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Research for Small Farms

Proceedings of the Special Symposium

Howard W. Kerr, Jr., and Lloyd Knutson, Editors

Invited papers presented at a symposium held November 15-18, 1981, at the Beltsville Agricultural Research Center, Beltsville, Maryland 20705

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THIS SPECIAL SYMPOSIUM PROVIDED....

"Papers, then Q&A, then meeting and mingling." B.P. (NJ)

"Presentations of new, practical ideas about approaches to small-scale agriculture." M.M. (AR)

"Finding the void that's affecting the progress of small farms." W.K. (MD)

"A broad-cross-sectional view of the problems of small-scale agriculture." E.J. (NH)

"Generally, that attention is being paid to small farmers in today's changing world." J.S. (PA)

"Opportunity to meet a broad spectrum of people who are deeply concerned with the future." S.S. (MA)

"Exchange of information, quality of speakers." D.R. (Canada)

"The recognition of the small farmer as well as the hope it generated for the chance that its existence and productivity can further be studied and enhanced in the future." F.B. (MD)

"Overview of problems and real lack of progress across the country." D.F. (DE)

"The symposium has stimulated possibilities for my own farm and given me information for the Environmental Board." W.J. (VT)

"What small farms need to examine in terms of production - Crops that make the small farmer money." C.M. (PA)

"Opportunity to meet others with some or similar interests and goals; exchange of current information." G.C. (FL)

"Talking to other individuals attending, looking for solutions to their problems." M.H. (ND)

"Actual examples of innovative farming experiences outside of USDA." G.N. (DC)

"Meeting people and thereby gleaming ideas." R.T. (MD)

"Overview of thinking and plans regarding small farms research." D.L. (VA)

"The exposure to many ideas and the opportunity to meet and talk with farmers, researchers, etc." P.M. (NJ)

"Talking with people about the problems of small farms, the potentials and desirability of small farms." S.G. (NY)

"New information of use in small farming; reports on current research in progress; new ideas." V.D. (NY)

AND IN ADDITION....

"Small farmers do exist, have needs, hope for help and information may be forthcoming." W.K. (MD)

"I question the concept that agricultural research is size neutral. The fact that this Symposium was held is significant recognition of new trends. It was very helpful to me in gaining background in agricultural issues that I was formally trained in." E.L. (ME)

"I was impressed by the congeniality of all the participants. No cold shoulders. The mixing of farmers with scientists was appreciated." N.M. (MD)

"....the Symposium was beautifully organized and an important gathering in the on-going effort to accomplish something of lasting significance." S.S. (MA)

"Scientists at USDA must review their findings with Extension personnel to make them more rapidly available to and easily understood by their ostensible recipients." W.L. (NY)

"I think that food pressures in the coming decades will require that we begin producing crops on all available land, much of which may be marginal for large scale farming, but which can be handled carefully and made productive on a small scale. But we all are going to need much more help from USDA to accomplish this. Let's get going!" A.L. (ME)

"It gave me an overall understanding of the small farmer and the problems he faces." R.W. (MN)

"Sensitization of a non-farmer like myself to realistic knowledge of small farms problems; needs, especially information dissemination to farmers." V.D. (VA)

"A wide variety of topics - the brevity was excellent yet presentations were very good." M.M. (KS)

"You need more farmer input." L.H. (CA)

"Needed greater participation by small farmers, so communication can go two ways." J.C. (VT)

"Research data is fine if it's used. Research people need to get out and apply the needed technology in the area of small farms. New England States have lost a large portion of their agricultural land, they are now very aware of their situation. Let's not make the same mistake in Maryland, as well as the rest of the Northeast." F.B. (MD)

"More opportunity than I expected for organic farming methods to be recommended." J.T. (NJ)

"A valuable conference - should have others on small farms." C.S. (PA)

APPLICATION OF NEW PROCESSING TECHNOLOGY TO SMALL FARMS

Donald D. Bills[1/]

ABSTRACT

Work at the Eastern Regional Research Center has developed, over the years, a number of processing technologies of considerable value to small-scale producers of honey, cider, and maple sirup. Current work on plant materials includes the development of appropriate technologies for the small-scale handling and processing of fruits and vegetables, including edible sprouts. There are opportunities in small-scale processing for the family-size work unit, but a collective approach permits broader options. New, large-scale technologies have been developed, and some of these can be adapted to serve the needs of small farm operations. The products of small-scale manufacturers are most likely to succeed in the marketplace if the products project an image of "old-fashioned, farm-fresh" goodness combined with convenience. Competition with large food processing firms generally should be avoided by concentrating on items, such as regional or ethnic foods, that have a strong but geographically limited market and are of little interest to large companies.

Keywords: Food processing, small-scale farms, technology, appropriate technology, processing opportunities, collective approach, marketing.

[1/]Chief, Plant Science Laboratory, Eastern Regional Research Center, Northeastern Region, Agricultural Research Service, U.S. Department of Agriculture, Philadelphia, Pennsylvania 19118.

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RESEARCH AT THE EASTERN REGIONAL RESEARCH CENTER

The potential economic benefits from involvement in processing operations are substantial. Only forty cents, on the average, of the consumer's food dollar goes to the farmer to pay for the raw commodities. The remaining sixty cents represents the value added to the food by processing, transportation, handling, and merchandising plus profit for each of the intermediaries between the farm gate and the consumer. For many processed foods, the value added after leaving the farm is much greater than the average. Roadside stands, pick-your-own operations, and farmer's markets shortcut ordinary marketing channels and yield a higher return to the farmer, but these outlets handle largely fresh, perishable produce, are seasonal and may require an inordinate amount of time to conduct the retail aspects. Small-scale processing provides an opportunity to market farm produce in other forms that can be even more profitable.

Work over the years at the Eastern Regional Research Center has yielded many new processing technologies that are of considerable value to operators of small farms. Although maple research is no longer active, new procedures for efficiently collecting and processing maple sap into sirup and other maple products were developed at ERRC--among them, methods for producing high-flavored, premium sirup; preventing the spoilage of sap through pasteurization with ultraviolet light or by chemical treatment; and removing the "buddy" off-flavor from sirup--as summarized in a USDA Handbook (12). Procedures for extending the shelf-life of fresh apple cider through pasteurization and/or the incorporation of sodium sorbate, a harmless food additive, were developed (3), and numerous requests are received for plans for the construction of a simple cider pasteurizer that can be assembled with a 55 gallon drum, aluminum tubing, and other parts from the hardware store. At a cost of slightly over $200, the homemade cider pasteurizer is an outstanding example of a piece of processing equipment that truly fits the needs and pocketbook of the individual small farm operator. Research on honey also has benefitted the many beekeepers in the United States, many of whom are operators of small farms and some of whom do their own processing and packaging of honey.

Currently, work at ERRC is being conducted to develop appropriate technologies for the small-scale processing of fruits and vegetables. One aspect of the work involves the development of a method that can be applied by the individual small farm operator for the production of cider-vinegar. Vinegar can be made from cull apples and also can be made from excess cider. The technology for large-scale vinegar production has made considerable progress, but the methods require scaling-down for small farm use. One of the problems involved in small-scale vinegar production is to develop an efficient, inexpensive, and low-energy-consuming means of aeration for the fermentation that forms acetic acid. A second problem involves the selection of a strain of yeast for the primary fermentation to form alcohol and a strain of the acetic acid-producing bacteria for the secondary fermentation of alcohol to acetic acid. Production of vinegar on a small-scale is nothing new, but it is not practiced to any extent anymore. There is an excellent possibility for the introduction of new technologies and microorganisms that are used by the large-scale, commercial industry.

Another line of research involves partial processing of products sold at farm stands or farmer's markets. The objective is to transform the raw products into a form more convenient for the consumer. For example, apples for use in pies or sauce could be peeled, cored, and sliced at the time of sale. Such partially-processed material must be stable enough to remain relatively unchanged until it is prepared in the home. In the case of apples, which begin to brown and deteriorate immediately after peeling, we have developed a treatment with common food additives that retards the deterioration of apple slices for several hours and results in pies that are equal to, if not superior, to those made from freshly prepared fruit. The market for fruits and vegetables that are partially processed at the point of sale for later preparation in the home is unknown, because consumers have never had this option. In view of the importance of convenience foods in supermarket sales, partial processing may have promise.

Information on recipes for canned foods comprising mixtures of low acid and high acid ingredients has been compiled in a data bank. From the statistical analysis of data obtained from determination of the pH of representative products, the pH of products containing various proportions of common ingredients now can be predicted. This capability enables the prediction of thermal processing procedures (boiling water temperature vs pressure canning) without actually formulating a product and measuring its pH, but does not replace the conventional means of physically determining pH and thermal processing parameters.

A final area of research involves the determination of appropriate small-scale conditions for producing edible sprouts. While the sprouts of seeds such as mung bean, soybean, and alfalfa are not traditionally produced by farmers, sprouts have a good and increasing market in restaurants, health food stores, and supermarkets, and there is no reason why some operators of small farms could not become involved in this endeavor. In addition to producing sprouts, operators of small farms also might consider producing seeds for sprouting in the home; bean seeds for sprouting sell at up to five times the price of dried beans for cooking.

TECHNICAL OBJECTIVES OF FOOD PROCESSING

The grand objective of food processing, like any other manufacturing industry, is to profit from the assembly and manipulation of raw materials. The technical objectives of food processing require some description here, however, since they are mainly quite different from those of most other industries. Food processing involves the manipulation of raw commodities to achieve one or more of three technical objectives: to assure the safety of the product, to change the form of the raw materials or to retard spoilage. Many foods

are processed to achieve all three objectives in a single product. Processing operations range from the simplicity of washing raw potatoes before they are displayed for sale to the complexity of processing and bringing together the many ingredients in a package of cake mix. The first example involves just a minor change of form, from dirty to clean, but the second example involves processing to assure safety, to drastically alter the form of the raw materials, and to provide a product that will remain stable for many months on the shelf.

Pasteurization of dairy products is an example of a processing operation aimed primarily at assuring the safety of the products. Before the introduction of pasteurization, frequent outbreaks of milk-borne diseases were common. The number of people involved in an outbreak was small when families kept a single cow or a few cows to supply their own needs and, perhaps, to sell small amounts of milk to nearby neighbors. With the introduction of large-scale distribution procedures, several thousand persons became susceptible to contracting brucellosis from the consumption of raw milk from a single infected cow when that cow's milk was intermixed with the rest of the milk supply. The relatively mild heat treatment of pasteurization was introduced to assure that Brucella abortus (the bacterium responsible for the infection called brucellosis) and several other disease-causing microorganisms are totally destroyed before dairy products are consumed. Since pasteurization also destroys over 99% of the population of bacteria that cause the spoilage of raw milk, the shelf-life of properly-refrigerated pasteurized milk is extended by two weeks or more over that of raw milk. The extended shelf life is advantageous to distributors and consumers alike, but the primary objective of pasteurization is clearly safety.

Even when safety is not the primary objective of a food processing operation, it remains the single most important aspect of a processed food from the legal standpoint. An overwhelming portion of the body of food laws and enforcement activities deals with food safety, and the conditions for handling and processing food are stipulated rather rigidly by local, state, and federal governments. In considering how processing technologies can be adapted to benefit the operators of small farms, the legal requirements for equipment and facilities for handling and processing food for sale to the public are critical.

Changing the form of a raw food material is an outstanding way to add value through processing. There is hardly a way to improve the form of a juicy, dead-ripe peach--most of us would prefer to eat it out of hand or minimally process it by peeling, slicing, and serving with sugar and cream--but even this desirable fruit is consumed in many other forms, such as peach cobbler, jam, and as an ingredient in ice cream. Some unprocessed commodities have little value to the consumer--there is essentially no consumer market for wheat in the United States until it has been processed into flour, and flour sales to consumers are small compared to products that involve further processing such as pasta, baked goods, and cake mixes. Processing to change the form of raw materials must result in products that appeal to the consumer from the standpoints of appearance, flavor, convenience, and cost. Consumers also are influenced by nutritional quality and less tangible aspects, such as the "naturalness" of the food, the package, and advertising. The concept of making a food more convenient through processing operations conducted outside of the home or family unit is hardly new--millers have been grinding grains into flour or meal since antiquity--but the availability of a wide variety of foods that are ready to heat and serve is a relatively new concept. The U.S. potato industry, for example, has developed a wide array of convenience products--nearly 60% of the U.S. potato crop is converted into processed forms ranging from instant mashed potatoes to precooked French fries (5). The introduction of new technologies coupled with the changing lifestyles and perceptions of consumers has made possible the profitable marketing of highly-processed and, consequently, expensive and profitable convenience foods.

Processing to retard spoilage permits foods to be consumed at a later date and frequently at a distance from the point of production. Dehydro chilling of raw fruits and vegetables is a process aimed at delaying spoilage by a few days. Processes, such as freezing, that delay spoilage for many months or even years are called preservation. Foods are spoiled by the growth of bacteria, fungi and yeasts as well as by various chemical changes and mechanical damage. Because many chemical mechanisms of food spoilage require the presence of oxygen, exclusion of this gas or the addition of antioxidants is often part of the preservation process for certain products. Some chemical processes are promoted by enzymes that are naturally present in all raw food commodities, so preservation usually involves procedures that inactivate or retard the action of enzymes.

Although remarkable advances have been made in the technology of food preservation, no new basic principle for food preservation has been commercialized since 1810 when Appert published his treatise on canning (1,2). Drying, smoking, salting, pickling, fermenting, and chilling or freezing are ancient methods of food preservation that have been practiced since prehistoric times. All of these preservation procedures, including canning, originally were carried out without benefit of an understanding of why they worked. Only since 1864, when Louis Pasteur gave his report on microorganisms before the French Academy, has a systematic, though still incomplete, understanding of the scientific basis for food preservation been developed. In part because of the systemization of knowledge and in part due to other advances, great technical changes and improvements have been made in the application of the old methods of food preservation--for example, consider the impact of mechanical refrigeration vs the use of ice on the storage and movement of refrigerated foods in commerce. In determining how processing may contribute to the economic benefit of small farms, a prime consideration and researchable area is the scaling-down of

sophisticated and complex technical processes for application by less centralized operations that may need to use more labor and less energy and machinery.

FAMILY-SIZE OPERATIONS

In considering operations that could be applied by an individual or a family-size work unit, there are three primary considerations: the cost of the processing equipment must be low, with the return equalling the investment in a very short period of time; operations and products must meet the minimum public health requirements; and there must be a reasonably predictable market for the products. These considerations restrict the range of possibilities for the individual small farm operator, since the equipment and facilities needed to comply with minimum legal requirements for many products are costly.

The processing of foods for sale by the individual small farm unit must be kept simple, and care must be taken to assure that the facilities, products, and licensing conform to local and state codes. If any of the product is to cross state lines, it also will fall under the jurisdiction of federal regulatory agencies. With a minimal, suitably equipped room, a small farm operator can consider, for example, processing operations that involve washing, sorting, and packaging fresh produce for sale to restaurants or retail outlets. Shelling and packaging dried beans, nuts, or sunflower seeds represents an opportunity for those who have an outlet in a farm market or can develop sales to retailers. The market for so-called health foods, natural foods, and organic foods may provide an outlet for dried seeds and nuts, especially if the farmer is willing to produce these "organically" without the use of pesticides and synthetic fertilizer. With a somewhat greater investment in equipment and facilities, the individual might consider a small milling operation to prepare specialty flours and meals for the health food trade. The production, processing, and packaging of honey is entirely possible for the individual entrepreneur and may provide income through the rental of beehives for pollination (in some areas) and the sale of honey. A USDA publication on beekeeping is available (11).

Fresh cider can be produced by orchardists without an extensive investment in equipment and facilities. Cull apples that are of little value can be transformed into thick, brown nectar that sells well in the autumn. Refrigeration is a necessity, though, because of the perishable nature of the product. A market for other fresh unclarified juices such as pear "cider" could be developed.

Many other possibilities for food processing operations of a scope similar to the above are within the reach of individual operators. The ambitious family might even consider marketing at least some of their farm production in the most highly processed form of all--the complete meal. The two most important requirements for opening a restaurant are a supply of good fresh food and culinary skill, and both are usually available on the farm. In Pennsylvania, many Philadelphians drive 50 or 60 miles to sample authentic Pennsylvania Dutch cooking in Lancaster County. Many of these restaurants had humble beginnings in a family operation. In Georgia, one successful country restaurant serves only catfish reared in a farm pond, hushpuppies, and French fried potatoes. The capitalization for even a modest restaurant is high, but the returns can be good. A location near a well-travelled highway or in a small town probably is necessary to succeed.

In addition to considering commercial operations, preservation of farm-produced food for consumption by the farm family deserves mentioning here. Home canning of even low-acid foods (e.g., corn, green beans, peppers, meat, and poultry) can be carried out in an inexpensive pressure cooker in the farm kitchen whereas a commercial operation legally would require an expensive retort equipped to monitor and record times and temperatures, a licensed operator, and other expensive equipment and facilities. With increasing food costs, the capability of producing and preserving much of their own food may be the most immediate way for families who live on small farms to improve their standards of living. Obviously many families do preserve food for their own use, but surveys indicate that considerable spoilage occurs due to the use of inadequate methods and that risk of botulism from the consumption of low-acid, home canned foods still stems from canning such foods in a boiling water bath, although this is a completely unacceptable and nonrecommended procedure. Educational efforts need to be directed to those who could benefit from an improved understanding of the procedures and scope of possibilities for preserving foods in the home. A number of USDA publications provide explicit instructions for canning, pickling, preserving, and drying foods for home consumption (6-10). Processing equipment of a scale between kitchen and commercial use for canning and making jams and jellies can be purchased by community groups. Such equipment can serve the collective needs of several dozen families in preserving food for their own use, but does not have the necessary features for processing food for sale to others.

COOPERATIVE PROCESSING

In order to afford to enter into more sophisticated food processing opportunities, operators of small farms need to develop cooperative or community enterprises. The concept of cooperative processing and distribution, wherein farm producers share in the profits (or losses), is hardly new. The history of dairying in the United States involves the formation of numerous large and small cooperatives (some of which remain successfully in business today) that took on the responsibility of receiving milk from the farmer members, transforming it into various products and distributing the products for sale. Obtaining sufficient capital to buy necessary equipment and facilities is a problem in these days of high interest rates, and it is absolutely essential to establish that there will be a reasonable market for products before any such business venture is undertaken. The

shelves of retail food stores are full--any new brand or product line can be displayed only by displacing an item that is already on the shelves, and retailers are reluctant to stock too many brands of similar products. In order to gain entry, a new manufacturer's product must have uniqueness or cost and quality features that are highly appealing--retailers will not stock items that gather dust.

The most probable route to success for new cooperative ventures in food processing may well involve very small initial operations that manufacture high-quality foods that project an image of "down-on-the-farm" goodness. The initial outlets for the products may be limited to retail sales at the manufacturing facility itself, if it is well-located, and to retail outlets other than chain stores. In order to maximize return on the investment, the processing facility must be operated as many months of the year as possible. Obviously, the seasonality and perishability of the raw materials to be processed will control the length of the processing season. Meats, poultry, and milk are available in the fresh form throughout the year. Nuts, seeds, and grains are harvested during a short period, but after drying require no refrigeration and can form the basis for operations that extend throughout the year. Economical processing of fruits and vegetables usually requires the handling of several seasonal crops in a series, but a few crops such as potatoes, onions, and apples can be stored and processed over a period of many months. Some pickling operations are extended throughout the year by quickly brining the crop as it is harvested and then withdrawing the materials from brine for further processing as needed. Very few processing operations can be expected to function economically based on a single, highly perishable fruit or vegetable with a short harvest season. Refrigeration or freezing as a means of storing raw materials for later processing is costly and not applicable to many fruit and vegetable products that cannot tolerate the changes in texture caused by freezing. These limitations suggest that certain commodities may have great advantages over others in determining whether a profit can be made from small-scale, cooperative processing.

MARKETING OPPORTUNITIES

The best food products for introduction into the marketplace by small-scale industries may well be those that have a limited market. This sounds contradictory, but large companies cannot afford to diversify their production lines to manufacture a myriad of low-volume products. Regional and ethnic foods that might sell well in a very limited geographical area are of little interest to the large processor. According to David Robinette, president of Del Monte Sales Company, the U.S. canning industry is already scaled-up to operate at a capacity greater than needed (4). Consequently, a potential new small-scale processor should not consider canning sweet corn, for example, since this market is saturated by several highly-competitive giants of the food processing industry who depend on sheer volume rather than a large profit per case to stay in business. On the other hand, a good market has been developed by some very small, regional processors for products such as sausage and cured meats, ethnic foods, pickles, preserves, and specialty cheeses. In the northeastern United States, the maple industry, which is composed of many small-scale operators, continues to thrive despite outdated processing equipment and extremely high prices for maple sirup. In effect, there is a consumer demand for "old-fashioned" yet convenient products--many of which can be produced by 1981 technology.

It is not possible to recommend exact products that potential small-scale processors should consider. Opportunities will vary according to the raw materials that can be produced locally and the numbers and types of consumers near a given location. Proximity to an urban center provides better opportunities for sales through "health food" stores, restaurants, and farm markets than an isolated rural location. Any group considering entry into small-scale processing should consider test marketing a potential product before any attempt is made to raise capital for the purchase of equipment and facilities. This will require that some of the product be prepared to specifications by a custom processor at another location, and the processing, labeling, handling, and product must conform to all legal requirements. Test marketing will require a cash outlay, but it is preferable to sacrifice the cost of an unsuccessful test market trial than the capital involved in establishing a processing operation that ends in failure.

Consultation in the early stages of planning a small-scale processing operation is highly desirable and should begin at the time feasibility is being considered. Extension Specialists in Food Science at Land Grant Universities may be able to offer substantial assistance to potential small-scale food processors. Technical consultants also are available, but their fees are often high.

CONCLUSION

Establishment of a food processing operation requires the investment of capital and an associated risk, but neither of these is a stranger to the farmer. Many operators of small farms divide their time between farming and other employment off the farm. The cash returns from involvement in processing could exceed the income from other employment if the processing operation is selected and developed with care. However, specific knowledge of both the technical and legal aspects of commercial processing of food is absolutely necessary. From both the moral and legal standpoints, food products sold to the public must be safe. The liability, publicity, and cost of product recall surrounding a single outbreak of a food-borne illness have bankrupted some companies. An individual or group considering food processing as a way to generate income must take care to gain adequate knowledge about finance, facilities, equipment, and processes as the initial step.

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