STABY

Brody '88

THE IMPACT OF CONTROLLED ATMOSPHERE PACKAGING ON AMERICA'S FOOD PACKAGING INDUSTRIES

DR. AARON L. BRODY
MANAGER, MARKET DEVELOPMENT

CONTAINER CORPORATION OF AMERICA
OAKS, PENNSYLVANIA

In man's unending search for the means to sustenance, he (and she) have chanced upon drying, fermentation, heating, cooling, intentional chemical preservatives and more recently, ionizing radiations. Removal of food from the ground, the tree, the animal or the sea engenders the initiation of catabolic reactions that result in rapid deterioration of quality and nutritional value and the possible generation of toxic end products. Thus, the separation of man from his (or her) food sources has required processing to prevent or retard degradation. Shelf life extension has been a major factor in creation of civilization as we know it today.

But food preservation is not utopian: the closer the food product is to its natural state, the lower its effective shelf life. Indefinite safe shelf life under ambient conditions may be achieved by thermal processing coupled with oxygen-free hermetic sealing. Very short shelf life - on the order of hours or days - is achievable through reduction of temperature to just above the product's freezing or chill point. The act of heat processing severely alters the product. Chilling has almost no measurable effect on the product.

Understanding of the principles of food preservation in recent years has led to the concept of combining two or more processes to synergistically attain a result in which product damage is minimized and shelf life is maximized. For example, heat inactivation of enzymes usually precedes freezing for vegetable preservation.

It is this engineering of foods and processes that has led to the unprecedented American food supply, more plentiful, safer, and more nutritious and less expensive than any in world history. But the synergies have not led to perfection - we do not yet know how to provide indefinite shelf life of the unchanged, fresh food at ambient temperatures - although we are continuing the research to this end.

Until this utopia is reached, we shall continue to employ different processes for different foods and different distribution objectives. Our $300 plus billion retail value food processing industries will be segregated into overlapping segments: almost $50 billion of fresh meat; $12 billion of processed meat; over $10 billion of frozen foods; $15 billion of bakery products; $15 billion of canned foods; etc.

The U.S. government's fifty category classification of "food and kindred products industry" nowhere mentions controlled atmosphere, a process that has been effectively employed for preservation for a century or more. Despite increasing usage in the past two decades, the process is presently ancillary to other processes and is only infrequently a dominant preservation process. But this situation will be radically altered before the turn of the century. Controlled atmosphere will take its place as a significant food preservation technique in conjunction with refrigeration and its supporting packaging.

From a process virtually unknown to any but its most ardent researchers and practitioners to a major method in less than a quarter century is a giant step. But the signals are clear and loud: even in the absence of a visible industry leader, controlled atmosphere food preservation is growing along a broad front, invading meats, fruits, salad vegetables, fish, bakery goods, precooked entrees and cereal grain products. And the results are dramatic: markedly extended shelf life under refrigeration and even at ambient temperatures. Great reductions in losses due to spoilage, staling, water loss, etc., have been experienced when controlled atmosphere techniques have been applied. A relatively recent arrival, controlled atmosphere packaging will be instrumented in this exponential growth in the coming fifteen years.

More food will be packaged under controlled atmosphere by the end of this century than will be under aseptic plus flexible and semi-rigid retort packaging - an awesome achievement for the food packaging technologist.

The obvious question is how can a process almost unknown to the technical, business and lay communities become so important in such a short time horizon? First, and probably most important, the technology of controlled atmosphere has amassed a scientific literature bibliography that must be in the hundreds in the 1970's and 1980's. And the discipline of technological forecasting asserts that the future of technology is written in the scientific literature. Further, controlled atmosphere processing and packaging is being employed successfully for foods in both the United States and Western Europe, with almost no reported impediments.

To comprehend the future, it is necessary to understand the past and present. What is controlled atmosphere? In its essence, the process means control of natural respiration or catabolic rates of enzymes, microorganisms and biochemicals indigenous to the foods are altered. By elevating the normal carbon dioxide level, and in most cases, by reducing the oxygen concentration, microbial reactions are suppressed. When this effect is supplemented by control of minor gases such as carbon monoxide, ethylene, ethyl alcohol, nitrogen oxides, etc., the degradation rate may be reduced by factors of two to ten times. Removal of oxygen reduces the biochemical, enzymatic and aerobic microbial action. Except when oxygen provides a beneficial effect, as in the retention of the color of red meat, the synergism of elevated CO_2 and reduced O_2 can result in major shelf life extensions - weeks or even months.

In general, controlled atmosphere may function on its own, but the benefial effect is minimal unless the coincidental effect of refrigeration is introduced. Thus, in general, controlled atmosphere and refrigeration function in concert with each other.

Controlled atmosphere is our generic term describing alteration of the gaseous environment surrounding a microbiologically or enzymatically susceptible food product. In the strictest definition, controlled atmosphere means regulating the gaseons environment at all times to prespecified concentrations. Many scientists and practitioners use the term modified atmosphere to describe an initial atmospheric modification with no further regulation. Thus, the product environment will change depending on the initial gas content, the product's action and the transmission rate of the package to gases. Although this semantic differential is of consequence, it is less important than the basic concept.

Alert microbiologists will note that the absence of oxygen could lead to anaerobiosis, a potential hazard in the presence of low acid foods. Under proper initial sanitation and with good refrigeration, this risk is virtually eliminated - as is well demonstrated in vacuum packaging - a corollary to controlled atmosphere packaging.

Like so many food preservation processes, controlled atmosphere was discovered by serendipidity. Shipments of meat carcasses from Australia in the late nineteenth century were augmented by dry ice or solid carbon dioxide refrigeration. Since scientists in that time had not yet determined the casual effects of microorganisms on food spoilage, the multiple benefits of chill plus CO_2 was only observed and not translated into a meaningful technology.

In early years of the twentieth century, pomologists noted that apples stored in enclosed refrigerated chambers kept much longer than in air. These fruits sometimes could be held almost from the end of one harvest season to the beginning of the next without softening, browning, scab and shriveling. Some farmers prospered on the empirical discovery while scientists pondered. In retrospect, the reason is simple, but at the time the unpredicted and sometimes negative results were frightening. When removed from he tree, fruit continues to respire, taking in oxygen and expiring carbon dioxide and water. In circulating air, the respiration process continues uninterrupted, inexorably converting cellulose to sugar and sugar to gas and apples to inedibility. Enclosed, the carbon dioxide and water vapor build while the oxygen decreases, and, by mass action laws, the entire respiration process slows significantly. Retarded respiration equates to extended shelf life - and elevated water vapor reduces water loss - all beneficial to maintaining fruit quality for prolonged periods. But as hinted above, the results were not all positive. If the oxygen is permitted to decline to extinction, respiration is replaced by fermentation, and the process leads to aldehydes, ketones and alcohols and not be CO_2. The result is anaerobic spoilage, as economically devastating as conventional spoilage.

With limited air ingress, controlled atmosphere storage based on natural respiratory processes was used for commercial apple and pear storages through the 1950's and into the 1960's. In 1958, in an effort to build upon its base of domestic refrigeration, Whirlpool Corporation embarked on a visionary program conceived by its technical and marketing staff and fully supported by its managements. By 1961, the Whirlpool Tectrol, Total Environmental, Control process was commercial. Apple and pear storage facilities around the world were equipped with gas burners to combust oxygen and produce CO_2 and water, scrubbers to absorb excess CO_2 and minor gases and valves to permit in small quantities of O_2. By the 1970's, more than two billion pounds of the apple and pear storages in the United States were blanketed under controlled atmospheres, and the population consumed last year's still delicious apple crop in June and July. The onset of the conflict in Southest Asia led to a new need - fresh food for the troops. Applying controlled atmosphere principles, containers of lettuce , citrus and red meats were successfully shipped across the Pacific Ocean. Simultaneously, a few bold technologists, sparked by the storage and transportation results, now founded in the scientific literature, embarked on a new venture, controlled atmosphere packaging. Ohio radishes were packaged under nitrogen in two plies of polyethylene - not enough to exclude oxygen, but more than required to maintain a humid interior and retain turigidty and crispness.

In Florida, salad vegetables were cut into bite size pieces, packaged under reduced oxygen and marketed - successfully - in a limited number of supermarkets. And the Bivac system was used to skin package large citrus fruit.

Despite this paucity of commercial ventures due in large measure to an absence of packaging supplier involvement and interest, the academic community became active - generating the scientific basis for this future packaging system - and probably stimulating the projects in Western Europe.

While fruit and vegetable progress was largely limited to bulk storage and distribution, work in meats expanded rapidly. Vacuum packaging coupled with refrigeration suppressed microbiological growth and enzymatic activity. Red meat with tight skin packaging in low oxygen permeability flexible materials could be held with almost no weight loss attributable to water evaporation and with little or no microbial growth, but with some proteolytic enzyme action to tenderize the muscle tissue. Although the shrinkable polyvinylidene chloride (PVDC)/ethylene/vinyl acetate (EVA) based films were - and are - expensive - the total system costs - meat weight retention versus packaging - benefitted meat packer and retailers alike. Despite resistance from butchers who feared job losses, vacuum packaging of primal cuts of beef emerged as a major innovation of the 1970's. More than half of American beef, rather than moving in hanging carcass or quarter form, is boned and trimmed into knife and saw ready primal cuts, vacuum packaged and shipped in corrugated fiberboard cases from the packing house to retail store and restaurant backrooms. In addition, many more millions of pounds of ground beef are packaged in chub or keeper casings, also without air. Twenty plus billion pounds of beef, hundreds of millions of unit packages - are packaged and distributed in this manner - unknown to almost all consumers and to most of the business community.

And, several billion of the sixteen billion pounds of pork and lamb are now vacuum packaged; with a minute amount sold at retail level. The economic impact upon the entire red meat distribution industry - packers, transporters, corrugated fiberboard case converters and retailers has been measured in the hundreds of millions of dollars - an investment that has resulted in billions in savings.

Some purists argue that vacuum packaging is not controlled atmosphere, but the package contents are respiring and the internal atmosphere is dynamic. Initial vacuum produces soluble CO_2 in equilibrium with gaseous. We defer this issue of semantic classification, which is technically valid, to others, contending that the application of vacuum is within the spectrum of controlled atmosphere.

Vacuum packaging has extremely significant drawbacks: anaerobic conditions on flesh muscle can permit the propagation of toxin producing microorganisms, and the absence of oxygen creates a purple rather than cherry red color characteristic of freshly cut or ground red meat. It is not in the scope of this introductory presentaion to discuss either problem in depth, particularly since other speakers address them. Suffice it to assert - somewhat simplistically - that good sanitation and refrigeration obviates the microbial problem - and since the consumer does not see the meat, color is of no commercial consequence.

Although vacuum packaging offers satisfactory technical answers for distribution, it is insufficient for retailing and eventually, retail packaging must take place. The notion of a minimeat factory in the back of all 30,000 - 35,000 American supermarkets, each with a breaking, cutting and packaging line, plus refrigerators and U.S. Department of Agriculture inspection, would be humorous were it is not a reality. Staffing and

operating a facility like this might have been necessary when beef and pork were available only in hanging carcass form, and the concept of prepackaged meat was a radical innovation for the housewife - but that was a quarter of a century ago. Today's homemaker purchases tofu, prepackaged precooked pasta, packaged croissants, fresh feta cheese and Diet Coke in polyester bottles. In the light of these dramatic changes in food, isn't the on-premises retail butcher a vestige? Again, this important topic is not in the scope of this presentation - but cannot be overlooked. We believe that the total systems economics probably favors centralized red meat packaging.

The other facet of this issue is the red color. Obviously, this is not an issue with pork, lamb, mutton or poultry - and, for those who have been alert enough to follow the market , the intrusion of prepackaged poultry is very much a flood. In some regions, up to half of all poultry is precut and prepackaged at a central factory branded, advertised and marketed much like Swiss cheese or soup. Who in the United States has not seen or heard the disconcerting face and voice of Frank Perdue extolling the virtues of his chickens? Regardless of the penetration into other meats, beef retains three quarter market share - and only small fractions are retailed in opaque chubs. The traditional steaks, roasts, stew beef and brisket continue to be cut, trimmed, packaged and weighed individually in retail back rooms in the United States. Attempts to perform these basic factory operations in central locations, i.e., in centralized meat packaging, have been unsuccessful with one reason cited being the color. In Minnesota, Erdman's, a small four store chain, uses a Bivac system and from a central location, distributes vacuum packaged purple beef to its outlets for retail sale. The one machine is expensive and the vacuum packaging materials cost more than does oxygen permeable PVC, but consumers and the retailer appear satisfied.

Red color arises from loose bonding of oxygen with the myoglobin molecule of the muscle tissue. The presence of oxygen is required for persistence of the red color. Assuming the necessity of red color, again an issue for further study and discussion, controlled atmosphere systems have been developed. Either the Food Science Department at Rutgers, the State University of New Jersey, or Kalle in West Germany, or both - or perhaps another research group developed a controlled atmosphere to simultaneously maintain the red color and extend the shelf life. Thus, in one stroke, the semantic issue is vacuum packaging really controlled atmosphere and the consumer demand red color were resolved. Using both elevated oxygen and elevated carbon dioxide in the atmosphere surrounding the red meat, the cherry red oxymyoglobin color is maintained and the deteriorative processes are retarded, provided, of course, the package is hermetically sealed.

Under the name Atmospak, and packaged using Multivac equipment millions of kilograms of centrally prepackaged red meat are being retailed in West Germany, Denmark, Sweden and the United Kingdom.

Meanwhile, in the United States, a small market test has been underway in Kroger's in Atlanta, using St. Regis materials.

Another new venture not presented in CAP 84 today is Cryovac's Darfresh program. Several Western European firms employ analogues, such as Akerlund & Rausing's Tray Vac. Cryovac's Darfresh system appears to be a vacuum skin packaging method for flesh foods such as red meat, poultry, fish, veal, lamb, etc. A base sheet is formed; the product is inserted; a top film is heated and draped over the product to conform to the shape of the product contents. Not unlike the Bivac system for vacuum packaging, Darfresh is regarded as a total packaging system - that is, beginning with effective

product handling to ensure sanitation, and controlling distribution temperature very carefully. As with all red meat vacuum packaging, product color is purple - and so is perceived to be limited in the United States. On the other hand, color is not an issue for fish, veal, pork and poultry - and for paprika seasoned products.

According to unpublished reports, refrigerated shelf lives of up to 15 days for beef, veal, and lamb; ten days for pork; seven days for offal and six days for fish are achievable.

Darfresh is being employed in three or more locations serving many retailers in France.

Although the absence of up-to-the-minute reports on the St. Regis American and Cryovac Western European venture reflects a paucity in this program, the information from the commercial interests from Western Europe is significant. Those professionals who are visiting us are sharing with you data that have been obtained only after many years of intelligent visionary and intensive effort. And these data reflect successful commercial activity which might be translated into an American experience.

When the inexorable thrust of centralized red meat packaging occurs in the United States - as it ultimately will - American packaging systems suppliers are looking at packaging close to 50 billion pounds annually of beef, pork, lamb, and fish.

In materials, that is more than the total number of individual packages used for carbonated beverages or beer - currently the benchmarks of American packaging statistics. Obviously, the weight of materials is vastly different between cans and bottles and the probable plastic - ? -composites that will constitute the controlled atmosphere or vacuum packaging in that future era. More than 500 million pounds of low water vapor/gas transmission materials would be required - with a possible value of a billion dollars - in today's value terms. Add to that, the cost of equipment at another hundred million dollars annually, and the possible economic effect can be more than just interesting.

On the down side, of course, those firms currently engaged in supplying equipment and materials for meat and fish packaging must reassess their positions.

Virtually everyone in the meat packaging supply industries has been and is cognizant of the alternatives to their current offerings. Only in our generation, the corner butcher has given way to the supermarket backroom; cellophane displaced glazed paper; PVC replaced cellophane; molded pulp trays came into existence and were since replaced (mostly) by thermoformed foamed polystyrene. And behind the retail package the vacuum barrier bag for primal cuts entered only sixteen years ago to totally alter distribution, to provide the market basis for coextruded barrier films, and to create an entire major new market for corrugated fiberboard shipping cases. Three decades of repeated upheaval in meat packaging should alert everyone to the potential for change.

Could any rational participant in the flesh food packaging industries believe he or she is not vulnerable to new packaging systems?

Our Western European colleagues will describe some of their commercial activities which are highly visible. Both the Bivac and Atmospack systems are in test market in the United States. Cryovac's Market Ready system in which the retail cuts of red meat are vacuum packed in bulk to be repackaged in unit sizes without cutting at the retailer's is being used. And the dynamic Printpack has acquired Standard Packaging's patents for sequential inert gas/oxygenation packaging of red meats. Considering the recent history, the dynamics of the product requirements and the convoluted economics which materials combination will dominate: coextruded plastics? ionomer? Plastic coated paperboard tray? Foamed plastic? And what type of distribution package will be used: Single use? Paperboard? Corrugated Fiberboard? Shrink film? Reusable plastic?

The diversity and intensity of activities and possible alternatives highlights the magnitude and needs of the target market and the potential for sales and profit growth for both suppliers and packagers. Because less than one percent of the American market is using prepackaging for retail cuts of meat - except poultry - the system or systems that will capture the market cannot be detailed from the vantage point of today.

It appears that whichever organizations seize the opportunity that is today highly visible will - after much agony, of course - lead the ultimate conversion to centralized packaging.

The presence of a very few American packaging firms in the forefront today does not in any way ensure their success when the change takes place.

What is certain is that centralized packaging will take place - as it did for processed meat (remember when you could purchase cured meats only at the delicatessen) and in the past five years for poultry - the systems of choice are still open for development.

When the exponential growth will occur is uncertain - but almost assuredly we shall witness significant movement by the next decade due to the unprecedented economic pressure on retail marketing volume. Five years is not too short a period for development of an effective packaging system for those who recognize the opportunity and elect to begin now.

While meat represents the largest potential market for controlled atmosphere packaging - and the one most advanced in Western Europe - other markets are already larger in the United States - or growing just as rapidly.

At three billion pounds consumption, seafood is not nearly as popular in this country as is meat, a situation that has been unchanged for more than a half century.

For several years, National Fisheries Institute has sponsored major conferences highlighting controlled atmosphere packaging and distribution of seafood. Thus, virtually unbenownst to the majority of food and packaging industries, controlled atmosphere packaging of seafood has apparently entered its exponential growth phase. Millions of pounds of seafood are being distributed under controlled atmospheres - 60% CO_2, 20% O_2, and 20% N_2 - by air, in intermodal containers, on pallets shrouded by pallet bags, and in specially designed and constructed lined corrugated fiberboard cases. The most sensitive of all foods to spoilage, seafood has a tight requirement for controlled environment. Although very little seafood has yet entered retail controlled atmosphere packaging in the United States, major action is reported taking place in Canada. Fresh salmon from Alaska, fresh scallops, live Dungeness crab, lobster and numerous other seafood products are being distributed annually using mechanisms belonging in the controlled atmosphere packaging family.

The needs of the seafood industries for markedly improved packaging means signal that when a new and viable scheme is available, it is quickly adopted. The rapid embrace of controlled atmosphere distribution systems underscores this thesis. Thus, just as both traditional and non-traditional packaging suppliers have leaped into the new generation of seafood distribution, we can expect major changes in retail packaging when viable innovations are introduced. And any new retail packaging system will affect the current frozen fish packaging.The several alternatives from Western Europe which will be described in this conference represent only a fraction of those possible.

It is likely that the system that dominates for meat will greatly influence the system which to be offered to the seafood industries.

As our brief historical overview, which diverted into flesh foods indicated, the major initial surge in controlled atmosphere in the 1960's came from fruit and vegetable storage. In the twenty years since, about 20,000 truck trailers and sea containers have been equipped for controlled atmospheres - and more that 200 million pounds of lettuce, cherries, bananas, apples, pears. and other fruits and vegetables were distributed last year by these vehicles. But, of course, containers are not packages. The rapid growth of permanent reclosable bulk containers would appear to preclude any other vehicle for controlled atmosphere packaging. Nevertheless, in the past five years, plastic pallet bags have grown even more rapidly - to probably already exceed containers for controlled atmosphere distribution of produce. As much as five percent of all produce consumed in the United States are under controlled atmosphere - with packaging innovations being introduced almost annually - as will be

described by Mr. Pumala. More than two billion pounds of fresh fruits are stored in fixed controlled atmosphere storages --- a demonstration of the confidence held in the technology.

Right behind bulk controlled atmosphere packaging has been the dramatic introduction of CA packaged cut vegetables for hotel/restaurant/institutional applications. Well over ten million pounds of produce were distributed in this manner in 1983. Ready-to-serve lettuce and other salad greens are delivered to the kitchens of restaurants minimizing weight loss, spoilage, wilting and trim. And, in addition to the volume being packaged under intentionally controlled atmospheres, much more is being packaged in plastic containers in air - and permitted to build a modified atmosphere.

The technology is sound as has been demonstrated vividly by the rapid commercially growth.

But, the activity has been so quick and confined to so few organizations that a vast area for new growth will occur when the base is broadened. When others become aware of the multi-million dollar opportunity represented by controlled/modified atmosphere produce packaging, major innovation might be expected.

The principal thrust will probably initially be to the hotel/retaurant/institutional industry. But the largest nugget, by far, is the supermarket which experiences horrendous waste and trim losses from fresh produce while at the same time generating large profit margins.

Centralized prepackaging for fresh produce is another of the inevitable packaging innovations that will upset today's conventional wisdom of food distribution.

Continuing this hopscotching technoeconomic history, the 1960's was witness to research identifying the potential role of controlled atmosphere for bakery products.

Bakery goods deteriorate by staling and by mold growth. Staling may be somewhat retarded perceptually if the surrounding moisture content is maintained high. Elevated water vapor promotes surface mold growth, however.

Research results from the United Kingdom demonstrated that 20% or above CO_2 can significantly reduce mold growth, thus permitting high moisture which helps to slow staling. This mechanism is not applicable to products with textural differential between crust and crumb.

Armed with this technical knowedge, considerable commercial testing was conducted - with very limited success.

In France, infared radiation was used to destroy surface mold within nylon packages of crusty bread. Not until West German regulatory authorities required that the presence of chemical antimycotics was to be declared on bakery product labels did controlled atmosphere packaging become important. The so-called "natural food preservation method was applied for dark breads which could then be distributed over the entire European Economic Community. Using either thermoform/gas flush/seal or horizontal form/fill/seal machines and gas barrier flexible materials more than 100 bakeries in West Germany began controlled atmosphere packaging.

In the United Kingdom, Unilever introduced yet another concept - CA packaged prebaked bread intended to be finished in the homemaker's oven. Unfortunately, this product was withdrawn from the market this year. Nevertheless, controlled atmosphere packaging of hamburger and frankfurter rolls, brown breads and pizza dough is widespread in Western Europe, an otherwise "fresh bakery" continent. The Swiss Army uses controlled atmosphere packaging to preserve bread for a year.

The transfer of this technology to the United States in this decade has not been as rapid as predicted. Perhaps the most intriguing of the controlled atmosphere packaging applications in this country is for the rapidly expanding soft cookies.

Because of the staling problem, bakery goods are generally manufactured close to the consumption site. The alternative is to freeze the product - which imposes a day of staling deterioration - and to use expensive low temperature distribution. The speed of staling is so fast that almost daily delivery is required, and yet stale return goods represent a significant and highly undesirable fraction of the production.

Costs of distribution and returns of the fourteen billion industry dollar are so high that controlled atmosphere packaging could represent a significant saving for American bakers. It is difficult to project a short term conversion for sliced white bread which constitutes well over half the total volume.

On the other hand, specialty breads and cakes which have longer distribution requirements should benefit from controlled atmosphere packaging.

When technology is by bakers, elucidated and accepted controlled atmosphere packaging will affect bakery products frozen for distribution. Subsequently, market share will grow in specialty cake production.

The current available systems emphasize plastic composites, but these do not always provide protection against shock, vibration and compression. Thus, the potential for packging innovation is present - for controlled atmosphere packaging of bakery goods.

A new packaging technology from France permits a wholly new product concept, controlled atmosphere packaging of entrees. Products such as pizza or beef stew are sealed in elevated CO_2 atmospheres and distributed under refrigeration - to achieve three and four weeks shelf life. Instead of the daily delivery of conventional refrigerated, product distribution can be handled much like frozen foods. And, of course, product quality is significantly better than that of frozen entrees.

Controlled atmosphere packaging of entrees thus opens a totally new food product category which can succeed by itself - and can also penetrate a market now dominated by frozen entrees.

Controlled atmosphere packaging of entrees is in its infancy - but is so interesting in concept and implementation as to warrant in-depth investigation by all packaging suppliers and refrigerated and frozen food packagers.

By describing the application of controlled atmosphere packaging to the almost 50% of all food that is fresh or partially processed, the potential for new packaging has been highlighted. On an optimistic upside, up to half of all food could convert to controlled atmosphere packaging, representing several billion dollars annually of packaging sales.

More realistically, over the next five years, we must anticipate some market testing for centralized red meat packaging, marketing for fish, considerable volumes for CA packaging of produce, some significant market testing for bakery products, and some very serious incursions in refrigerated entrees.

At the outset of this introductory presentation, we predicted that by the next century, CA packaging will exceed aseptic and retort pouch/tray packaging in terms of volume contained. With little semantic freedom, perhaps CA packaged product volume may be already number one.

Aseptic packaging and its distant relative, retort pouch packaging, today total about 500 million pounds of food. Considering the known fruit and vegetable, fish, soft bakery goods and red meat in test, classical controlled atmosphere packaging contains about 250 million pounds of food, not counting that derived by natural respiration, used for process meats and cheese or vacuum packaging of red meat primal cuts - a remarkable statistic for a packaging process that is almost unknown to the packaging and food communities.

And much more significant: current growth is exponential; and the technologies being introduced as a consequence of the Western European experience signal major impact in food and packaging industries for those who recognize and accept the challenge.

Today's International Conference on Controlled Atmosphere Packaging marks a beginning - we are bringing the process out of the laboratory and pilot plant and exposing it to professional and trade view. To accomplish this feat, we have assembled a small fraction of the great worldwide team that has been quietly working to create this innovation in food packaging and distribution.

On another day, another group from the same dedicated universe would reinforce and embellish what we are to share today.

Mr. John Segura of MG Industries, Valley Forge, PA, a part of the West German Buse gas interests will open with an overview of what is happening in Western Europe, based on very fresh information. He has just landed from a two week tour of the CA industry.

To provide the technical bases for fresh food CA packaging, Dr. Gunnar Finne of Texas A&M and Dr. Robert Lindsay of University of Wisconsin, both research pioneers in this field are here.

And to focus on CA packaging of meat and seafood in the United Kingdom where a major growth is occurring, we have two good competitors, Bob Watkins of Transparent Papers and Chris Burland of Smith Brothers.

To discuss the new worldwide equipment component, Mr. Lawrence Starr of Koch Supplies, America's Multivac supplier.

Because we wanted to provide as much information as possible, we have gathered a panel that includes the morning speakers plus Mr. Goran Lindstam of Akerlund & Rausing and two professionals from a major British chain. Marks & Spencer, Mr. Bob Franklin and Dr. T. A. Clayton.

The afternoon is divided into two sessions beginning with CA packaging of fruit and vegetables. Leading off is a time pioneer Dr. Steve Wolfe of Fresh Western Marketing, to set the stage. Dr. Syed Rizvi of Cornell University and Mr. Roger Rij of U. S. Department of Agriculture will provide some technical bases, and the commercial packaging overview will be presented by Dick Pumala of Shields Bag.

And, of course, we shall have a panel.

The third session is perhaps the most intriguing - bakery and precooked products. The pioneers in the field, Mr. David Seiler of British Flour Milling Association and Andy Benson of Rose Forgrove will discuss, in sequence, the principles and the packaging. And, fresh from France, M. Pierre Louis, the recorder and reporter of the latest in packaging to detail CA packaging of entrees. And, of course, a panel.

One day of conference that in future days might well be described as a conference that shook the food packaging community.

Concluding Remarks

We have introduced the concept of controlled atmosphere packaging for meats, fish, poultry, fish, vegetables, bakery products and entrees. What we could not deliver all the comprehensive and definite information and interpretation is of little matter - even in its infancy, this technology is already overwhelming in its power, in its success and in its potential. We, each of us, have been part of a major sharing that will enable us to make great slides forward when we put this information to effective use.

Thanks again to each of the participants and thanks to you for coming.