Feasibility of Packaging Potatoes

In Institutional Size Retort Pouches

by

Donald L. Hinman
Graduate Research Assistant
Department of Agricultural Economics
Michigan State University
East Lansing, Michigan

Thomas R. Pierson
Professor
Department of Agricultural Economics
Michigan State University
East Lansing, Michigan

Abstract

Packaging potatoes in institutional size retort pouches is analyzed as a possible market outlet for Michigan potatoes. A two-pronged research approach involves estimation of unit costs of retort pouch potato products (RPP) and an assessment of the market potential for RPP in the food service industry. Break-even costs for a six-pound pouch is estimated to be $2.62 (44¢ per pound), which translates to a likely price disadvantage relative to competing products. Food service operators expressed general satisfaction with existing potato products and will not readily switch to use of retort pouch potato products.

Introduction

Michigan potato growers, especially growers of round white potatoes, have expressed concern that there is insufficient demand for their product and that developing new processed potato products using Michigan potatoes may be one way to improve the situation. This research considers the feasibility of establishing a plant to process potatoes employing a packaging technology not currently used in Michigan, the retort pouch. The research has two main parts: 1) determination of the costs of establishing and operating a commercial scale plant, and 2) preliminary market potential assessment for the product within the food service industry. The results presented herein are a summary of the senior author's thesis for the M.S. degree.

What is a Retort Pouch?

The retort pouch is a flexible package made from a laminate (several layers joined by adhesives) of three materials: polyester, aluminum foil and polyolefin or polypropylene, depending on the pouch manufacturer. As the name implies, the retort pouch is capable of being retorted. In other words, foods are first sealed in the retort pouch, followed by heat sterilization as in a canning process. Food products contained in pouches of this basic construction have been marketed commercially in the United States since 1974. More

recently retail entree retort pouch products have been marketed with a non-metallic layer in place of the aluminum to allow for cooking in microwave ovens.

In the proposed retort pouch plant, raw peeled potatoes would be placed inside a pouch which is then sealed and retorted, yielding a sterilized, shelf-stable, cooked product. One of the pouch's main advantages is its thin profile compared to a can, which results in less time and energy required for sterilization. The reduced heating time also allows the potatoes to maintain an improved texture since the need to sterilize potatoes in the center of standard cylindrical cans overcooks potatoes on the edges. Also, canned potatoes require added liquid. Much less liquid is required for retort pouch potato products, and perhaps none, depending on the product form. Potato products in retort pouches may have shelf lives similar to cans; however, research experience at this time is insufficient to be more definitive.

Historical Development of the Retort Pouch

The historical record indicates that the commercial success of retort pouch foods has fallen far below expectations. Major reasons for this include higher costs associated with packaging, processing, and handling as well as lack of familiarity among potential users. The technology is not new; retort pouch products have been available for commercial use for over a decade. Most of the firms currently manufacturing retort pouch foods sell primarily to the U.S. armed forces. Retail sales are limited to specialty niches such as recreational markets. Early expectations were that institutional pouches might displace No. 10 cans of vegetables in the food service market, but this has not yet happened. Only one product (fruit slices) currently is processed and sold in the United States in institutional size retort pouches. Thus a major obstacle to successful development of retort pouch potato products is that such an undertaking involves entering relatively uncharted territory, in which entrants have not had significant success to date.

Choices Among Type of Retort Pouches

The "typical," pre-made retort pouch has two sides or webs of the same thickness and is generally filled vertically. In contrast, an alternate pouch construction involves using a lower web which is thicker than the upper one. Using a horizontal filling method, the lower web is pulled downward (drawn) so that it conforms to a die or mold as it travels through the filling area of the form/fill/seal machine. After the food product is placed into the tray-like cavity, an upper web covers the food and the package is sealed. The lower web is thicker than the upper web to withstand the additional stress it must undergo. The resulting package is somewhat more rigid than vertical-fill, pre-made retort pouches. This package is referred to as a formed container; the thicker gauge laminate is called formable retort pouch material. Because horizontal filling is more likely to maintain several pounds of potatoes in good condition than would vertical filling, the model plant proposed in this study uses a Koch Multivac form/fill/seal machine. Koch, Inc. is one of only two U.S. firms that offer this type of equipment.

Technical Challenges
In Establishing and Operating the Plant

Considerable technical expertise is necessary to make technological choices required in designing the plant largely because there is a very limited track record of firms processing institutional size pouches. Consequently, little knowledge is available to draw on except that of packaging small consumer size pouches. As discussed above, choosing the type of pouch construction and filling method involves one set of such choices. In addition, meeting federal government requirements for sterilization and other aspects of establishing the plant also pose substantial challenges due to the pioneering nature of this processing method.

Objectives

The first objective of the research was to estimate costs of establishing and operating a small scale commercial retort pouch plant for packaging potatoes. Small scale in this instance is defined as a plant with one retort pouch filling

machine and the equipment necessary to keep the filler operating at or near capacity. This new potato product would compete with canned, frozen and fresh products already on the market. The resulting cost information facilitates useful comparisons of production costs of the proposed new product with market prices of its competitors.

The second objective was to assess the potential acceptance of the new product by selected operators in the food service industry. This attitude assessment provides insights regarding likely food service market acceptance of the product; i.e., what are the requisites of, and barriers to, successful marketing of this product to the food service industry?

In many feasibility studies, assessments of profit potential are undertaken. Commonly used methods to investigate economic feasibility are to estimate costs and revenues over a predetermined time horizon and to calculate the internal rate of return or the net present value. However, revenue projections would be highly conjectural in the case of institutional retort pouch potatoes because the product has never been marketed in the United States. Thus, the financial component of this study is limited to the cost side. New product costs, competing product prices and assessments of likely market acceptance of the new product provide highly useful, though not definitive, guidelines to Michigan potato growers concerning the likely success of such a venture.

Methods and Procedures

An economic engineering approach was used to specify a model plant for packaging retort pouch potatoes. Fixed and variable costs of owning and operating the processing facility were estimated and used to calculate unit costs per pouch and per pound of finished product. Although costs estimates are presented in a manner designed to be as realistic as possible, the model plant design is based on certain assumptions, including the capacity of the plant as well as days and hours of operation.

The food service buyer attitude assessment phase of the research consisted of personal interviews with the principal food buyers of a cross-section of food service operators in the Lansing, Michigan area, and executives from leading institutional wholesaling firms in southern Michigan. Interviews were conducted using a participant interactive approach. Sample pouches and photographs of retort pouch foods were shown. Respondents offered their opinions and perceptions of the products and whether they were likely to use them after being told the approximate costs of the new products relative to currently used products, such as fresh, frozen, or canned potatoes. Interviews with a selected, though not statistical, sample of institutional food buyers provided a useful assessment of the likely acceptance of this product.

Summary of Cost Analysis

Cost collection procedures are limited to determining processing and handling costs from the "front door to the back door" of the plant. That is, the first operational stage of the model plant is receiving raw potatoes and the final stage is placing finished product into temporary storage in preparation for shipping.

Fixed and variable costs are calculated and summarized as unit production costs that are compared to unit sales prices of competing potato products. Even though comparing costs of the new product to prices of competing products appears akin to comparing apples and oranges, the comparison is nonetheless useful. For example, if the production cost of the new product is equal to or greater than market prices of competing products, it is apparent that the new product will have to have a higher market price, putting it at a price disadvantage relative to existing competing products.

Annual costs of durable assets are determined by amortizing the cost over the estimated life of the asset. This method is analogous to determining a loan payment given the term and interest rate. Even though this approach has not been widely applied for cost analyses, it is very appropriate and useful for this purpose. The annual cost or annuity is calculated by dividing the original value of the durable assets by the present worth of an annuity (PWA). In addition, steps are taken to account for estimated salvage

value at the end of the durable assets' useful life and for the tax savings from the stream of depreciation. Useful life was estimated at ten years for equipment and 25 years for buildings. A discount rate of 9 percent for the proposed investment was chosen to represent the rate of return of an alternative investment (Treasury bill rates have averaged 9 percent in recent years).

Cost Collection Framework

Figure 1 below shows how costs were categorized to summarize the annual investment and operating costs of the plant. Operating (variable) costs are those directly attributable to plant operation, including hourly labor wages, materials, utilities, and operating capital.

The first elements listed under equipment costs are annualized costs of durable assets. Other costs, including repairs, taxes, and insurance, are added to yield annual ownership costs of equipment. Building and land costs are calculated in an analogous manner. Administrative costs include salaries and fringe benefits of the managerial staff, whose work is not directly related to the number of hours of plant operation. The sum of the four components yields total annual cost. Total annual cost represents all costs except for: a) the cost per pound of potatoes in each pouch, and b) brokerage. The reason for separating out these costs and adding them subsequently is so that future users of this research can supply their own estimates. Potato costs vary substantially depending on sources of supply, time of year, and variety. Brokerage cost is the only selling or marketing expense which is included in the cost estimate. Three percent was suggested as a reasonable estimate. Selling costs other than brokerage such as trade promotion and advertising take such a wide variety of forms and vary so much in amount among firms that it was judged best to leave these costs out of the calculation. Thus, costs as determined are likely to be somewhat understated.

As shown in Figure 1, total annual cost divided by total number of pouches produced per year results in total annual cost per pouch. In the next step, total annual cost per pouch is summed with the cost of potatoes packaged in each pouch, plus brokerage cost. The sum of those three items equals the cost per six-pound package. In the final step, cost per pound is calculated by dividing cost per pouch by the number of pounds per pouch.

The unit cost per pound of the retort pouch potato product is the key figure that results from the analysis. It provides the best available estimate of the minimum (break-even) cost for which the retort pouch potato products could be produced. No assumption is made as to an appropriate marketing margin covering profits. Users of this cost estimate can determine what margin is acceptable and/or possible given market conditions.

Summary of Annual Costs

A key assumption underlying the unit cost calculation is eight months of plant operation based upon 180 days or 2,880 hours per year, while assuming two shifts per day, five days per week. Eight months is the period that a Michigan plant could be supplied with Michigan potatoes. Beyond this period, Michigan storage potato supplies would be exhausted, and potatoes would have to be brought in from other areas at higher prices, adding at least several cents per pound in transportation costs alone.

Key results are cost per pouch and per pound as follows:

8,640 pouches/day x 180 working days/year

= 1,555,200 pouches per year

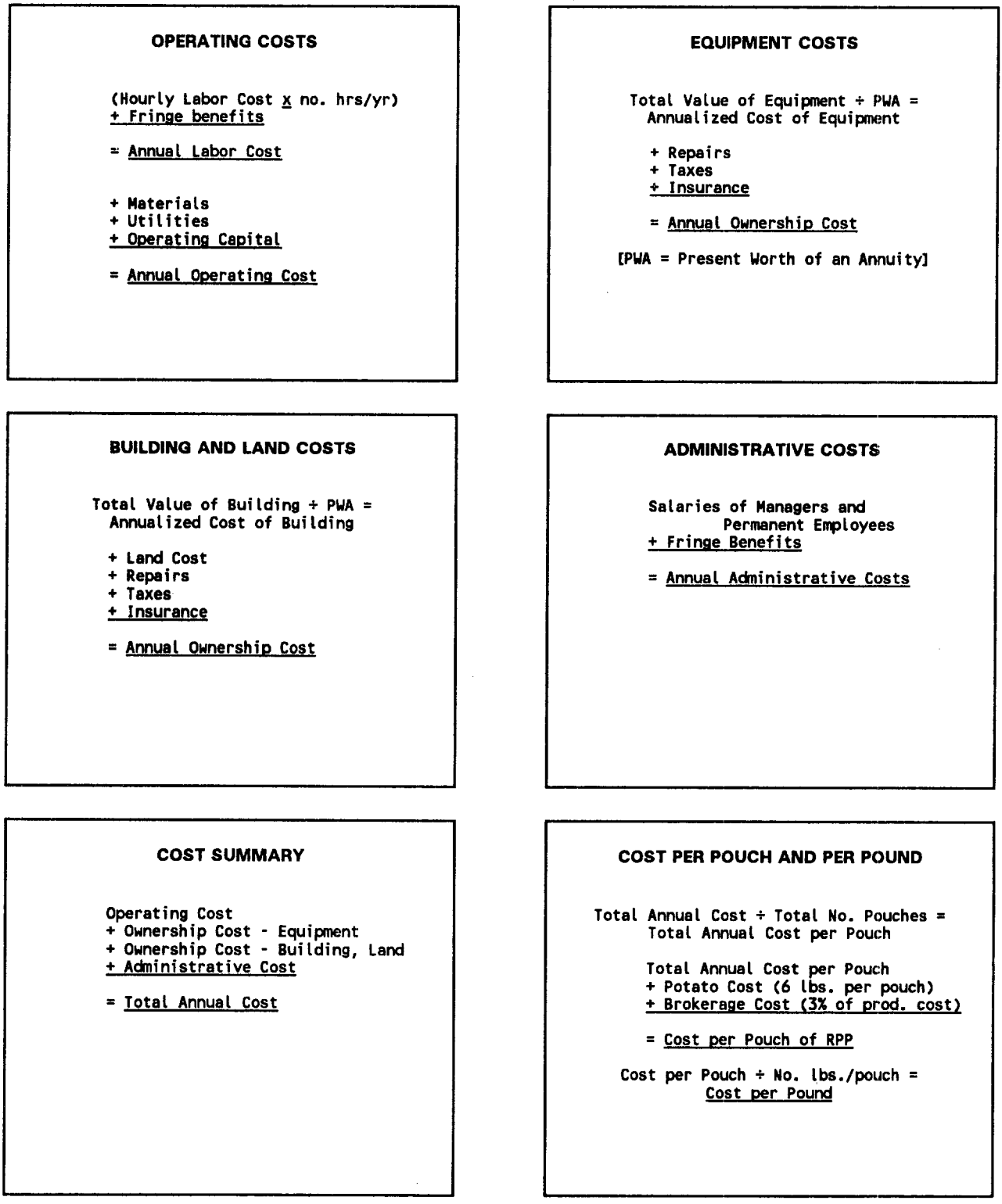
$$\frac{\text{Total Annual Costs of \$3,811,556}}{\text{1,555,200 Pouches/Year}}$$

= \$1.94 = Cost per Pouch

Estimated unit cost of packaging potatoes in retort pouches is \$1.94 per pouch not including cost of potatoes or brokerage.

Figure 1

Summary of the Cost Analysis Process



A six-pound average weight of pouch contents is based on interviews with executives from several retort pouch food manufacturing firms and an examination of retort pouch packages from a German food manufacturer. The raw product cost estimate must account for the fact that on average potatoes will lose approximately 45 percent of their weight as waste during processing; the 0.55 factor in the denominator of the formula below represents the 55 percent of the original potato weight remaining after processing.[1] Cost per pound of the raw product is thus expressed in terms of the pounds of potatoes in the finished product, so that it can then be added to the processing cost calculated above. The average price for U.S. #1 bulk potatoes in Michigan has averaged 5.5¢ per pound in recent years.

$$\frac{\$0.055/\text{pound}}{0.55}$$

= $0.10/finished product pound of potato

= $0.60 for six pounds

The final figure needed for the unit cost estimate is the brokerage cost; plant managers from several leading potato processing firms in Michigan indicated that 3 percent of the above mentioned costs was a reasonable estimate:

3% *x* ($1.94 + $0.60) = $0.076

or approximately 8¢ brokerage cost

Using these cost figures, the unit cost per pouch of retort pouch potato product is calculated as follows:

$1.94	**Total annual cost per finished product pouch**
+ 0.60	**Cost of potatoes**
+ 0.08	**Brokerage cost**
= $2.62	**Unit cost per pouch of RPP**

Cost per pouch is divided by six to get the price per pound:

$2.62 ÷ (6 lbs. per pouch) = 44¢ per pound

This figure, 44¢ per pound, is the key figure that emerges from this analysis; it is an estimate of the minimum break-even cost to produce the retort pouch product, following the assumptions made in the design of the model plant, and given that the pouch will be designed to hold six pounds of potatoes.

Comparisons with Competing Potato Products

A key conclusion derived from this research is that retort pouch potato products would need to command higher prices than those of several traditional competing products. Table 1 shows that at a cost of 44¢ per pound (for a six-pound pouch) the new retort pouch potato product would be at a price disadvantage relative to several competing products. Note that 44¢ per pound is the estimated break-even cost of producing retort pouch potatoes. Sales costs, other than brokerage, as well as profit and marketing margins were not included in the cost calculation. Thus, if the product is manufactured and sold, the selling price would need to be even higher than 44¢. In contrast, wholesale market prices are quoted for a number of competing potato products. If the estimated cost of retort pouch potatoes is higher or only slightly below the market prices of competing products, this is evidence that the retort pouch product is at a price disadvantage.

In Table 1, the 44¢ manufacturing cost of retort pouch potatoes is, with one exception, about the same as the lower range of wholesaler list prices. Wholesale prices for "fresh-processed" or "peelers" (fresh potatoes delivered peeled and ready to use), range from 45¢ to 57¢. However, it appears likely that the price of retort pouch potato products, including promotion and advertising expenses, would likely be above wholesaler prices for "fresh-processed" and frozen potatoes. When further necessary allowances are made for manufacturing profit margins as well as wholesaler margins, the price situation becomes even more disadvantageous. Thus, it appears unlikely that retort pouch potatoes could gain customer acceptance based on price considerations alone.

Table 1

Comparison of Retort Pouch Potato Product Manufacturing Costs and Wholesaler Prices for Competing Products

PRODUCT	COST/PRICE PER LB.[1]
1. Retort pouch potatoes	44¢ Cost
2. Fresh-processed	45-57¢ Market prices
3. Frozen, various products	43-54¢ Market prices
4. Frozen hash browns	50-67¢ Market prices
5. Canned - sliced/diced	44-45¢ Market prices

[1] Wholesale market prices from survey of food service operations in Lansing, Michigan.

Reasons for the High Cost Of Retort Pouch Processing

An important question to ask is: Why is the new product so expensive? One key factor resulting in high cost estimates is that, given current technology, horizonal-fill retort pouch operations have a relatively slow line speed and are more labor-intensive than other food processing methods, such as canning and freezing. The relatively high labor requirement for pouch processing results from several points where pouches must be manually handled. Also, every pouch must be visually inspected twice.

Materials are also relatively costly. The laminate for one pouch is estimated to cost 51¢, a high proportion of total costs. That compares to a cost of 40-45¢ for a No. 10 can. Additionally, shipping cartons are expensive relative to those for No. 10 cans because pouch cartons must be considerably stronger to protect the pouches.

The high cost of packaging retort pouches raises the question of whether this kind of pouch product, even with its positive attributes, can be sold in high enough volumes at the higher prices required. The answer to this question is suggested by interviews carried out as part of the market assessment discussed in the next section.

Summary of the Market Potential Assessment

Retort pouch foods have not made significant inroads into the retail packaged foods market despite early predictions of success. This study focused on institutional size retort pouch potato products because of the poor record of success in consumer product sales and because food product innovations often find better initial acceptance in food service operations than in consumer retail sales. That is, many precooked entrees first achieve market acceptance in restaurants and subsequently as consumer retail products. Frozen hash browns and chicken nuggets are examples.

Table 1 provides information suggesting that retort pouch potato products may need to be sold for higher prices than most competing products. Since retort pouch potatoes are relatively expensive, restaurant managers and other food service operators were interviewed to determine if there were positive product attributes that would induce the operators to purchase them despite the likelihood of higher prices. Six out of sixteen food service managers interviewed indicated some interest in trying the product if it was available. The remaining ten managers expressed little or no interest in the product and were satisfied with the potato products they were currently using. Key retort pouch attributes such as shelf stability, ease of handling and disposability were not considered sufficiently important to induce purchase of the retort product. If numerous products beyond potatoes were available in retort pouches, food service operators would be more interested. However, having only potatoes--out of the numerous food products handled by food service operators--in retort pouches, was not considered to be a great advantage. Handling potatoes in pouches which differ from other food containers could be viewed as a nuisance.

Restaurants emphasizing fresh products were not attracted to retort pouch potatoes for use on their menus. Schools and certain public medical facilities receive large USDA commodity donations and are thus unlikely to purchase retort

pouch potatoes, especially if priced at a premium. Executives from four Michigan-based institutional wholesalers were interviewed. They emphasized the need for substantial promotional efforts to stimulate sales and suggested that the product will not sell itself, largely because there are numerous competing potato products currently on the market with which food service operators are generally satisfied. They also stressed that existing products will not easily be displaced. Inertia in wholesalers' product lines is an additional hindrance to the successful market introduction of retort pouch potato products. There are limited numbers of warehouse slots and items carried by wholesalers. Furthermore, executives interviewed indicated that their salespeople tend to concentrate on selling high volume products, devoting relatively little time to introducing new products.

In summary, the food service market potential assessment indicates that few positive considerations are present that would help overcome the likely price disadvantage of retort pouch potato products.

Conclusions and Implications For the Food Industry

Packaging potatoes in institutional size retort pouches was investigated as a possible market outlet for Michigan potatoes. Unit costs of retort pouch potato products were estimated and market potential in the food service industry was assessed. Break-even costs for six-pound pouches were estimated to be $2.62 (44¢ per pound), which suggest significant cost and price disadvantages.

The market potential assessment yielded generally negative results. Food service operators interviewed expressed general satisfaction with their current potato products and will not readily switch to retort pouch potato products. Institutional wholesalers indicated that an introduction of retort pouch potato products would necessitate costly promotional efforts to displace existing potato products with no guarantees of success.

Estimation of processing costs requires specific assumptions concerning the model plant, including plant capacity and duration of operation. The model plant was designed with a single form/fill/seal machine and two retorts. Subsequent cost studies may assume different plant layouts, capacities, and outputs; and estimated costs would vary accordingly.

The research results suggest that it is difficult to market a plain, low-value "commodity" type of product in a relatively expensive non-traditional container. A number of industry executives and researchers believe that the greater expense of retort pouch packages and processing technologies, with associated texture, handling, and distribution benefits, can best be justified in combination with more value-added ingredients such as meats, or perhaps potato products in sauces with spices and flavors added. To the extent that higher value ingredients make the overall product worth more, higher cost retort pouch packaging, processing, and handling constitute a smaller portion of total costs and perhaps the total product becomes more acceptable to purchasers. What such retort pouch food products might be, and whether some could be potato-based value-added products, is a subject for future research.

Endnote

[1]Generally accepted potato industry standard from Professor Jerry Cash, Department of Food Science and Human Nutrition, Michigan State University.

Reference

Hinman, Donald L., *Economic and Market Feasibility of Packaging Michigan Potatoes in Institutional Size Retort Pouches*. Unpublished M.S. thesis, Department of Agricultural Economics, Michigan State University, 1990.