

Meat processing, now and in the future

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When I was asked to review the area of meat processing, identifying recent advances and areas for future research, I was told that "all reviewers should highlight future prospects in meat science." I readily accepted primarily because of the honor it affords me to address such an august group but also because as part of my job as a Research Manager at Oscar Mayer I am intimately involved with the future of meat science, particularly meat processing.

Before I talk about specific meat processing issues I want to review the subject of technological forecasting very briefly. Then I plan on touching on some of the key demographic trends which will influence meat processing. I will talk about some of the processes which are in limited use today which may be more widely used in the future and finally I will discuss some of the more avant-garde technology as it relates to meat processing.

From earliest times man has been concerned not only with today but what is going to happen tomorrow, next week or next year. Seeking information on the future via the soothsayer, the fortuneteller, the oracle, or the prophet, has long been traditional. Even in these modern times the readers of tabloids and newspapers have an opportunity of finding "what the stars foretell." It is not surprising therefore that over the years a considerable amount of effort has been devoted to the development of technological forecasting techniques, particularly for use in business and government. One report I read noted that in 1976 about 90% of U.S. firms had some kind of formal planning compared with only about 20% in 1947.

In industrial meat research, forecasting is particularly important because our companies do not just hand us some money and say "here, do something." They want us to do more than just gaze into our crystal ball to come up with facts to justify the research which will, hopefully, move the corporation ahead.

To convey the image that we are doing more than "breathing stuporous gasses" or chewing "sacred laurel" to come up with our projections we call this area of research management Technological Forecasting. We do use some fairly well established forecasting techniques. These techniques can be divided into four groups.

- Intuitive Forecasts
- Trend Extrapolation
- Morphological Research
- Normative and Relevance Trees

Intuitive Forecasts

The intuitive forecast is probably the most familiar to each of us and is based upon the individual forecast of one "genius" or, in the absence of a genius, a committee consisting of a group of specialists working together to produce consensus. However, committee forecasting can rarely be a proper consensus since one or two dominant individuals will sway the opinions of their colleagues. The Rand Corporation's Delphi Technique is designed to overcome these problems. The name stems from the similarity in structure to the forecasting done by the Oracle of Apollo in the ancient Greek city of Delphi. There, a virgin (or an old married woman dressed like a virgin) who claimed to have been anointed by Apollo would make her way to a special chair. After chewing some bay leaves, breathing deeply of gasses emanating from a geological fissure under her chair, and drinking from the sacred stream that flowed nearby, she would go into a trance and utter unintelligible sounds. These emanations were interpreted by a group of prophets, seated around her, as answers to questions previously submitted to them in writing by the laity.

The modern version consists of a series of questions submitted to randomly selected members of a population of experts on the subject. Their answers are tabulated statistically so that the consensus indicates a measure of probability. Much of the information I will convey today was derived from a Delphi type forecast commissioned by some members of the food industry.

Trend Extrapolation

Carrying out a time series analysis on past data is familiar to most of us. There is no doubt that in certain situations, trend prediction can be of considerable relevance and value: for example, in predicting microbiological shelf life and stability of food stored under various conditions. Nevertheless, prediction of future trends in a subject based upon historical events is beset by hazards of technological innovation. A frequently quoted example of this is the harness maker who built a large new plant in 1915 based upon the horse population trend from 1890 to 1915. He of course did not reckon with the automobile. Speaking of that, how many of us, in 1972, only 12 years ago, could have accurately predicted the price of gasoline today?

Trend extrapolation over a relatively short period offers the forecaster considerable potential but the choice of parameters and the interactions that occur make application of this technique extremely dangerous. Because I have arbitrarily limited my presentation to advances which should occur before the turn of the next century, only 15 years from now, I have used trend extrapolation to some degree in its preparation.

Normative Relevance Trees and Morphological Research

I did not use either of these techniques in preparing this view of the meat industry in 2000. Relevance trees involve formalized guided discussions usually carried out in so called "think tanks" and have been used extensively in "impact" forecasting.

The morphological approach involves, again in a think tank setting, exploration, without prejudice, of all possible solutions to any given problem.

Let me set the stage for the meat industry in the year 2000 by giving you some demographic trends that will have a profound influence on our industry.

Demographic Highlights

The American population is now almost 238 million people. This population will increase by 0.9% (or 2 million people per year) until 2000. The population will then be 266 million. This is 14% more of our own mouths to feed.

A baby "boomlet" is underway with the number of kids under 5 years of age increasing over twice as fast as the whole population through the year 1990. This will create, of course, a ripple effect so that by 2000 we will have more teenagers. This boomlet reflects the family choices made by working women, particularly in the 25-49 age group and differs from the post war baby boom in that it will not lower the average age of the total population, nor is it expected to result in the culture changes that followed the baby boom. Child oriented products will get some lift from the baby boomlet.

Over the remaining years of this century our life span will continue to increase. The declining mortality rate will reflect itself in the growth of the 65 and over segment of the population. The older population segments will represent an opportunity for the meat industry because of their relatively high disposable income, specific nutrition needs and extensive leisure time.

In 2000, more women will be working than today. In the US more than half of the adult women (41 million) are now employed and represent 42% of the labor force. By 2000, 75% of all women 20 to 54 will be in the labor force. A similar trend is predicted for Western Europe. This will result in more middle and upper income households because of the addition of a second wage earner. The working women will struggle to balance the roles of homemaker and career woman. Delayed and skipped meals will become more common with fewer weekday meals prepared at home. Working women are most likely to: 1) buy quality products which offer speed and convenience; 2) be less price conscious, but expect value for their money; 3) be attracted to products that enhance their personal appearance, especially low calorie/light foods and beverages; 4) be more aware and concerned with health and well being, and 5) eat out more.

The household composition will change in the future. In America 22% of all households are comprised of a single person living alone. By 2000, 1/3 of all households will be composed of a single person. Singles households provide opportunities in portion control and convenience foods.

While we are still talking demographics let us not forget the world situation. Because of education, improved living levels, social change and public programs, the world birth rate will decline. While the American population growth rate will maintain a fairly uniform 0.9% increase per year, the world rate, which is now double that, should decline somewhat. The Western food industry will continue to be a major supplier to this market. Several "prophets of gloom" have predicted that there will not be enough food to go around in the year 2000. However, many highly respected agriculturists such as Don Paarlberg and Norman Borlaug predict that there will be enough food in this world to feed it--if

If we permit the market to give farmers the price incentives they need, and

If we avoid subsidizing the conversion of a substantial share of our high-value food into low-value non-food, and

If we make the needed investment to develop and distribute new agricultural knowledge, and

If we share with the developing nations the knowledge and experience we have gained during the past century, and

If the developing countries themselves work diligently on both sides of the food equation, improving their agriculture and reducing the rate of growth in their population numbers.

General Considerations

I want to share some thoughts on how new technologies will be used in the meat industry of the future, but first let us take a look at some general considerations which can be incentives or deterrents to our development in the years ahead.

The food safety laws characterized in America by the Delaney Clause need to be realigned with today's and future technology. The ultimate resolution of the legislative debate could be an incentive to basic research and technological advances, but if the objective remains centered about a zero risk concept, research investments will be severely curtailed. For this reason, there needs to be broad acceptance that safety is a relative term and a recognition that risk assessment is one of the keys to a change in the system. We have accepted it in dealing with the risk of getting killed each time we step into an automobile; why not in terms of our food safety laws? Personally, I am optimistic the situation will be resolved in this decade and will then allow progress toward the twenty-first century.

Closely allied to food safety legislation is the concern for residues in the food supply. Herbicides, pesticides, growth stimulants and other chemicals have, from an economic standpoint, developed as necessary inputs to maximize crop and livestock productivity. Just as we have learned to develop them, we will also learn to control them. Monitoring will be a very common function in the future. But I believe the burden of monitoring will be justly put on the primary producer rather than on the food processor. Monitoring methods will be simplified to enable this to happen.

Biotechnology is a "buzzword" which means the controlled use of genetic engineering, enzymes and microorganisms for a specific desired purpose. I am sure Professor Niinivaara did not consider his 1955 thesis on the use of pure bacterial cultures for fermented sausages as biotechnology. Nor did the people at Swift and Co. when they used the vascular system to distribute proteolytic enzymes to tenderize beef. At present there are in the US, 150 small genetic engineering firms trying to find themselves. By 2000, the sifting and winnowing process will have been completed and good firms will have succeeded. Succeeded at what? Making products or raw materials we want now, but cannot have, or can have now, but at a very dear price.

- The Cetus Corporation should commercialize a fructose production system by 1987.
- Gentech/IMC should have a hoof and mouth disease vaccine in 5 or 6 years.

- Gentech/Monsanto should have a genetic engineered bovine growth hormone by 1987.
- Cetus is hard at work developing nitrogen fixation in non legumes. This should be commercial by 1995.
- Genex will have a natural antioxidant at an affordable price by 1987.

These commercialization dates are the 1984 based predictions. They have been advanced one year each of the past couple of years. This trend of advancing the target date will continue for the next few years--research never goes as fast as it is planned--but I feel confident by 2000 we will clearly see the effects of biotechnology in the meat industry.

Several firms are already producing and marketing food grade protein which is being used in meat products. By 2000 this will be common. We are all aware of the production of high fructose corn syrups by enzymatic modification of starch. Expansion of this technology will be clearly seen by the next century.

There is a high degree of consensus that by the end of the century we will have many microbial biotechnology products available for use in the food industry, including gums, vitamins, colors, flavors, antimicrobial agents, food enzymes and proteins. The only area in which there will be little biotechnological activity, but one which we in the meat industry think needs a lot of work, is fat utilization. The meat industry will move faster to keep fat out of our products, as the consumer is demanding, than the livestock industry can keep it out of our raw materials. Therefore, fat will become an unwanted commodity that we would like to know how to effectively use.

Food preservation is going to be basically the same in 2000 as it is now. Even though there will be shifts and subtle modifications, heat sterilization, pasteurization, refrigeration, freezing and drying will still be our main preservation processes. As much as I would personally like to see it as a front line preservation system, I do not believe food irradiation will be widely used by 2000. It of course is not a new technology. I was told in 1961 that in five years every American household would have beef steaks stacked on the pantry shelf rather than in the refrigerator or freezer ready for that last minute question housewives all ask themselves at 3 or 4 p.m., "What am I going to feed the family for supper tonight?" Of course it did not happen, not because of the lack of technology, but, because of the concern for zero risk that I spoke of before. In the US the FDA pendulum is now swinging toward approval of food irradiation but even if it is approved, the consumer

will not readily accept it. When the consumer hears the term irradiated food their response is Three Mile Island or the nuclear arms race. That reaction will not change much in the next 15 years. The technology will, however, be developed for products for selected international markets.

Meat packaging is not going to change much by 2000 either. Oscar Mayer Foods Corp. pioneered the concept of packaging processed meats for prolonged high product quality in the early 1960's. Some of us can remember, I am sure, moldy wieners and moldy bacon because the only film we had available was oxygen permeable cellophane. We avoided these problems by developing non-oriented impermeable saran which prevents the growth of these microorganisms. The trend now and through the remainder of this century will be to continue to fine-tune the system. Selection of less expensive but equally effective films, automation of film application, replacement of metal with plastic packaging materials. Package designs will change somewhat as more and more food processors interpret what the consumer wants.

Certain raw materials for meat processing purposes will be increasingly restricted in availability and more costly as time goes on. There will be extensive modification of traditional meat products with widespread ingredient substitution and greater use will be made of untraditional meats and fish and of plant and microbial protein in manufactured products.

Some of the ingredients used for substitution will be the result of extensive biotechnological research while others will result from public acceptance of processes we already know, such as mechanical deboning. The development of proteins from novel surplus or otherwise downgraded protein foods is highly probable within the next decade, yet some forms of novel food ingredients will require legislative permission.

Mechanically deboned meat will be, after its agonizing history, an expected part of meat plant operations. With general usage, machine manufacturers will be encouraged to develop greater capabilities in their equipment and we can expect an even greater application in the years ahead. The fact that the unused residue from efficient deboning operations today contains 22% protein provides that opportunity. It is most unfortunate that a development of this magnitude has been obstructed by well meaning but ill advised regulations. I am confident the new regulations will be accepted and allow the use of this process to add to our meat supply.

Consumers' concern about health and well-being will continue into the 21st century. Increasing attention will be paid to perceived health benefits such as lower calories, lower sodium, less fat, less cholesterol and fewer additives. There will be continued pressure for improved meat product labeling.

Meat companies cannot ignore the concern of their consumers if they wish to exist. Fifteen years ago our company did not have a nutritional program but established one to meet the increasing number of requests for nutritional information by our consumers. Today we have detailed and current nutritional information on all of our products and our subsidiaries' products. While it is not cheap, our consumers appreciate receiving accurate nutritional information. This appreciation is reflected in increased sales.

Nutrition and its roll in determining the type of products we will see in the market of 2000 is now being considered by our company's marketing managers. Calorie content and fat concentration are now included in product planning formats.

Sodium content will be reduced in many meat products and of course it will be declared on the label. Sodium in meat products that now contain significant quantities of salt for technological purposes will not be reduced to the point of non-detection. It will be shown to consumer advocates that the risk-benefit rule will apply and providing a safe food supply for the masses is more important than possibly reducing hypertension for a few. Those with hypertension will not be forgotten, however, because they will have, even by the end of this decade, the best selection of sodium reduced foods they have ever had.

One area where trend extrapolation has helped in predicting the future, is one in which the trend is changing so fast we have to use exponential prediction equations rather than the more common linear prediction equation. This of course is computerization. Without any doubt whatsoever computers will play a major role in the future of the meat industry.

I wrote this talk, in part, using my home computer. I inserted many of the facts and used the computer to help organize them. With that computer, I have the potential of accessing, from my home, titles and abstracts of all of the scientific articles written in the field of food science over the past 15 years. I can consult the airline schedules to see the best way to get from Madison to Bristol and back again. If I were so inclined, I could subscribe to a Dow Jones Service and essentially have a stock ticker in my home. In some cities, banks are giving away home computers to test the concept of direct home banking. Food shopping in the year 2000 will be done by computer by some--but not all--of our customers.

While the home computer will affect us personally other computers will play more significant roles in the meat industry. By 2000, robots or computer controlled devices, like those already used by the auto industry and machine tool industry, will be doing much of the labor now done by hand. Robots will bone hams and split carcasses. They will analyze meat being processed

for proximate composition and correct it to a predetermined standard. The micro-processor will permit heretofore impossible processing changes in heating and cooking cycles which will improve food product quality and yield.

We should not fear the computer, but learn how we can use it to work for us and how to get the most of it.

There you have my views of the meat industry of the future. By nature I consider myself at the same time an optimist and a conservative. These traits, I am sure, have come through in my predictions even though I have relied heavily on scientific methods for forecasting. Byron said, "The best prophet of the future is the past", and Lamartine said, "Experience is the only prophecy of wise men." I put it yet another way when I say, "I used some 20-20 hindsight in preparing this presentation." I am sure some of you are disappointed because I did not paint a "Buck Rogers View" of the near future. But the astronauts took Oscar Mayer® Wieners to the moon--the same kind of wieners, in the same package, Americans can buy at the store today. The sliced bologna our customers eat tastes just as it did a generation ago but today it can be made without being touched, even once, by human hands. The point I am making is that the food industry is conservative, but it will move steadily ahead.

Many of you have witnessed the meat industry for several years and when you think how difficult it has been to bring about change, you know that Buck Rogers will eat pretty much the same kind of food we are eating today. Not a lot that we would call earth shattering will occur in the food industry in the remaining 15 years of this century. I thought many times of the old New England Sage--James Russell Lowell--as I was preparing this talk. He said, "Don't never prophesy--unless ye know." I think most of us are smarter than we give ourselves credit for. Because of our past personal experience in the food industry, we qualify as prophets of the future.

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