	34	31	29
Good Red Color/ Dark Red	17	12	15
Good Color/Like Color	14	11	11
Overall Quality (Net)	27	24	31
Looks Fresh	20	12	21
Like Nothing	27	36	35

product, consumers look for the oxymyoglobin bright red color ("bloom") as a freshness indicator. Confidence in the color phenomena permits consumers to continue to age the product in the household refrigerator to obtain maximum palatability. If excessive oxygen permeates the film or package evacuation is incomplete, the true myoglobin color does not develop but rather metmyoglobin is produced and no "bloom" or delayed "bloom" occurs when the package is opened. In addition to vacuum packaging, product sanitation and good refrigeration control are key factors in obtaining and maintaining desired beef color.

Research is continuing to determine optimum conditions to insure both continued product aging and extended shelf life

in the distribution system. Some researchers are looking to controlled atmosphere packages to accomplish the same results. It appears that significant research effort and consumer education will be required to determine the acceptance of this approach. Color control and product purge loom as major obstacles to the success of the controlled atmosphere approach.

When a CO₂/nitrogen gas mixture is used, the deoxymyoglobin color develops similar to the vacuum system. However, you do not have the security of the package or the control of drip loss offered in vacuum packaging nor does the product freeze well. If oxygen rich atmospheres are used the potential for off flavors and development of metmyoglobin spots is greatly enhanced. In addition, the package appearance is adversely affected and the shelf life is reduced by ½ to ⅔ versus vacuum packaging.

While the fresh product may vary greatly in color and acceptance, the broiled product cannot be differentiated in appearance. However, the vacuum packaged product has consistently been determined to be more palatable. In this period of extreme economic pressure and high beef prices, the improvement in tenderness and product moisture content is significant.

While significant research activity remains to be conducted and continuing consumer education will be required, the conditions necessary to commercially vacuum package retail beef cuts at packer level are being developed.

Consumers have learned to accept the difference in color of frozen versus canned green peas and find menu uses for both of the products.

We are confident that in time, through the proper education and positive experience, they will also accept vacuum packaged fresh meats in the deoxymyoglobin pigment state along with tray overwrapped products.

Discussion

R. J. Epley, University of Minnesota: In visiting with the people at Erdman's, they tell me that one of the things they are most excited about is the increase sale of center ham slices. They also indicated they were having trouble with a fresh bone-in pork product, as opposed to a fresh boneless pork product in a vacuum package. Would you care to comment in terms of difficulty in packaging.

L. J. Ernst: Yes, on the initial question on the ham slices, dealing with a four-chain supermarket, it is necessary with the type of equipment that was involved in packaging the product, when you have a packaging machine that costs in the neighborhood of \$100,000, is you have to find utilization for it. So they package in their operation because of their size, a wide variety of products, including center cut ham slices. Their volume on ham, regular whole bone-in ham, has increased about four to five times over what it was prior to their getting into the program. Rather than buying whole hams and cutting them into shanks and butts and then buying center slices on the outside or cutting them at the store level, they are able to package all these center slices at their central store operation and as a result they are also probably getting two or three extra center cuts out of a ham. That is up to each individual's discretion, I guess. The real key area is that they have

been able to expand their total meat business. As far as the pork problem is concerned, we are continuing to do work on the pork problem. There is work being done at Iowa State University right now and will probably be reported later this year. In relationship to the factors that affected the problems with pork color or pork odor, we are not really sure which was more critical, the color seemed to be quite satisfactory. The odor that developed was not necessarily due to microbiological activity and we are exploring that since Erdman has relatively poor control over his incoming product and has no means of inspecting it. We feel that in these cases, the product developed this problem due to temperature history, sanitation, etc.

J. Scott, Iowa Beef Processors: In your study that you conducted, I have a couple or three questions—like what is the length of this distribution chain you undertook?

L. J. Ernst: OK, the length of storage, the product was coded 14 days from the point of pack and most of it was moved out of the store in seven or less days. That product that was not moved out in 14 days was opened and if it was considered saleable, it was put into ground or cubed product. If it was not considered saleable, it was discarded. The actual shelflife that has been developed under their storage conditions has been 28 days with the package, if the carcass conditions, etc. were met initially that we considered necessary.

J. Scott: In any system of vacuum packaging, you are going to get packages at your final distribution that will, let's say, have various degrees of leaker conditions. What is your recommendation for these retail outlets for these types of packages? Are you going to express or experience quite a few of those?

L. J. Ernst: All of the packages were inspected off the machine, as they were shipped to the store and as they were received in the stores. Off the machine, while initially when you are teaching people how to work with the system, you experience some erroring and sometimes high package reject rates. After six months into the program, they were experiencing something under one percent rejection off the packaging machine. Now again, we must emphasize this is a small operation—they are not attempting to get any dramatic machine speeds. They are probably operating in the neighborhood of 12-15 cycles per minute, which would be one or two or three packages per cycle. At the store level, you see the totes in the picture that they were using to take the product

off, with the plastic totes and with interleaving the different package layers. We were experiencing between the shipment to the stores and in the stores under half of one percent rejection. Immediately when the leakers are noticed, there is an inspection of the cases or inspection of the cooler prior to loading the product into the case. Inspection of the case occurs every hour or two and the leaker packages are immediately opened and again put into ground beef or cubed beef.

J. Scott: One last point is central distribution of beef. When you eliminated some of the cost in terms of transporting of excess backbones, what we call wasted product that the consumer is not going to use, aren't we starting to replace some of these transportation expenses with the transporting of cardboard, plastic and trays and interwraps?

L. J. Ernst: Well, in this particular case we are talking about real low cost interleaver sheets and the plastic totes are reusable as they return from the stores. After the trucks bring in the loaded totes, they take back the empty ones, they are washed and put back through the system. We really feel, that this is going to be developed at the packer level. The problem is that most people, such as yourself at this point, are concentrating their activities on the development of the distribution system of the primals and subprimals and we wanted to find out what the consumer reaction was and this was the point to start at. We agree with you that the distribution point for this whole thing should be back at the packer level.

Unidentified: In your presentation, you alluded to Winn Dixie and, as I recall, this firm has been involved in experimenting with certain vacuum packaged retail cuts for several years. Can you bring us up-to-date on what their current status is? As time goes by, are there more and more, or less and less, vacuum packaged retail cuts.

L. J. Ernst: I can't give you an update as of this moment. My last update would be about six months ago and there have been a lot of changes in the marketing conditions, pricing and availability of beef since then. At that particular point, they were on limited stores, limited quantity marketing of three to six selected items. One of which we showed here. They are not offering it in all their stores, they are not offering it without controls. They feel it is a means of educating and getting a good experience with the customers for what ultimately will come. They don't see it as a commercial program right now.