PRODUCTIVITY-INCREASING TECHNOLOGIES IN THE FOOD INDUSTRY: THEIR IMPACT UPON SOCIETY

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The authors discuss the role of (OTA) Office of Technology Assessment, in determining the affect of technology in the processing, distribution and retailing sectors of the food system upon society.

INTRODUCTION

It is a pleasure to have the opportunity to address the 16th annual meeting of the Food Distribution Research Society. The theme of this year's meeting, "Serving the Consumer: Quality, Convenience, and Value," is easier said than done. Over the years, U.S. food policy has been production-oriented. It has concentrated on bushels and yields, farm income and price supports, commodity research and grain reserves or carryover. Over the past few years, policy makers have begun to understand that these elements, although essential, represent only a part of the total picture. More decision makers realize the basic purpose of food production is adequate nutrition for people.

- People consume the additional bushels, the increased yields, either directly or indirectly.

- People should be kept in mind during the planning, selection, and execution of research and development programs.

In sum, food is nutrition for people; food is nourishment for health--not merely commodities for commerce. Today, consumers demand more. They demand quality, convenience, and value for the hard-earned, inflation-depleted dollars they pass to the food industry.

Both the amount of food consumed and the form in which it is consumed has changed. Today, the "bundle of services," once considered a luxury, are now a demand. The food industry, while trying to either react or, as some feel, manipulate these changes, is faced with a multitude of regulations and issues that deal with food labels, additives, grading, safety and quality control, and technology and its implications.

Rising food prices have triggered consumer surveillance of and pressure on the food industry, particularly with regards to the practices of food processors and retailers. Industry and consumer representatives have become adversaries. Consumers charge industry with "ripping them off," while industry contends that it only provides services that consumers desire and that these services cost more.

* The views contained do not necessarily represent the views of OTA. This material reflects initial research and discussion of the OTA food group relative to a future assessment of the impact of food technology on society.

Consumers are demanding expert advice as to how to make their food purchases more meaningful. The answers are few and far between:

- Experts can be found who disagree with other experts;

- Experts can be found who tell consumers that they are demanding more than science and the food industry can deliver;

- Experts can be found who tell us we need a lot more research and development;

- But we cannot find experts to provide the answers or the guidance so that consumers, industry, and the Government can deal with the rapidly changing nature of the U.S. food system; to develop a national food policy that judiciously balances such goals as:

--The assurance of adequate food production;

--The assurance of food quality and of safety for the health of the American people;

--The development of continuous food surveillance and monitoring capability to assure constant concern over the nutritional status of all people;

--The development of nutrition education techniques for all levels of our population;

--The attainment of better balance in our research efforts.

Increasing food prices is not the only issue which pits the consumer against the food industry. However, it is the most visible, and its impact is best evaluated at the retail level--the last stop between consumer and industry. The cost of food is an issue which affects all consumers and is an issue which all consumers readily understand. The 1973 consumer meat boycott comes immediately to mind; likewise, the introduction of Universal Product Code (UPC). Other consumer issues, such as informative food labeling and food safety regulations, have gathered their support from an outgrowth of escalating food costs. Consumer awareness seems to be related directly to rising food prices.

Productivity-increasing technologies are seen as a means to control the spiraling cost of food. The increasing cost of labor in the form of wages is viewed as one of the major reasons for increasing food prices. In the food marketing system, nearly 50 percent of all costs involved in moving a product from the farm to the consumer are a result of labor costs, and in the typical supermarket, labor accounts for about 80 percent of all controllable operating costs.[1/] Development of technology in the food industry is seen as an important substitute for labor, i.e., mechanization of the food marketing system.

For my appreciation of the productivity concept, I rely on Dr. Gordon Bloom's definition of productivity as the ratio between "output measured in specific units and any imput factor measured in specific units."[2/] Bloom notes that "the most widely used statistics on productivity are those published by the Department of Labor." They release two series of statistics, "one measuring productivity in terms of output per hour paid, and the other in terms of output per hour worked." Primarily because of the lack of data, "most productivity series are generally based upon hours paid."[3/]

The Department's statistics are considered a conventional index. They should not be considered the only means

of measuring productivity. It is true that individual companies of the food industry still measure productivity as a ratio of total output with labor input, but other industries are applying the "concept of 'total factor productivity'"[4] as a way of comparing total output "to all associated inputs; i.e. the input of both labor and capital."[5] This new index realizes the importance of capital investment affecting a firm's output and represents a truer measurement of productivity.

While the above is a simple explanation of the differences between "total factor productivity" and conventional productivity, the discussion points to the rigidity within the food and other industries with regards to measuring productivity. This limited viewpoint could affect the development of technologies whose purpose is to increase productivity for social good as opposed to productivity limited to economic terms.

The development of technology could be adversely affected in two ways: (1) if such development is limited to mechanizing the marketing system, i.e., reducing manual labor and accelerating the distribution and manufacturing of food for the purpose of cutting costs. Technology limited in this manner would severely hamper technological improvement in important areas within the food industry; for example, improving methods of freezing, canning, or transporting foods or developing and improving convenience foods. (2) If such development is for the sole purpose of improving productivity by cutting costs, without concern for the impact of the technology on society. This underscores technology's use as an economic tool.

This paper will focus on both the effects of specific food technologies per se and the effect of "gaps" in technological developments in the food industry. In addition to discussing the impact of technology on our society, this paper will explore the Government's role, if any, in technological developments in the food industry. Should, or can, Government enhance technological development? Should it regulate such developments? The answers to these questions will determine the direction that the U.S. food marketing system will take in the next decade.

Finally, I should say that this paper will raise more questions than it will answer. It hopes to demonstrate that important dialogue between Government, industry, and the public is needed at a time when food costs are escalating and the industry is coming under increasing attack from the consumer. Emotions will not effectively solve the problems; only objective, clear-headed thinking will produce the proper solutions.

These comments are background to the key aspects that my paper will review:

Firstly, the organization and operations of the newly created Congressional Office of Technology Assessment; and secondly, some initial ideas of a prospective OTA assessment of the impact of food technology on society.

OTA'S ORGANIZATION AND OPERATIONS

The second annual OTA report provides useful background material.

The Office of Technology Assessment (OTA) was created by the Technology Assessment Act of 1972 to help the Congress anticipate, and plan for, the consequences of uses of technology, OTA received funding in November 1973, and commenced operations in January 1974.

The statute specifies that OTA shall consist of a bipartisan Congressional policy Board, an OTA Director and Deputy Director, a citizens Advisory Council, and such other employees and consultants as may be necessary in the conduct of OTA's work. The Congressional Board sets the policies of the Office and is the sole and exclusive oversight body governing OTA. The OTA Director is the chief executive officer and is responsible solely to the Board, of which he is a member. The function of the Advisory Council is to advise on such technology assessment matters as may be requested by the Congressional Board.

OTA's Congressional Board comprises six Senators and six Representatives, evenly divided by party, who are appointed respectively by the President Pro Tempore of the Senate and the Speaker of the House. The current Board Chairman is Congressman Olin E. Teague of Texas, and the Vice Chairman is Senator Clifford P. Case of New Jersey. The two posts rotate between the Senate and House in alternate Congresses, with the Chairman chosen from the majority party and the Vice Chairman chosen from the minority party. The Advisory Council consists of 12 members. Ten are public members, appointed by the Board, who are persons eminent in one or more fields of the physical, biological, or social sciences or engineering, or experienced in the administration of technological activities, or who may be judged qualified on the basis of contributions made to educational or public activities. The Comptroller General and the Director of the Congressional Research Service of the Library of Congress are ex officio Council members.

In providing assistance to the Congress, OTA is to:

--identify existing or probable impacts of technology or technological programs;

--where possible, ascertain cause-and-effect relationships;

--identify alternative technological methods of implementing specific programs;

--identify alternative programs for achieving requisite goals;

--make estimates and comparisons of the impacts of alternative methods and programs;

--present findings of completed analyses to the appropriate legislative authorities;

--identify areas where additional research or data collection is required to provide support for assessments and undertake such additional associated activities as may be directed.

OTA's unique role is to assist the Congress through the developing art of technology assessment, an interdisciplinary form of policy research designed to identify alternative approaches to technology-related issues and to provide thorough analyses of the probable consequences of such options.

The objective of each assessment is to provide an early appraisal of the probable impacts and uncertainties of technological programs, so that both beneficial and adverse factors can be identified and considered in the legislative planning process. Both near-term and longer-term effects, whether intended or unintended, are examined, as are the diverse interests and viewpoints of the many different parties foreseeably to be affected by the technology.

Technology assessment is not primarily an exercise in forecasting or prophecy. It is a process designed to ask the right questions, and to seek answers based, as much as possible, on hard, factual information which can be obtained through disciplined analysis. Where important data are unavailable, the need for additional research can be spotlighted. Technology assessment is an aid to, not a substitute for, the judgments which must be reached by elected officials in policymaking positions.

Initiation, Processing, and Flow of Assessments

The Office of Technology Assessment, by statute, is located within and is responsible to the legislative branch of Government. Accordingly, its basic mission is to provide Congressional committees with assessments or studies which identify the range of probable consequences, social as well as physical, of policy alternatives affecting the uses of technology. Requests for OTA assessments may be initiated by:

1. The chairman of any standing, special, or joint committee of the Congress, acting for himself or at the request of the ranking minority member or a majority of the committee members;

2. The OTA Board; or

3. The OTA Director, in consultation with the Board.

The authorization of specific assessment projects and the allocation of funds for their performance is a policy responsibility of the OTA Board. The Board has established priority areas of study, and has approved individual assessment projects within those areas. The priority areas are food, health, oceans, materials, urban mass transportation, energy, and international trade and technology.

In arriving at these decisions, the Board considers recommendations and plans developed by OTA staff, and applies the following general selection criteria, developed in consultation with the Advisory Council:

--Is this now or likely to become a major national issue?

--Can OTA make a unique contribution, or could the requested technology assessment be done effectively by the requesting committee?

--How significant are the costs and benefits to society of the various policy options involved, and how will they be distributed among various impacted groups?

--Is the technological impact irreversible?

--Is there sufficient available knowledge to assess the technology and its consequences?

--Is the assessment of manageable scope--can it be bounded within reasonable limits?

--What will be the cost of the assessment?

--How much time will be required to do the assessment?

--What is the likelihood of Congressional action in response to the assessment?

The development and performance of each OTA assessment is supervised by a program manager, assisted by other staff professionals with expertise in the subject under study, and by a citizens

advisory committee or panel, comprised of persons directly involved with major aspects of the study. Assessments are carried out by panels of experts, consultants, contractors, OTA staff members or a combination of these resources, as deemed appropriate by the OTA project management team. The approach to a given assessment project can be determined by a variety of ways and may involve exploratory meetings or workshops of advisory panels, staff analyses, and consultant studies.

As the assessment or study proceeds, responsibility for its management remains solely a function of OTA. The resources of the associated advisory committee or panel are utilized throughout the entire project. Members and staff of the interested Congressional committee also are kept informed on a regular basis of the progress and, as appropriate, the preliminary findings of the study. In many instances, such preliminary information assists committee staffs in their legislative analyses and preparations for public hearings.

Completed assessments and studies are transmitted by the OTA Congressional Board to the Committee which requested the project, as well as to other interested committees. The committees of the Congress have first access to OTA assessment results and findings. At the direction of the Board, printing and public dissemination of final OTA reports takes place at the earliest possible date in accordance with arrangements worked out with the requesting committee(s).

Impact of Food Technology on Society

A. The Distribution and Retailing Sectors

Without downgrading its importance, this paper merely notes the fact that technology has played a vital role in increasing production and yield per acre. The focus of this paper is "after production," i.e., the processing, distribution, and retailing sectors of the food system. These three aspects of the food marketing system have not been given the same importance as agricultural production. The importance of these three components must be given more attention, as they are key determining factors in the cost, quality, and safety of food products. It is time to understand the marketing system in its totality, rather than just the system's first link.

The Universal Product Code (UPC) presents a good case study. UPC illustrates the various components of the marketing system making changes to benefit primarily a distinct component--retailers.

UPC is also an example of adverse consumer reaction to a technology development in the supermarket. Consumer opposition to technology developments in the food industry and cooperation among the various industry components are factors which may occur with other technologies. Thus an understanding of the UPC controversy should be a useful guide to the development and introduction of future technologies in the food industry.

We are told that consumers oppose the UPC because the code replaces prices marked on the products. Though prices will be displayed on the shelf, consumers indicate this is not sufficient and will hinder price comparison opportunities. State legislatures and Congress are responding to consumer reaction. Though only 21 test sites across the United States[6/] have begun to implement the UPC and the automatic checkout system on a trial basis, legislation has already been introduced in Congress and state legislatures

which requires that a price be printed on all items in a supermarket. Connecticut and Rhode Island have already passed such laws.[7]

One of the major reasons for installing the UPC is the saving of time and the cost of labor required to stamp prices on all individual items. McKinsey & Company estimates that 25 percent of a supermarket's savings will be lost if every item has to be stamped.[8] If more legislation requiring the stamping of price is passed, the implementation of the UPC and the automatic checkout system, which has been hailed by many as the most important technological development in retailing, may be severely hampered.

While other important advantages do exist in implementing the UPC, such as automatic inventory control and speeding up the checkout procedure, the pricing controversy has many implications. Industry seems to have misjudged the extent of consumer opposition, an aspect of the UPC that industry should have anticipated. Industry's action seems to substantiate consumer charges that the food industry is not interested in consumer concerns.

Though UPC is seen as primarily an aid to retailers, with consumers hopefully benefiting from the costs saved and the reduction of time spent at the checkout counter, other uses of the UPC and checkout mechanization are foreseen. The UPC has the potential to be a unique information gathering device on the eating habits of the American population. Not only will information be gathered on a nationwide basis, but it can also be gathered on the eating habits of socio-economic groups and even possibly individual families.

Why would it be advantageous to acquire information on America's eating habits? It would be an effective way of determining national nutrient intake, which should enable Government food programs to be more effectively planned and evaluated. If more information was available on the eating habits of children of poor families, then school lunch and breakfast programs could be devised to meet specific nutrient needs of the children. Foods which are bought more often than others but which lack certain nutrients could be appropriately fortified. The potential use for UPC may be greater than originally imagined.

These new vistas could easily become a reality with the development of a practical application of the computer technology used in systems analysis and UPC. The social and economic benefits of the UPC might easily exceed the lack of price on items, and this issue might not be worth the delay of implementing the UPC and automatic checkout systems.

The UPC controversy has demonstrated that industry, consumers, and Government tend to react without fully realizing the implication of a new technology. The fault lies in not fully understanding the impact of technology developments on society. Ignorance is the culprit, a charge that has been levied at consumers and Government on more than one occasion.

The UPC has successfully demonstrated, though, that various components within the food marketing system can solve their problems through a cooperative effort. Solutions to other productivity problems within the food industry may require similar ventures. Because the food industry is so integrated, one component of the industry usually needs the compliance of another component in order to implement major changes.

This is particularly true in the distribution aspect of the industry. Distribution requires the cooperation of manufacturers, wholesalers, and retailers in order to produce a more efficient process in the industry.

One of the most striking characteristics of food distribution is the extent of waste and inefficiency. Forty percent of the nation's trucks are traveling empty at one time, and "only 56 percent of all available transportation cubage is utilized." Nearly 90 percent of America's rail cars are out of use.[9] These figures are difficult to appreciate, especially since America knows it cannot afford to be so "fuelish." It is interesting to note that America's food system accounted for 12.8 percent of the total U.S. energy used in 1970.[10] The distribution component is key user.

In the distribution sector, failure to develop needed technology, rather than the impact of technology, is having an adverse effect on society. America can no longer tolerate waste and inefficiency in the distribution of its food. Not only is distribution using up what has become a limited and precious energy source, but also this waste is contributing to the spiraling cost of food, for which the consumer pays, since the food industry passes on its cost.

One of the more wasteful practices in the industry is the lack of backhauling. "Backhauling accounts for only 8 percent of total incoming freight."[11] In this case, the Government is the guilty culprit. The FTC ruled on a General Foods proposal, in a letter dated October 2, 1967, that implementation of this proposal would most likely be a violation of Section 2A of the Robinson-Patman Act.[12] Because of this ruling, very few companies have utilized backhauling. If the FTC opinion is responsible for restricting backhaul practices, then it might be necessary for Congress to revise Section 2A of the Robinson-Patman Act in order to allow a more efficient utilization of trucks on the road. Extensive use of backhauling could most certainly save millions of dollars, not to mention fuel. Some experts estimate that over half a billion dollars could be saved.[13]

The unit train is a concept which can be implemented today. The technology exists, but the railroad companies lack the capital to take the risk in developing the concept. The unit train would cut down the time of travel considerably. A run from northern California to New York could be reduced from 11-21 days to 77 hours.[14] The cost saved in traveling time alone would be considerable; but because the unit train will deal in high volume, the cost charged to the manufacturer would be less per specified item. In addition, unit trains going to the East could return to the West full of items needed on the West Coast. The unit train could develop its own backhauling system, but backhauling does not seem necessary to make the unit train cost effective. One of the few unit trains used in the food industry carries orange juice from Bradenton, Florida to Kearney, New Jersey and makes the return trip empty.[15] While the train is able to leave Bradenton every eight days, the train still remains empty during 50 percent of its traveling time and is able to still be a profitable practice. The unit train will be able to maximize the load while minimizing the energy used and would be competitive to trailer trucks.

Further emphasis should be stressed on using maximum space available in trucks and rail cars. Only 56 percent of available cubic space in trucks is presently being utilized.[16] This waste is caused by the variety of containers being shipped. At the present time,

about 2,500 different shapes and sizes of containers are in use. While one can understand that consumers demand variety in packaging, this fact does not necessarily justify such a variety of shapes and sizes. Containers should be standardized as much as possible in order to maximize the space utilized in trucks and rail cars.

In addition, such standardization will assist in the development of mechanized warehouses. Mechanization would be more likely if the variety of containers were reduced substantially. While some warehouses are being automated, the initial cost is substantial and a deterrent to smaller operations utilizing such technology. In addition to advancing automation of warehouses, standardization of containers would also reduce damage, damage caused by irregular packing due to the variety of sizes and shapes. Waste of space and damage are paid for by the consumer because of inefficiency in distribution.

Some efforts are being made to reduce inefficiency. Due to rising cost, the unsanitary condition which they create, and because the railroads will no longer return them free of charge, pallets are on their way out. The elimination of pallets will produce 10 percent more space in transportation. Pallets are being replaced by investing a few hundred dollars to convert a forklift to clamp or pullpack. It is estimated that the loading or unloading procedure will be reduced from 1/2 day to 1/2 hour. Thus, a considerable amount of time is saved in addition to reducing the amount of time wasted by trucks or rail cars during the loading process. Though only 10 percent of food products are presently loaded by a clamp or pullback, it is estimated that in five years clamps or pullbacks will move 80 percent of food products.[18]

Most of the productivity-increasing technologies benefit the industry directly and consumers only indirectly; these technologies concentrate on reduction of waste and labor. However, developments in the retailing sector, while reducing labor, concentrate on assisting the consumer in his or her shopping.

The first shopping time-saver is the warehouse-to-door shopping. Warehouse-to-door shopping will be made profitable only as a result of "intensive controlled materials-handling systems, computerized order-taking, billing and inventory control, broadband communications (perhaps CATV), and homebased electronic computer terminals."[19] Present warehouse-to-door shopping systems have orders called in over the telephone with human operators taking the call and punching the order into the computer, where another person retrieves the order from the computer to pick out the items.[20] Future systems would replace the operator and picker with mechanization which has yet to be economically developed. However, "a computer-controlled, single unit order selection system is certainly achievable with present technology."[21] A warehouse-to-door system would save considerable energy by eliminating consumer pickup of food. The order would be delivered to the house and would eliminate the supermarket as the halfway point between the consumer and the warehouse.

Such a system would have a ready-made clientele of people who are dissatisfied with the present supermarket system. They are young mothers with preschool-age children, families in which husbands and wives both work, families in which the nonworking homemaker prefers to devote her time to volunteer projects and community activities, and the elderly and the handicapped.[22] The size of this clientele

is considerable and one which could be easily convinced of the warehouse-to-door system.

An extension of this convenience is the development of the fully automated supermarket. While there are many variations for such a system, one of the most feasible is the fully automated store which carries only 100 to 150 items in an area where a need is established. Elderly housing projects is an excellent example because such a store would be a convenience to such a group.[23] Because the number of products would be limited, such a store would be stocked to meet the needs and eating habits of this particular age group. This type of consideration may increase the chance for acceptance of an automated store.

"Assessment of current technology indicates there are no fundamental inventions needed in order to achieve full-scale automated shopping systems. A new systhesis of existing technology from a complete systems viewpoint is needed, however."[24] Application of this current technology is an excellent example of the food industry meeting the needs of its clientele while still being able to reduce its labor costs, as opposed to technology developments in the distribution process within the industry.

As has been demonstrated in this discussion of technology development in distribution and retailing practices in the food industry, cooperation of the various marketing components in the industry is necessary to effectively utilize technology in order to improve productivity. Standardizing containers requires cooperation among manufacturers, wholesalers, and retailers, all of whom are concerned with either packaging or distributing, if not both, food products. All three must agree on the types of containers to be fully utilized. The food marketing system is integrated too heavily to allow individual components to utilize technology without affecting other components. In many cases, either all affected components utilize current technology, or none of them can.

It must be recognized that much of the technology discussed here is directed towards replacing or reducing labor. Installing technology to improve efficiency in the industry is commendable. However, it must be recognized that people will be out of jobs, replaced by machines. At a time when this country has high unemployment, with little reduction in sight over the next few years, both management and labor must be concerned with the future job opportunities of people who are replaced by technology.

The food industry has an obligation to improve its efficiency and reduce waste. The food industry can no longer allow over 40 percent of its truckers to travel empty and to allow rail cars to be underutilized. Such practices not only affect the increased cost of food, but they also drain our nation's energy resources. These conditions have an adverse effect on America's economy and our nation's well-being.

B. Quality of Food

More and more of America's food is becoming processed. Nearly one half of the food dollar is spent on processed foods. Dr. Alexander Schmidt, Commissioner of the Food and Drug Administration, estimates that "by 1980 probably two thirds of the meals in this country will be previously prepared out of the home..."[25]

There are numerous factors that affect our health. Food must be considered a prominent item. Thus this

increasing use of processed foods must come under close scrutiny.

Canning, freezing, fabrication, convenience, fortified, and dehydrated are methods for processing foods. Processed foods save time in home preparation and reduce waste by limiting spoilage and increasing the storage period. Productivity of the manufacturers is improved by reducing spoilage, and more food is available for consumption. Though the world food situation is in a precarious position, the World Health Organization estimates that about 20 percent of the world's food supply is lost through spoilage,[26] a loss which cannot be tolerated, obviously, spoilage is more of a problem in the underdeveloped countries than in developed ones.

Some methods rely primarily on the processing technique, such as freezing, to reduce spoilage, while others depend on additives.

A major issue the food industry must address is whether to improve processing techniques or continue to utilize additives. Both alternatives have negative factors. Though processors are likely to improve the efficiency of their processing techniques, increased processing of food will require further energy consumption, which no doubt will raise the cost of food. The adverse effects on both the economy and America's attempt to reduce consumption of fossil fuel are evident.

However, further utilization of food additives, which decrease the need for processing food, may save fuel. Food additives, however, are under public scrutiny. Books such as Turner's "Chemical Feast," Hall's "Food for Naught," and Hightower's "Eat Your Heart Out," are critical of the food industry and the food additives they use. These books imply that the food Americans eat is either detrimental to health or supplies little or no value to the human body. While industry is critical of such books, they have wide ripple effects throughout America, so that today industry faces increasing pressure from both the public and the Government concerning the use of food additives.

One of the more recent controversies involving food additives is the relation between human behavioral problems and food additives. Synthetic colors and flavors, which "constitute about 80 percent of all additives incorporated into our foods,"[27] have been linked with hyperkinetic children. Hyperkinesis has been rising over the past few decades, as has the increased use of food additives. This, coupled with the fact that 50-60 percent of all cases of hyperkinesis have been cured through proper dietary management in five separate studies[28] points to a possible correlation between food additives and hyperkinesis. I should emphasize that the correlation between food additives and hyperkinesis has not been proven. Hyperkinesis has become a serious problem involving several million American children, and one which must be dealt with accordingly. Synthetic colors and flavors have no nutritional value. Their purpose is to improve food's physical appearance and taste. The short-term solution has been to develop diets for children suffering from hyperkinesis. This solution allows synthetic colors and flavors to be used in our foods, but long-term solutions which will benefit more children might require more drastic actions which will affect the practices of the food industry.

Another area which food additives concern themselves with is the development of fabricated foods. Fabricated foods are "foods that have been taken apart and put together in a new form,

designed, engineered, or formulated from ingredients. They may or may not include additives, vitamins, and minerals."[29] In many cases, food additives are used in fabricated foods and are necessary in the development of the new product. This is especially important, since fabricated foods account for 6.5 percent of total food sales and they are estimated to rise to 8 percent by 1980. Total sales are expected to increase from $13 billion in 1972 to $23 billion in 1980.[30] The convenience that fabricated foods provide has been increasingly accepted by the American consumer; i.e., margarine has over 66 percent of the tablespread market, and nondairy whipped topping has 50 percent of the market.[31]

What are the implications of the fabricated food market? One major implication, which is increasingly becoming the problem for all processed foods also, is the dependence of manufacturers on RDA's for providing the nutrient quality of processed foods. Fortification is widely used in processed foods for a variety of reasons. Many raw products lose some of their nutrients after being processed, and, in order to replace lost nutrients, processors fortify the processed products. A fabricated food such as Breakfast Squares is a product developed for convenience as a replacement for what was once a typical breakfast. In this case, the manufacturer has printed on its label that "two bars (one serving) give you as much protein, basic vitamins and minerals, and total food energy as one slice of bacon, one medium egg, one slice of buttered toast, and a half cup of blueberries." The basic vitamins and minerals which the statement refers to are those vitamins and minerals of the U.S. Recommended Daily Allowances (USRDA).

This concern for a product's nutrient value is good. However, the questionable usage and interpretation of the USRDA's may be invalid and a disservice to the American consumer by having such a heavy reliance on USRDA's. Industry is not at fault here. It is working with the only nutrient labeling system available to it; a system provided by the Federal Government. USRDA's, while providing a measurement of nutrients, does not measure all the basic essential nutrients. It is estimated that there are at least 43 basic nutrients essential for proper human development.[32] America's increasing dependence on processed foods, coupled with a strong reliance on USRDA's might very well lead to an unconscious effort to diminish the nutrient intake of Americans. While better nutritional analysis and information is needed with regards to the nutrient needs of humans and nutrients within available food, the food industry must be aware that processed foods, particularly fabricated foods, might be lacking the necessary nutrients for human consumption. Though Breakfast Squares are equal to or greater than a balanced breakfast of an egg, toast, and bacon, Breakfast Squares might very well be void of all other essential nutrients such as trace elements which an egg, toast, and bacon provide.

Fiber's newly postulated importance in food has generated considerable discussion. If the issue is ever resolved in favor of fiber's importance, then USRDA might have to be revised to include fiber, and processing techniques will have to be modified to insure fiber content in the food product. As our capacity to analyze and measure the various nutrients in foods improves, the Federal Government will no doubt have to revise USRDA's accordingly. Such a revision will provide the American consumer with the needed nutrient information and help insure that the food industry provides the American consumer the necessary nutrients in food. This

becomes increasingly important as fabricated foods become more and more a part of our food system.

Another implication of fabricated foods in their reliance on ingredients which are on FDA's GRAS list. GRAS is the abbreviation for "generally recognized as safe." Those ingredients on the list are not regulated like other food additives. GRAS items make the list on the basis of supportive literature and/or time-proven safety. The list was put together in 1958 and for years items on the GRAS list were freely used. On October 18, 1969, the artificial sweetener, cyclamate, was removed from the GRAS list by the Secretary of HEW because cyclamates caused cancer in tests. Not only was cyclamate removed from the GRAS list, but it was also banned from all food destined for human consumption. Under the Delaney Amendment, any substance which caused cancer in any animal under any dosage must be banned from human consumption. Until 1969, cyclamates were used extensively in diet foods. Removal of a substance from the GRAS list has serious implications for both the food industry and the American consumer. Presently, the FDA is administrating a general review of all substances on the GRAS list, to be completed by 1979.

The GRAS list is mentioned here as an example of the magnitude of the problem which faces both industry and the Federal Government in insuring the safety of food consumed. Not all substances which met the requirements for the GRAS list in 1958 met the requirements in 1970. Cyclamates are only one example, but this example demonstrates that as our scientific capabilities of chemical analysis improves, substances which were once proven safe will be questioned.

A law, regardless of whether it is right or wrong, such as the Delaney Amendment, makes decisions by the FDA quite clear cut, and avoids any discussion or decision which weighs the risks of a substance with the benefits. DES, which was banned because it was carcinogenic in animals, was detected in an animal's liver at a concentration of between 40 and 120 parts per trillion in about 5 percent of the animals that used DES. DES, however, is still used in medication, particularly in the morning-after pill, which contains 50 mg. of DES. It is estimated that taking 1 mg. per day in medication is equivalent to eating 20,000 pounds of liver per day containing 100 parts per trillion of DES.[33] Couple this fact with the estimate that with the banning of DES in animal feed, an additional 30 days and 500 pounds of feed is now needed to produce a 1,000 pound steer.[34] If the decision was based on weighing the risks versus the benefits, some feel it is unlikely that DES would be banned in animal feed.

Obviously, DES and cyclamates are just two examples of substances which have had considerable impact on our food supply. The benefit was not considered in the discussion, only the risk. It is likely, though, with increasing public concern with the safety of food coupled with improved scientific analysis techniques, that further food additives and substances on the GRAS list will be banned from our food supply because of their potential or actual safety hazards. No doubt some of these banned substances will have considerable value in our food system, and removal of these substances will adversely affect processing practices.

Scientists in the future might be able to determine definitively what amount of a substance that produces a harmful chemical will be safe for human consumption because of the minute parts detected, and policy makers in

FDA could base their decision on both risks and benefits. Other problems evolve with the fact that certain substances reacting with other substances in a food product or in the human system could produce a dangerous substance. The variables seem to be unlimited, and effective solutions doubtful.

It is unlikely that our food supply could ever be 100 percent safe, even if all food additives were eliminated. All foods, be they natural or processed, are chemical compounds, and some so-called natural foods have also had adverse effects on people. Most people are probably unaware of these facts.

The safety of a food product's ingredients and the nutrient value of the product are two major concerns of food processors in their attempt to provide Americans with the best quality food available. Accomplishing this is a sound business practice. It also insures the health of American people. Since processed food dominates our food supply, the food industry is obligated to insure its safety and nutrient quality to the best of the industry's ability. The Federal Government must monitor their actions.

C. Findings and Conclusions

The lack of research in the food sector, either by the industry or the Federal Government, is quite obvious. A study conducted by the Industry Studies Group of the National Science Foundation revealed that the top 5 industries accounted for 80 percent of the total industrial research and development funds. The food industry, though recognized as the largest industry in the United States, is not in the top 5. In fact, it is way down the list.[35] An examination of Federal allocation for R&D shows agriculture receiving in excess of $400 million.[36] USDA-State systems spent $800 million on agricultural research, with the Federal Government accounting for nearly 60 percent of this sum.[37] Four hundred million plus is paltry compared to the $10 billion spent on defense R&D by the Federal Government, but further examination of the $400 million plus reveals that most, if not all, is allocated to food production. The rest of the food industry receives little or no assistance. The FDA allocated $4,274,000 in research of food additives and GRAS review. The GRAS review received $2,300,000, or nearly 54 percent of the research funds. The Federal Government spends 100 times more on research for food production than on research which attempts to insure the quality and safety of food consumed.

The state of R&D in the food industry, excluding agriculture, is bad. The result is wasteful practices in distribution, processing, and retailing at a time when this country cannot afford waste, particularly in energy. Consumers have to pay the steadily increasing cost of food, not because of the rising cost of raw produce but rather because the costs between the farm and the consumer have risen so much. A considerable amount of this cost might be eliminated by research aimed at technology development in distribution, processing, and retailing. More efficient practices are needed. Some see technology development as the answer. They feel that the Federal Government should consider allocating funds for additional research in the areas of processing, distribution, and retailing. Others feel that incentives are needed for industry to commit its capital for more research. Both industry and the Federal Government must be committed to improving the practices of the food industry through technology.

Food Additives

The controversy of food additives has consumers up in arms and industry running scared. With the banning of cyclamate from the GRAS list and from human consumption, consumers are becoming more and more aware and concerned about the composition of their food. Industry, on the other hand, fears further regulations that will restrict them in their practices and increase costs. The present situation regarding food additives seems to benefit neither industry nor consumer, but not in the way consumers and industry view it.

With our present abilities to detect a substance at parts per trillion and with anticipated capabilities assured to improve, regulations such as the Delaney Amendment may require new assessments. The argument that consuming a product which retains a substance of an amount in parts per trillion is safe seems to have considerable validity. As our techniques of detection improve, this development would dictate research which would be able to determine how much of a substance is safe. To do otherwise could very well eliminate many, if not all, food additives.

A labeling system similar to cigarette packages has been suggested for food products using food additives whose consumption might be hazardous, but whose benefits are great and which do not justify being banned for a possible risk.[38] Can we let the people decide what risks they wish to take? Should the individual evaluate the risk and benefits? If so, what information is required?

The Role of the Federal Government

What should the role of the Federal Government be with regards to the practices and technology development of the food industry? The answer to this question will strongly affect the technological development of the food industry. Many of the industry representatives spoken to have indicated that the food industry has spent more time and money in responding to and abiding by Federal regulations than on research and development. This represents a defensive attitude, but if such is the case, then it appears that Federal regulations have become a significant hinderance to food technology development.

What about the need for the various components within the industry to work together for developing and implementing technology? What if the industry decides to standardize its shipping containers, which could affect the variety of packaging sizes at the store and by this action reduce the number of sizes which consumers can choose from? Would the industry be open to charges by the FTC of collusion? If so, would the industry take the risk? Not likely! Food industry officials seem to be running scared. The industry seems to fear the Federal Government and the attention and influence of self-appointed, articulate consumer advocates.

The Federal Government is in a unique situation to provide a forum for both industry and consumer concerns. While Federal regulations will always be present, it is possible for these regulations to be based on fact, not emotionalism or industry pressure. The Government can be a clearinghouse for information and weigh the evidence objectively. The government can also bring the two opposing parties, consumers and industry, together in order to make each other aware of the other's problem. The Government could play

the role of an ombudsman where each side can be assured that they will receive a fair hearing and be satisfied with the decision made. None of these characteristics exist in any degree of satisfaction.

The Government must do its part to calm industry fears while at the same time reassuring consumers and reminding industry that the Government will not tolerate or defend practices which abuse consumers. The Government, most likely, will be damned if it does and damned if it doesn't, but it is essential that the Government be viewed as fair in its decisions by all interested parties. Regulations, or lack of regulations, should not be viewed as punishing one group of society while defending another, but rather regulations should be seen as the best solution to a problem which affects society.

Future

The food industry will have to devote more money and time on research and implementation of technology. There is very little choice left. At the same time, the industry must be aware of the impact of technology on society. The fact that the developers of UPC did not anticipate consumer opposition is a case in point. Most technology developments will affect people in some form or another, and industry would reduce much of its problems by incorporating technology impact studies before installing technology improvements. Coupling this concern with fully informing the public of technology and its impact might pave a smoother road for the implementation of technology in the food industry.

Technology can be man's savior, as long as its users are aware of technology's impact on society and they remember that technology exists for the benefit of society.

FOOTNOTES

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